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ASSESSING THE IMPACT OF ASSET TANGIBILITY ON CAPITAL STRUCTURE: CHOICE FOR LISTED FIRMS IN NIGERIA

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Abstract

This paper seeks to examine determinates of corporate financing pattern for listed firms on the Nigeria stock exchange. Several studies have been conducted on financing patterns and capital structures in western countries with very little studies carried out on developing nation. The main objective of this paper is to investigate if observed trend of financing patterns in western countries is applicable within the Nigeria context. The theoretical contributions of trade-off, agency and pecking order theories were examined in assessing impact of asset tangibility on financing patterns for listed Nigerian firms. Results shows that Nigerian firms do not follow observed patterns observed in western countries. In analysing firm leverage, Nigeria firms were found to have a positive non-statistical significant correlation between asset tangibility and leverage.

Key words

Capital Structure; Trade-off Theory; Agency Cost Theory; Pecking Order Theory; Corporate Financing Strategy; Nigeria Stock Exchange.

INTRODUCTION

The discussion on how firms raise capital with regards to instruments used to finance investment decisions have generated a lot of academic debate amongst scholars of finance in recent past, with scholar's examining plausible reasons why listed firms raise capital through primary listing, secondary listing or issuing debt using different combinations of instruments such as ordinary equity, debt and hybrid securities which includes; preference shares, convertible and warrant debt.

In the past four decade, much of the research on capital structure by scholars have advanced theoretical models to explain the capital structure patterns for firms and also to provide empirical evidence concerning whether the theoretical models have

explanatory power when applied in real business world. Examining reasons behind the preference of firms choosing their financing patterns, Modigliani and Miller's (1958, 1963) contribution on the irrelevance of capital structure and tax shield advantage sets the stage upon which several capital structure theories have been developed.

Empirically, several studies have been conducted to investigate the relevance of capital structure in explaining firms financing behavior, amongst this, the static trade-off theory, agency cost and pecking order model appears to come across strongly.

Aim: To examine the impact of asset tangibility on the choice of capital structure for listed Nigeria firms in influencing their corporate financing strategy and performance analysis.

Objectives

1. To determine whether the main theories of capital structure (trade-off, agency and pecking order theories) explains financing behavior for listed firms in Nigeria.
2. To examine the impact of asset tangibility on the choice of capital structure for listed firms in Nigeria.

THEORITICAL FRAMEWORK

For over four decades, literature on corporate finance has profound different theories to identify and explain determinants factor for a firms financing policy and capital structure. These theories span across various aspects of the firm explaining how firms choose their capital structure.

In corporate finance, the academic contribution of Modigliani and Miller (1958, 1963), provided possible explanation on how financing decisions (debt-equity mix) informs the firm's capital structure. Modigliani and Miller (1958) in their seminar paper examined the relationship between the firm financing choice and its value. Modigliani and Miller in their paper explored the relevance of taxation in determining the firm's financing behavior which they stated given a world devoid of taxation, the firm's value will be independent of its debt-equity mix. The theory holds that the firm's market value is calculated by the risk associated with the underlying assets of the firm and also on the earning capacity of the firm. The contribution on capital structure irrelevance and the tax shield advantage by Modigliani and Miller (1958, 1963) paved the way for the development of alternative theories and series of empirical research initiatives on capital structure.

The alternative theories include the trade-off theory, the pecking order/asymmetric information theory and agency cost theory. All these theories have been subjected to extensive empirical testing in the context of developed countries, particularly the United States (US), however not much research has been done with respect to



developing countries. Some of the reasons that account for this are clear; many developing countries initially opted for a state-sponsored route to development, with a relatively insignificant role assigned to the private corporate sector (Prasad, 2001).

Theoretical Contribution Static of the Trade-off Theory

The trade-off model predicts that the trade-off between the benefits of debt financing (e.g., the tax deductibility of interest and reduced agency costs through the monitoring role of debt) and debt-related costs (e.g., bankruptcy costs and agency costs of debt) creates an optimal capital structure towards which firms move over time (Myers, 1977). In essence, the static trade-off theory predicts that more profitable firms should have more debt since they have more profits that could be shielded from taxes without incurring an undue cost of bankruptcy. However, empirical evidence presents a contrary view (Myers, 1984; Titman & Wessels, 1988; Fama & French, 2002).

Myers (1997) and Jensen (1986) also examined the impact of corporate income tax on the capital structure and suggested that firm's optimal capital structure is related to cost and benefits associated with debt and equity financing. Myers (1984), suggest that the trade-off between the tax advantage of debt and cost of financial distress is expected to yield the optimal level of debt that maximizes the value of the firm

Ngugi (2008) submits that there are benefits and cost associated with the use of debt as against equity, thus the firm will only choose an optimal capital structure that trades off between the tax advantages of debt against bankruptcy cost. This benefit was later extended to cover benefits and costs associated with the use of debt in mitigating the conflicts among agent groups associated firm i.e. managers, equity-holders and debt-holders (Jensen & Meckling, 1976; Jensen, 1986).

Several studies have been conducted on developed and a few on developing countries to examine capital structure theories. Booth et al, (2001) carried out studies in ten (Malaysia, Zimbabwe, Mexico, Brazil, Turkey, Jordan, India, Pakistan, Thailand, and Korea) developing countries to assess whether capital structure theories are applicable across developing countries with different institutional structures. Booth et al, (2001) use three measure of debt ratio; total debt ratio, long-term book debt ratio, and long-term market debt ratio with average tax rate, assets tangibility, business risk, size, profitability, and the market to book ratio as explanatory variables.

The study showed that the more profitable the firm, the lower the debt ratio, regardless of how the debt ratio was defined. It also showed that the more the tangible assets, the higher the long-term debt ratio but the smaller the total debt

ratio. Booth *et al.* (2001) conclude that the debt ratio in developing countries seemed to be affected in the same way by the same types of variables that were significant in developed countries. However, they pointed out that the long-term debt ratios of those countries are considerably lower than those of developed countries.

To test the relevance of the static trade-off theory in the Nigeria context these alternative hypothesis have been derived:

H1: *There is a positive relationship between leverage ratios and asset tangibility.*

Theoretical Contribution of Agency Cost Theory

The theory examined the conflict of interest that arises between shareholders, managers and debt holders. In this case, the shareholders and debt holders are referred to as the principal while the managers are regarded as the agent acting on behalf of the principal. The need to ensure that agent act in the best interest of the principal to avoid conflict was examined in the contributions of Ross (1973), Shavel (1979), Fama (1980, 1990), Arrow (1985) and Jensen & Meckling (1992). They all debate that conflict arises if the firm issues equity, the proportion of owners-manager's interest within the firm minimizes, this invariably encourages the owner-managers to engage in activities that might not be beneficial in the long run because of the reduced equity stake.

Jensen and Meckling (1976) examined the question of asset substitution that arises when share holders decides to seize wealth from debt-holders by investing in riskier projects which if successful offers high returns benefits to owners-mangers solely but with a high possibility of failure. The switching from a safer to a more risky investment portends potential conflict that may arise between shareholders and debt holders.

Myers (1977) identified firms in financial difficulties to have incentive to sacrifice low positive net present value (NPV) projects whose benefits accrue mainly to debt-holders. This results in under-investment by the firm. He then postulates that the greater the investment opportunity in a firm, the greater is the potential conflict of interest between shareholders and debt-holders.

Jensen and Meckling (1976) identified two major types of conflict: agency cost that arise from conflict of interest between managers and shareholders and agency costs that arise as a result of the conflicts of interest between shareholders and debt holders. They reasoned that the firm is presented with two options to raise capital i.e. issue equity or debt. They argued that conflicts arise between managers and shareholders when managers hold less than 100% of the residual claim, this will lead to managers pursuing activities that will not help in maximizing the value of the firm. They then suggested that managers should be allowed to own a larger equity portion, these they stated will help engender better commitment towards enhancing the value of the firm by managers.



Gillan and Starks (2000) noted that the separation between ownership and control is not the only factor that gives rise to the agency problems, the diffuse nature of corporate ownership may motivate the agency problem, where no incentive exists for small shareholders to bear the cost of monitoring the management behaviour. Um (2001), contends that given that the firm keeps its level of tangible assets low, the management of the firm is presented with the opportunity of choosing a high level of debt to mitigate equity agency cost while the firm size may then be used as a proxy for debt agency costs arising from conflicts between managers and shareholders. He thus established a positive relationship between debt and tangibility.

To assess the relevance of agency theory within the Nigeria context these alternative hypotheses have been derived:

H2: There is a positive relationship between leverage ratios and asset tangibility.

Theoretical contribution of Pecking Order Theory

Pecking order theory predicts that due to the information asymmetry between the firm (mangers/insiders) and outside investors regarding the real value of both current operations and future income stream and prospects, external capital (debt and equity) will always be relatively costly compared to internal capital (retained earnings). Pecking order theory therefore suggests that firms should finance their investment in the order of internal funds, debt and equity (Myers, 1984; Myers & Majluf, 1984).

Two main literature approaches have been advanced that examined the impact of information asymmetry on firm's capital structure. The contribution of Myers and Majluf (1984) and Myers (1984) posits that capital structure is designed to mitigate inefficiencies in the firm's investment decisions that are caused by information asymmetry, by following a pecking order in their investment decisions. In the second approach, Ross (1977), and Leland & Pyle (1977) assert that firm's capital structure choice is used as a means to signal to outside investors the information held by insiders.

Myers (1984), Myers & Majluf (1984), argue that managers use private information to issue risky securities when they are overpriced. Investors are aware of this asymmetric information problem, and the prices of risky securities fall when new issues are announced. Managers anticipate the price declines, and may forego profitable investments if they must be financed with risky securities. Managers must therefore follow a pecking order in issuing securities of the firm to avoid this type of distortions. Given this view, Myers was able to demonstrate that given asymmetry

of information between investors and firm insiders, firm equity may be underpriced by the market and this will result in new equity being under-priced.

Similarly, Myers (2001) explained that the equity issues occur only when debt is costly, i.e. at a dangerously high debt ratio where managers and investors foresee costs of financial distress. Myers demonstrates that equity issues are spurned by investors if debt is available on fair terms, and in equilibrium only debt is issued. He then argues that debt has the prior claim on assets and earnings, while equity is the residual claim. In the context of pecking order theory, firms should issue equity when they experience high stock's valuation for two reasons: firstly, the asymmetric information costs to the firm are expected to be low when shares are overvalued, secondly, these firms are expected to have higher growth opportunities which induce them to finance their financing needs with equity in order to maintain their borrowing capacity for the future (see, Titman & Wessels, 1988 and Rajan & Zingles, 1995).

Mayer (1990) examined the source of industry finance in eight developed countries. His study reveals a number of stylised facts regarding corporate financing behaviour, which support the existence of financing hierarchies. He finds:

- Retentions are the dominant source of financing in all countries;
- The average firm in any of these countries does not raise substantial amounts of financing from securities markets in the form of short-term securities, bonds, or equity;
- Small and medium size firms are considerably more reliant on external finance than large firms; and
- The majority of external financing comes from bank loans in all countries.

Mayer found evidence that bank loans are the primary source of external finance for firms in developed countries. He interprets his findings as showing that banks perform a central function in eliminating asymmetric information in financial markets by playing a vital role in collecting and processing information that markets are unable to do or only do so at high cost.

A survey carried out by Beattie et al, (2006) on 831 finance directors in industrial and commercial UK listed firms shows that 60% of responding directors follow financing hierarchy. Internally generated funds were found to be the most preferred, and use debts only when internally generated funds are found to be deficient. Their findings also reveal that UK companies tend to adopt pecking order approach when information and transaction costs are found to be significantly large.

Using panel data technique Ngugi (2008) analyzed 22 listed firms on Nairobi stock exchange to determine the relevance of pecking order theory on listed firms. Ngugi (2008) submits that information asymmetries, non-debt tax shields and local capital



market infrastructure accounts for firms financing behavior, hence the pecking order model with an adjustment process cannot be rejected. In his analogy internal financing deficit was used as a variable to identify internal financing gap that triggers the use of debt. His result shows a significant relationship between internal financing gap and debt financing.

To assess the relevance of the theory on listed firms in Nigeria we these alternative hypothesis has been derived:

H3: There is a negative relationship between leverage ratios and asset tangibility.

METHOD OF ANALYSIS

This study makes use of econometric approach in estimating the relationship between capital structure theories (the static trade-off theory, agency cost theory and the pecking order model) and financing choice of listed Nigeria firms from 1997 to 2007. From the three main theories examined, the static Trade-off theory and Agency Cost theory postulates that there is a positive relationship between the leverage ratio of a firm and its asset tangibility, while the Pecking Order theory postulates a negative relationship between leverage ratio and asset tangibility.

H1: There is a positive relationship between leverage ratios and asset tangibility¹.

H2: There is a negative relationship between leverage ratios and asset tangibility².

Table 1 presents summary of the prediction trade-off, agency and pecking order theories.

TABLE 1. SUMMARY OF THE PREDICTION TRADE-OFF, AGENCY AND PECKING ORDER THEORIES

| Determinants | Trade-off theory | Agency theory | Pecking order theory |
|-------------------|------------------|---------------|----------------------|
| Asset Tangibility | + | + | - |

⁴The positive relationship is tested within the context of trade-off theory and agency cost theory.

⁵The negative relationship is tested within the context of pecking order theory.

To test the hypothesis the relationships between the level of debt (leverage) and explanatory variable asset tangibility is examined using the ordinary least square regression.

For the purpose of this study, asset tangibility is measured as fixed assets (FA) divided by total assets (TA). This can be represented as
$$\text{Asset Tangibility} = \text{FA}/\text{TA}$$

The research will analyse data samples of 216 listed firms on the Nigeria stock exchange from 1997 to 2007 using secondary data sources mainly from OSIRIS which contains financial information data on 62,000 listed and major unlisted/delisted

companies worldwide and African Financial Markets. Data set used for the purpose of this research work were obtained from both

balance sheet and income statements of selected firms and by averaging these data over the ten years period of analysis the researcher was able to smoothen the leverage and explanatory variables. The criteria used for selecting chosen companies were the availability of relevant information in the financial statements of each firm in the sample for the time period of 10 years (1997-2007).

In this view, the final sample set consists of a 47 firms spanning across all the major sectors on the stock exchange. This accounts for about 22 percent of the relevant population of listed firms on the exchange, however given the wide spread of observed firms across various sectors listed on the stock exchange, research sample can be viewed to be a good representative of firms listed on the stock exchange as it all classified sectors on the stock exchange was captured. Given the focal point of the research are listed firms on the Nigeria stock exchange, all non-publicly quoted firms were excluded from the research.

The proposed relationship for this study is depicted by these models;

MODEL 1

$$\text{Tot} = \alpha + \beta_1 \ln X_n + E_t$$

Where:

Tot = Trade-off theory is the dependent variable.

Xn = Asset tangibility of the firm is the Independent variables

α = Intercepts

E_t = Random Error

MODEL 2

$$Ag = \alpha + \beta_1 \ln X_n + E_t$$

Where:

Ag = Agency theory is the dependent variable.

Xn = Asset tangibility of the firm is the Independent variables

α = Intercepts

E_t = Random Error

MODEL 3

$$Po = \alpha + \beta_1 \ln X_n + E_t$$

Where:

Po = Pecking Order theory is the dependent variable.

Xn = Asset tangibility of the firm is the Independent variables



α = Intercepts

E_t = Random Error

Dependent Variable

This is the measure of the firms' performance. The proxy used to denote these within the context of Tot, Ag and Po in the assessment of capital structure theories is leverage (L_i). Leverage can be defined as the amount of debt in the capital structure of the firm. There exists a choice of approach to use in computing leverage i.e. the book leverage and market leverage. Elkamhi et al, (2010) identified reasons to support the use of book and market leverage. They reasoned that book leverage supports assets in place while market leverage in addition supports growth opportunities.

Graham and Harvey (2001) acknowledged that managers tend to track book leverage more closely than market leverage. This they attributed to ability of managers to control the extent of book leverage by the issuance and retirement of debt or issuance and repurchasing of equity. They opined that this may not be visible with market leverage which depends on volatile market prices beyond manager's control (Titman & Wessels 1998). Ngugi (2008) however suggest that there is no significant difference between book and market leverage. For the purpose of this study due to the limitation of the availability of data, the use of book leverage is adopted. Taking the lead from Bevan and Danbolt (2002) who analyzed leverage from the perspective of long term and short term debt, the researcher computes leverage as the ratio of total debt to total assets and short-term debt to total assets. Long-term debt to total assets was excluded by the researcher as a measure of leverage due to non-availability of complete data.

Where:

TDA = Total debt to total assets

STDA = Short time debt to total assets

Independent Variable

These are the explanatory variables which are viewed as factors influencing corporate performance:

Assets Tangibility: The tangibility of assets is characterized by the effect of the collateral values of assets on the firm's leverage level. The underlying argument behind the use of tangible assets as collateral for debt is the higher liquidation value of these assets in the event of financial distress or bankruptcy (Rajan & Zingales, 1995). In analysing the capital structure of the firm empirical studies have shown that there is a positive relationship between tangibility and leverage of the firm. It is

expected that the implied risk of lending to the firm with a high level of tangible asset is low when compared to firms with less tangible assets. In this context it is assumed that lender will demand a low risk premium for lending to the firm with high tangible assets.

According to Jensen & Meckling (1976) and Myers (1977) shareholders of levered firms tend to have an incentive to invest sub-optimally in order to expropriate wealth from the firm's bondholders and these gives rise to conflict between shareholders and debt-holders. In this study, asset tangibility is measured as fixed assets (FA) divided by total assets (TA). Table 2 presents summary measurement of variables.

TABLE 2. DESCRIPTIVE MEASUREMENT OF VARIABLES

| Variables | Measurement |
|----------------------------|---|
| Dependent Variable | |
| Overall Leverage (LEV) | Total debt to total assets (TD/TA) |
| Short-term Leverage (SLEV) | Short time debt to total assets (STD/TA) |
| Independent Variable | |
| Assets Tangibility | Fixed assets divided by total assets (FA/TA). |

Beta Coefficients: This variable is used to examine the strength of relationship between the dependent variable (leverage) and the independent variable (asset tangibility). The relationship between the dependent and independent variable was measured using the book value of leverage.

Sig: These represent t-test level of significance. When the value of "Sig" is below 0.01, 0.05 and 0.1 it implies that at 99%, 95% and 90% confidence intervals respectively the relationship between relevant independent variables i.e. size, is a good proxies that explains the leverage ratio for the firms been considered. Hence we cannot accept the null hypothesis. While when the value obtained is above 0.01, 0.05 and 0.1 we cannot reject the null hypothesis at 99%, 95% and 90% confidence interval, which infers that the relationship between variables occurred coincidentally.

RESULTS AND DISCUSSION

The use of t-test statistic was employed by the researcher to determine if the results of the analysis are truly relevant or if they occurred due to coincidence. The relationship between output of the dependent and independent variable was measured by standardized coefficient (Beta).

Tables 3, 4, 5 and 6 below presents the output of the regression analysis.



TABLE 3. SPSS OUTPUT - REGRESSION WITH INTERACTION COEFFICIENT

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|-------|------------|-----------------------------|------------|---------------------------|--------|------------|
| | | B | Std. Error | Beta | B | Std. Error |
| 1 | (Constant) | -0.183 | 2.377 | | -0.077 | 0.939 |
| | FA/TA | 0.442 | 0.712 | 0.111 | 0.622 | 0.540 |

Dependent Variable: Total debt (total debt to total assets)

Independent Variable: Asset Tangibility (FA/TA)

TABLE 4. SPSS OUTPUT - MODEL SUMMARY

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|----------|----------|-------------------|----------------------------|
| 1 | 0.577(a) | 0.333 | 0.256 | 1.3054124 |

Predictors: (Constant), FATA,

TABLE 5. SPSS OUTPUT - REGRESSION WITH INTERACTION COEFFICIENT

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|-------|------------|-----------------------------|------------|---------------------------|--------|------------|
| | | B | Std. Error | Beta | B | Std. Error |
| 1 | (Constant) | -0.183 | 2.120 | | -0.086 | 0.932 |
| | FA/TA | 0.292 | 0.635 | 0.084 | 0.460 | 0.649 |

Dependent Variable: Short-term debt (Short-term debt to total assets)

Independent Variable: Asset Tangibility (FA/TA)

TABLE 6. SPSS OUTPUT - MODEL SUMMARY

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|----------|----------|-------------------|----------------------------|
| 1 | 0.561(a) | 0.315 | 0.236 | 1.1642648 |

Predictors: (Constant), FATA,

Definition of Key Variables used in Analysis

Beta Coefficients: This variable is used to examine the strength of relationship between the dependent variable (leverage) and independent variables (asset tangibility). The relationship between the dependent and independent variable was measured using the book value of leverage.

Adjusted R-Square: Table 6 is used to give computed R-square more honest/fair value (where r-squared reflects the explanatory power of independent variable in predicting the dependent variable). For analysis the use of adjusted R-squared was

adopted because the linear model being explained constitutes a sample of listed firms on the Nigeria stock exchange. This makes the use of R-squared more relevant.

T-test Statistic: The use of t-test statistic was employed by the researcher to determine if the results of the analysis are truly relevant or if they occurred due to coincidence.

Sig: These represent t-test level of significance. When the value of "Sig" is below 0.01, 0.05 and 0.1 it implies that at 99%, 95% and 90% confidence intervals respectively the relationship between the independent variable i.e. asset tangibility is a good proxy that explains the leverage ratio for the firms been considered. Hence we cannot accept the null hypothesis. While when the value obtained is above 0.01, 0.05 and 0.1 we cannot reject the null hypothesis at 99%, 95% and 90% confidence interval, which infers that the relationship between variables occurred coincidentally.

ESTIMATION AND TESTING OF RESULTS

Influence of Asset Tangibility on Leverage of Firms

Empirical research findings by Rajan & Zingales (1995), Titman & Wessels (1988) on developed countries reveal a positive relationship between leverage and asset tangibility under the trade-off theory. They argued that companies with high level of tangible assets are less prone to default risk. The negative relationship between leverage ratio and asset tangibility reported by Booth et al, (2001) on ten developing countries, however negates these assertion.

Reviewing the contribution of the agency cost theory to understanding the pattern of capital structures by firms as influenced in their approach to debt issue, Jensen and Meckling (1976) identified conflicting interest between equity holders and debt holders who are regarded as principals in the firm and managers who act as agent on behalf of the principal. Harris & Raviv (1991), and Stulz (1990) provides evidence to support the argument that managers are less prone to use debt financing, because the use of debt tend to put them under pressure to deviate from firm's value maximisation objective. This preposition was supported by Fama (1980) who argued that a higher level of leverage is less attractive to managers because it tends to impose a higher risk to them (managers) than public investors. Jensen and Meckling (1976) addressed the incentive problems that could arise due to the separation between ownership and control and suggested that the use of secured debt could help in reducing the cost of debt. A positive relationship was therefore established between leverage ratio of the firm and asset tangibility.

Regression analysis result shows an asset tangibility value of 0.111 and 0.084 for leverage (total debt and short-term debt) respectively. This implies that a 1 unit change in asset tangibility will result in 0.111 and 0.084 increase in leverage (total debt and short-term debt) level for the firms. Given that observed Sig value 0.540



and 0.649 for total debt and short-term debt respectively is greater than 0.1, 0.05 and 0.01, we cannot reject the null (H_0), that the regression coefficient = 0. i.e. the null hypothesis is not statistically different from zero at 99%, 95% and 90% level of confidence.

The observed positive relationship is not statistically significant. The double digit inflation rate in Nigeria economy does not only make borrowing expensive but also makes it easy for the value of asset of firms to be easily eroded. This can be a pointer to the non-statistical significance of asset for the observed firms

Decision: CANNOT reject H_0 , which implies there is no positive relationship between leverage ratios and asset tangibility.

Research finding of Rajan and Zingales (1995) under the pecking order theory suggests a negative relationship between leverage and asset tangibility this trend was attributed to the negative influence of information asymmetric on the firms value. Values obtained from regression result shows a Beta value of 0.111 and 0.084 for total debt and short-term debt and a Sig value of 0.540 and 0.649. This infers that a 1 unit increase in size will lead to 0.111 and 0.084 increase in total debt and short-term debt respectively. There is no evidence to support that there exist a negative relationship between asset tangibility and leverage for examined listed firms on the Nigeria stock exchange as obtained results shows a positive relationship that is not statistically significant.

At 99%, 95% and 90% level of confidence we cannot reject the null hypothesis signifying that listed Nigeria firms do not follow the same pattern observed in western countries under the pecking order theory. Part of the reason that can be cited to be responsible for this trend is the heavy dependence of Nigerian firms on Bank loan as a means of raising funds and banks tend to place high preference on asset of the firm for debt financing due to bankruptcy eventualities. In this context, Nigerian firms are expected to have a positive correlation between asset tangibility and leverage ratio. This conforms to Mayer's (1990) preposition that bank loans are the primary source of external finance for firms in developed countries thereby banks helps to eliminate asymmetric information in financial markets by playing a vital role in collecting and processing information that markets are unable to do or only do so at high cost.

Decision: CANNOT reject H_0 i.e. there is no observed negative correlation between leverage ratio and asset tangibility for listed Nigerian firms.

CONCLUSION

This study examines the determinants of capital structure decisions for listed firms on the Nigeria stock exchange. Previous research work have focused mainly on

western countries, the objective of the research work is to examine the applicability of postulated capital structure theory (trade-off, agency and pecking order theory) in western countries to observed trend on listed firms in Nigeria. The research discussed how the capital structure decisions of firms are influenced, with focus on a sample of 47 out of 216 listed firms on the Nigerian stock exchange. The use of short-term and total debt was adapted as a proxy for determining leverage. We analyse the impact of firm's asset tangibility on choice of capital structure for observed listed firms.

The following major deduction can be inferred from obtained results. Observing the influence of asset tangibility on firm's leverage, a non-statistical significant positive relationship was observed under the agency and trade-off theory. Observed results findings of Jensen and Meckling (1976), Rajan and Zingales (1995), Titman and Wessels (1988) of western countries, however, negates findings by showing a significant positive relationship between asset tangibility and leverage under the trade-off and agency theory. Also Rajan and Zingales (1995) found a negative relationship between leverage and asset tangibility of firms in western countries under the pecking order theory, findings for listed Nigeria firms however shows a non-statistical positive correlation between leverage and asset tangibility for listed Nigerian firms. It can be stated that results observed from listed Nigeria firms negates postulated results in the western countries.

RECOMMENDATIONS

This study generally provided a number of insights which could form the basis of further research on Nigerian firms.

- 1) Carrying out a market leverage analysis to make comparison with book leverage will be useful in testing the robustness of observed results.
- 2) It will be useful to investigate correlation between observed dependent and independent variable by conducting studies based on interviews, questionnaire surveys and case studies.
- 3) The use of alternative methodology should be adopted i.e. panel data technique to take into account time variance observed in the result.

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WHITHER THE GERMAN COUNCIL OF ECONOMIC EXPERTS? THE PAST AND FUTURE OF PUBLIC ECONOMIC ADVICE

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Abstract

The article discusses the development and impact of the German Council of Economic Experts (GCEE). Firstly, the author studies the historical origins and the institutional setup of the GCEE. In the second step, an analyse of the impact of the annual reports of the German Council is given, along with the international comparison with other advisory boards. Finally, the paper discusses the current economic challenges and the need of modernization of the GCEE in special and political advisory boards in general.

Key words

History of Economics; German Council of Economic Experts; Economic Advice; Google Search.

INTRODUCTION

'Der Sachverständigenrat' (engl. German Council of Economic Experts, in short: GCEE) was founded as an independent committee devoted to economic advice to the government 50 years ago, on June 26th, 1963. The main task was the assessment of the overall economic development in Germany. The law regarding the formation of the 'German Council of Economic Experts' (Gesetz des Sachverständigenrates, SVRG) is in place up to this day, and it states that the board has to contribute "...to the simplification of rigorous scientific opinions at all economic authorities as well as in the public..."(§ 1 SVRG). The GCEE has been fulfilling this demand with its annual reports since the foundation year. Thus, the annual reports in autumn became an essential component of the economic discussion in Germany.

The institutional setup of the GCEE is of outstanding importance in Germany. In accordance with §2 of the GCEE law, the council shall examine "...how in regard to the free competition law, price-stability, a high level of employment and a trade balance together with sustainable economic growth can be ensured at the same

time." Although there have been significant economic and institutional changes in Europe within the past fifty years, these objectives are still relevant today. Since January 1st, 1999, Germany has been a member of the European Monetary Union (EMU) and the exchange rate of the Deutsche-Mark has been fixed irrevocably. Nevertheless, the main objective of the GCEE is still concentrated on the domestic economic policy tasks. The law of the GCEE is similar to the law of stability and economic growth adopted in Germany in 1967. Both laws are of paramount importance up to the date and impose a forward-looking setup in Germany's political environment. This was due to bold efforts of Ludwig Erhard, the 1st federal minister of economics and Germany's 2nd Chancellor.

The article takes the 50th anniversary of the GCEE as an opportunity to introspect its origins and developments. Section 2 provides a surveying view on the creation phase of the GCEE. This is followed by a unique evaluation of the GCEE's reports from 1964 to 2012, in section 3. In section 4, an international comparison with the most important advisory boards is presented. By doing so, I discuss the challenges for economic and political consulting bodies in modern democracy and the globalized world in general. These insights are finally analysed in section 5, and thereupon I propose some ideas for the modernization of the GCEE in special and advisory boards in general. Section 6 concludes the article.

ORIGINS OF THE GERMAN COUNCIL OF ECONOMIC EXPERTS

Historical Background

The demand for an economic expert committee in Germany first arose from several academic experts and other advisory boards in the 1950s. One of these was the scientific advisory board of the Federal Ministry of Economics (BWM), which mentioned such a committee in a report (Blesgen and Preiser, 1999). This debate gained pace in the subsequent years, and the topic was discussed again in the advisory board of the BWM in September, 1954. At the same time, there was a discussion among politicians whether to create another, however, independent advisory board in Germany. The liberal democrats (FDP), for instance, made a proposal for the creation of an economic advisory board on 11th of October, 1955 (BArch, 37(8)). Only one year later, on June 6th, 1956, the social democrats (SPD) introduced a bill for the promotion of a Committee of Economic Experts that had been advising the government on sustainable growth for the overall economy. On the one hand, such a new committee had to aim for professional economic advice, but on the other hand, it had to mitigate the general "Hysteria" in Germany's booming economy in the late 1950s. Whilst the SPD circles suggested that the politically independent committee mainly advise on macroeconomic questions, the FDP wanted the committee to mitigate the "Babylonian confusion of languages" in the existing wage negotiations (Nützennadel, 2002). Although the idea of a German Council of Economic Experts (GCEE) appealed to the Christian democrats and



conservatives (CDU and CSU), the government under Chancellor Konrad Adenauer did not take any initiative at the beginning. Only in 1958, this topic was placed on the agenda by the CDU representative and a member of the executive board of the CDU, Curt Becker. On February 1st, 1958, there was a discussion on this topic between Curt Becker and the Federal Minister for Economic Affairs, Ludwig Erhard. In this conversation, they discussed the idea of an independent expert board or council. The suggestion of establishing a scientific GCEE was appealing to the Minister of Economic Affairs for two reasons: firstly, Ludwig Erhard wanted to avoid another federal economic council consisting of representatives of the labour unions and trade associations, which was preferred by Chancellor Konrad Adenauer. It was due to Erhard's regulative conviction in the 'Social Market Economy', in which he considered the strict separation between state duties and private-sector activities as a prerequisite. Secondly, Ludwig Erhard hoped that a committee of independent scientists would support his vision on the successful free competition and free market course. Presumably, he expected, through the institutionalization of an independent and scientific expert council, that the basic principles of the social market economy would be established finally. At that time, this was important for Germany, a young and fragile country after Second World War.

However, Erhard thought little of Curt Becker's plan to associate the committee with a "mediator function" in wage negotiations, which was planned years ago by the FDP. In fact, Ludwig Erhard considered this as a glaring violation of the principles of the social market economy – the German model. Any restriction or intervention in the price mechanism is considered as a violation of the social market economy. According to Erhard, the state had to stay out of wage negotiations and the price mechanism, which was also established upon the free and collective wage bargaining concept in Germany (BArch Vol. 1254, No. 330). Instead, Erhard wanted to assign the committee the task of examining macroeconomic goals such as price stability, full employment and sustainable economic growth. The Minister of Economic Affairs, Ludwig Erhard, discussed this conception with representatives of trade associations and labour unions in March, 1958.

Although there was still no political agreement on the aims and tasks, the Federal Ministry of Economic Affairs immediately started drafting a bill. The outline was orientated to the so-called "magical four-sided figure" of full employment, price stability, trade balance and sustainable economic growth. The balance among these four objectives was established again years later, on June 8, 1967 with the stability and growth law. In drafting a bill for the German Council of Economic Experts, leading professors, such as Kromphardt, Preiser and Sauermann, were involved too. However, their ideas were not always the same with the suggestions by the Federal

Minister of Economic Affairs. A critical issue between the scientists and the minister was about the balance of financial and staff independence of the new advisory board. Up until now, its absolute independence from all political influences is a unique and important element of the GCEE's outstanding reputation.

After Ludwig Erhard had forwarded the draft bill to Konrad Adenauer, without any previous discussion, Adenauer expressed "serious doubts" about a German Council of Economic Experts in a letter to Erhard on May 22, 1958. According to Adenauer, an independent committee could "under circumstances completely take over the reins from the Federal Government and also me, who bears the responsibility" (Pohl, 1992). The Federal Minister of Economic Affairs was in an inferior position during the quarrel with the Chancellor due to the German constitution, which grants the Chancellor the final word. Furthermore, there was another point of criticism besides the ideological differences. Chancellor Adenauer had, according to historical documents, an underlying scepticism about scholars in general. He feared that critical reports could cause problems within the current government. Therefore, Konrad Adenauer did not want to give the GCEE the right to develop policy recommendations or proposals. Konrad Adenauer strongly believed that this would endanger the primacy of politics and that a scholar dictatorship could develop in the end. Adenauer was not the only one with this attitude at that time. It was rather a spirit of the time. Quite similar argued another German Minister Kurt Schmücker: "I won't correct myself on my political beliefs, not even by the best expertise!"

Given these circumstances, the draft bill was rejected at first. However, approximately four years later in spring 1962, the draft bill was placed on the agenda once again. There were three reasons behind the renewed attempt: firstly, the European institutional framework had changed. With the Treaty of Roma in 1958, the German government demanded a better coordination of the economic policy within the European Economic Community (EEC) (BArch B 136(7443)). The development of the necessary instruments was assigned to the state secretary Alfred Müller-Armack, a close friend of Ludwig Erhard. Secondly, the political situation in Germany was different too. The Chancellor Konrad Adenauer was forced to resign before the expiration of his full legislative period after the parliamentary elections in 1961. This has weakened the position of the chancellor significantly. Thirdly, the economic condition demanded an urgent need for action. The overheating of the economy was threatening Germany as a result of an export boom. The rate of inflation had already arrived at three per cent. Moreover, there was a revaluation of the D-Mark due to the restrictive policy of the German Bundesbank. In addition, it came to a heavy imbalance in the labour market, as there was an insufficiency in workers to fulfil the excessive vacancies in the labour market. In this situation, Adenauer's resistance immerged and he finally approved the foundation of the German Council of Economic Experts.



Foundation and Final Conception

Ludwig Erhard thereupon brought up his suggestion to Chancellor Adenauer again (BArch, B 136(7452)). He convinced Adenauer by the renewed proposal with the “substantial threats” to price stability, which resulted from the considerable wage increases during the years of boom. Despite Adenauer's doubts, which Erhard tried to mitigate beforehand, the government discussed the bill of a GCEE on April 11th, 1962 (BArch B 136(7452)). There is nothing officially reported on the meeting itself, however, the bill was denied once more. Nevertheless, soon after some minor changes, the government and parliament approved it with an overwhelming majority on June 26, 1963.

Thereby the highly regarded and independent German Council of Economic Experts (GCEE) was inaugurated on August 14, 1963. Since then, there have been only two insignificant changes concerning §6 of the law in 1966 and 1967. The first change of the bill required that the federal government must prepare an official answer statement on each annual report within eight weeks after publication. Today, this request is carried out by the government on a regular basis with the publication of the annual economy report ('Jahreswirtschaftsbericht') in January. The second change of the bill merged the GCEE's targets with a growth law implemented on June 8, 1967. Thus, the GCEE is based on a solid legal basis, which is an excellent example for legal stability. Due to the long-run legal stability and the distinguished board members of the GCEE – in public the five sage of economy – economic policy is on professional footing in Germany. Since then, the GCEE has been serving the public as a credible anchor for “good” economic policy suggestions and a stabilization of economic expectations.

Fortunately, the disagreement on the question, whether the GCEE shall receive the right for proposal making, was resolved after intense arguments between both sides. It was put in concrete terms as follows: "The GCEE shall show undesirable economic developments and options for their avoidance or elimination, however, not express any recommendations for certain economic or socio-political matters" (§ 2 SVRG). This wording provides the GCEE with flexibility for both normative statements and concrete suggestions. As long as the GCEE's economic suggestions are not expressed as recommendations with the aim to avoid undesirable economic developments, it is according to the law accepted. This possibility has been used by the GCEE for the past 50 years – in fact, even more intensively over the recent decade (cf. section 3).

The tasks of the GCEE are even more flexible than explained until now. Besides the periodical analysis and forecast of the economic situation, the GCEE has extended its analysis to other fields, such as public finance, tax policy, financial markets, monetary policy, labour markets and social policy. In the course of the intellectual

history and development of economics, the board has gone through different ideological phases in all fields of economics. In the 1960s and 1970s, the council believed that short-run business cycle policy is the best strategy to stabilize the economy. However, this initial period of Keynesian policy quickly ended. It was followed by a medium to long-term growth conception. In principle, the GCEE followed the so-called regulatory principles of the 'Social Market Economy' – a typical long-run view. This reorientation was supported by the supply-side revolution in economics sciences of the 1980s developed by Nobel laureate Robert Solow and his followers (Sievert, 2003). This mainly explains why the GCEE demands wage restraints aligned with price stability and sound public finances in almost all reports over the past three decades. Over the time, the GCEE got more importance because now the reports are directly submitted to the Chancellor and not, as in the beginning, to the Federal Minister for Economic Affairs.

The quality of the GCEE reports has always been serving as a guideline to the acting politicians up to this day. Yet politicians are not always satisfied with the suggestions in the reports. Therefore, it happens rather frequently within debates of the German parliament that it is tried to refer to pages in the report that are liked the most, whilst other parts, with opposing arguments, are not mentioned at all (quote, Chancellor Schröder, 2003). In brief, cherry picking is a common strategy in (even in German) politics.

ANALYSIS OF THE GCEE'S REPORTS

The GCEE reports are the megaphone of the committee, and accomplish their task in accordance with §1 SVRG, contributing to "...the simplification of rigorous scientific opinions at all economic authorities as well as in the public..." In this respect, an analysis of the reports provides an important insight to the action and function of the GCEE. I analyse all reports of the GCEE from 1964 to 2012¹. The reports are evaluated based on quantitative and qualitative measures.

The first annual report, consisting of 226 pages, was published in 1964. Since then, the volume of pages grew continuously; according to my linear regression, about 11 pages every year. The volume of pages averages at approximately 400 pages. In 2004, the absolute maximum was reached, with a volume of 1077 pages (Figure 1). The minimum, 193 pages, was in 1968. Figure 1 depicts the reports' development with respect to the number of pages. It is noticeable that the volume of pages has been diminishing since 2005. However, since that time, the GCEE has been publishing at least one additional special report every year (hatched bars). This shift was demanded by policy-makers and later on executed by the chair professor Rürup (Nienhaus 2009).

¹The annual reports 1974, 1997 and 1999 could not be evaluated due to missing electronic versions and technical problems with the PDF.

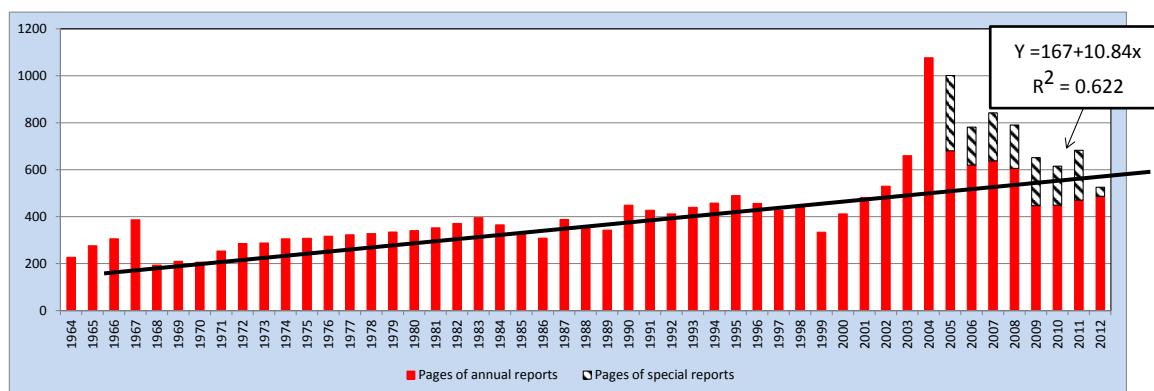


FIGURE 1. VOLUME OF THE ANNUAL REPORTS

What led to this continuous growth of pages over the years? In my view, as a former staff member of the council, there are two reasons: First, an increasing complexity of the economy required more sophisticated analysis and methods over the years. Moreover, the (empirical) research methodology improved and enabled the council to conduct research that is more complex. The second reason is concerning the institutional setup and the board members. Since the end of the 1990s, there has been an increasing effort by the GCEE to develop concrete reform proposals. These proposals, which are always very detailed, including legal and institutional issues, increased the number of pages significantly. Examples are proposals about the corporate tax reform, the reform of the pension and health care system and a labour market reform, especially the model of combination wages.

This trend of concrete proposals can be exemplified by investigating how often the words "reform" and "proposal" appear in the annual reports from 1964 to 2012. Figure 2 shows an obvious increase of the use of the word "reform" – in terms of reform proposal, health care reform, labour market reform, etc. – over several decades. The maximum, 856 times within one report, was reached in 2003; consequently, the word "reform" appeared 1.3 times on each page (Figure 2). A similar trend is detected for the word "proposal", however, not in an obvious manner as it is forbidden by law to express a proposal in a GCEE report according to §2 SVRG. Behind this growing dynamic was a rise of economic challenges in Germany at that time. These challenges are well known: the globalization, the European Monetary Union, the aging of the society, unsound public finances, geopolitical threats and climate change, as well as terror attacks.

Now, let me analyse some content-related issues. A long-run economic problem was an extremely high unemployment rate in Germany. The black-dashed curve in Figure 3 shows the development of the unemployment rate. It is easy to recognize the step-like rise of unemployment rates from the beginning of 1970s up until 2005.

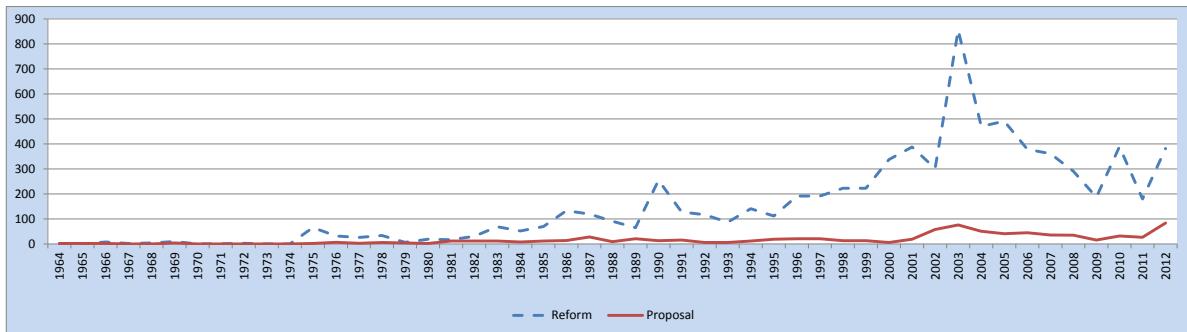


FIGURE 2. COUNT OF WORDS: "REFORM" AND "PROPOSAL" IN THE ANNUAL REPORTS

Only after discussions and proposals of the GCEE and other committees, policy-makers implemented bold labour market reforms in 2002 to 2003. Thereafter, these reforms reduced the unemployment rate – despite the worldwide crises – significantly (Figure 3). Comparing this development with various key words in the reports, such as labour market, social, and reform, it is noticeable that there has been a concurrent development. This demonstrates that the increasing economic challenges caused the GCEE to propose more of the needed reforms in all areas.

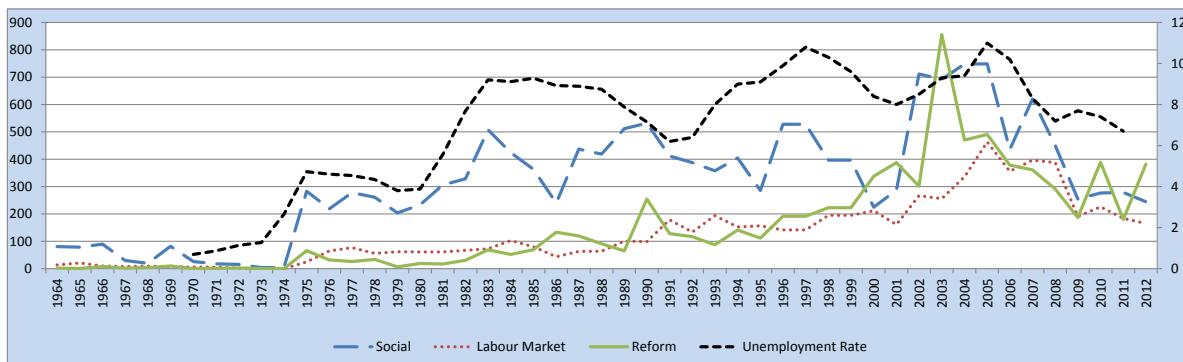


FIGURE 3. COUNT OF WORDS: UNEMPLOYMENT RATE, LABOUR MARKET, REFORM & SOCIAL IN THE ANNUAL REPORTS

A similar finding is for the words "recession" and "crisis". The increased occurrence of these two words falls in the periods of actual recessions. It is interesting to see that the word "crisis" gains a certain momentum, at present times in particular. In Figure 4, it seems clear that there is a increase in the use of the word "crisis", although the word "recession" would be more appropriate. In 2009, there was the most severe recession in Germany since the great depression in the 1930s. Germany's GDP dropped by more than 5 per cent in 2009. On the one hand, the frequent use of the word "crisis" indicates a shift in the use of language. The word "crisis" is used simply as a synonym for "recession" in German language. On the other hand, the term "crisis" stresses the abnormal and exceptional situation in the period between 2007 to 2012 (Figure 4).

Another interesting observation results from an analysis of the terms "business cycle" and "growth". As already mentioned, the GCEE followed Keynesian policy until the 1970s. However, this view changed in the 1980s.

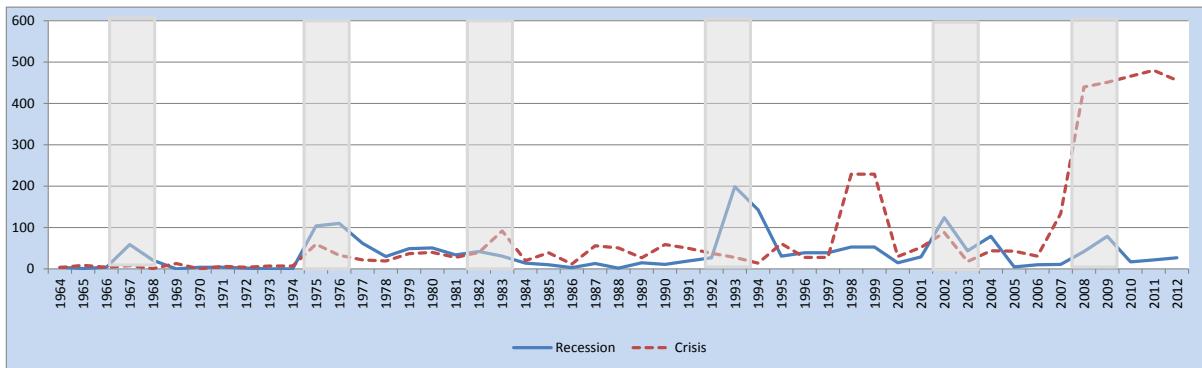


FIGURE 4. COUNT OF WORDS: “ RECESSION ” AND “ CRISIS ”;
ACTUAL RECESSIONS ARE GREY AREAS

Since then, the orientation of GCEE moved towards supply-side economics. Figure 5 illustrates this graphically. It can be seen that the term “growth” gained importance year by year, and appeared more frequently than “business cycle” in the late 1980s. Later on, the use of both words is more balanced. Note that the term, “business cycle”, is still used, but reflects a variety of other meanings in the German language. Interestingly, the appearance of the word “growth” in the reports is a leading indicator of real economic activity. This can be detected in the years followed by economic booms, e.g. 1987 and a boom between 1989 and 1991 as well as 2002 and a boom between 2006 and 2007. Furthermore, it is striking that, during economic downturns, the GCEE chose a pragmatic middle path and put some emphasis on demand-side policy (stressing “business cycle”) but simultaneously stressing the importance of long-run growth.

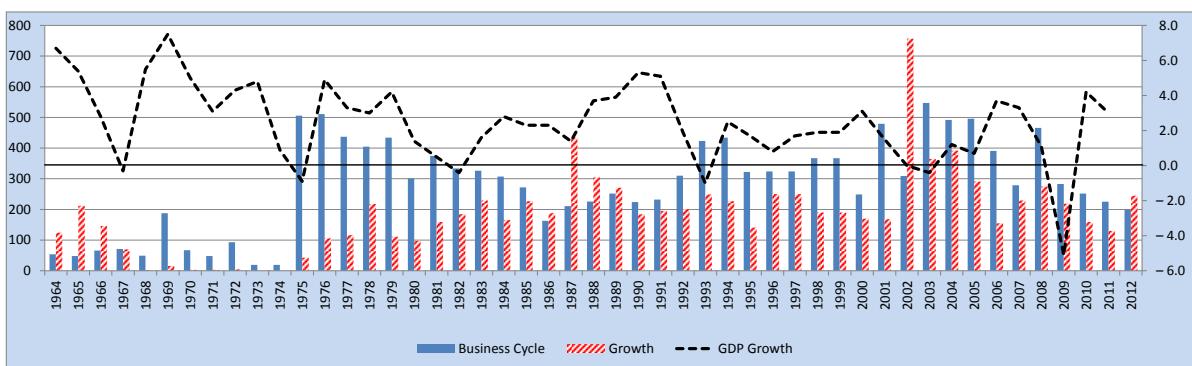


FIGURE 5. REAL GDP GROWTH VS. COUNT OF WORDS “ BUSINESS CYCLE ” AND “ GROWTH ”
IN ANNUAL REPORTS

Finally, I analyse the public attention to the GCEE based on Google Search data. There is a positive correlation between the attention of the GCEE in general and the attention of the reports, published in November each year, in special. Google searches for “GCEE”, “annual report” and “sage of economy” show almost identical search patterns. The correlation between these three time-series is positive, and it ranges from 0.786 to 0.858 (Google-Trends.com). Furthermore, it is recognizable that

the Google search data shows more spikes, and is thus more volatile in the recent years. I explain this by two realities: firstly, the publication of the new special reports in spring, and secondly, special statements in the course of the European sovereign debt crisis. Nevertheless, there remains an interesting observation for future research: What are the reasons for the declining public interest, measured by Google data, to the GCEE's reports? It may be due to institutional problems and competition with other councils in Germany and Europe. Alternatively, it may be due to news congestion or a tired public. There is anecdotal evidence that the increasing complexity in a globalized economy leads to rising "cacophony" and over-alarming statements of expert boards. Both issues may mitigate the public attention and interests to new reports of GCEE.

THE CHALLENGES OF ADVISORY BOARDS

International Comparison

In principle, there are advisory boards worldwide.² The following section describes the differences between the major boards. I discuss the constituent features as well as their advantages and disadvantages. In order to obtain a comprehensive overview, the section concentrates on the most important and, at the same time, most different expert committees:

- a) The German Council of Economic Experts (GCEE)³;
- b) The US-American "Council of Economic Advisers" (CEA);
- c) The French model of a "Conseil d'Analyse Économique" (CAE); and
- d) The Dutch model of a "Central Planning Bureau" (CPB).

Table 1 compares the four boards across six institutional dimensions: i) legal basis, ii) legal order, iii) composition and tenure, iv) frequency of meetings, v) publications and vi) independence. The description of the GCEE has been discussed previously. I just have to add, that the GCEE consists of 5 board members (renowned professors) and a staff of 10 economists. The board members are nominated for five years by three intuitions: the government, the trade unions and the employer associations. Moreover, the GCEE is fully independent of politics.

The American Council of Economic Advisers (CEA) features another conception of an advisory board. The CEA was established through the "Employment Act" by president Truman in 1946, and is an integral part of the US-administration, which belongs to the "Executive Office" of the American president. The president, in accordance with the senate, appoints two to three members of the CEA for two years

²There exists a kind of expert committee even in China: "Development Research Center" (DRC). This is a part of the governmental administration. They are responsible for strategic research in terms of the economy and social politics.

³A similar model is found in Sweden. The "Fiscal Policy Council" (FPC) is a public authority founded on 1st August 2007. The FPC consists of six members and is supported by an administrative office of five employees. The task is an independent evaluation of the Swedish fiscal policy.



(Cooper, 1987). Consequently, the CEA cooperates with the political bodies in Washington D.C. and is more dependent on politics. In contrast to the GCEE, the CEA is integrated in the decision-making process of the president and public communications. The chair of the CEA has a specific position in this board; he solely represents the board and bears full responsibility. Moreover, the chairperson gives direct advice to the president in all economic affairs, either through personal discussions or in the form of a written briefing. Furthermore, the chair is a member of all relevant committees, and takes part in auditing public statements. The two other members support the chair and represent the chair in case of her or his absence.

A group of professional staff, a statistical department and an administrative department supports the three CEA members. The professional staff consists of approximately 30 economists, some of whom are renowned economics professors⁴. These economists are exempt from their duties at the universities, and stay for approximately two years at the CEA. Apart from the advisory tasks, the CEA has to create growth forecasts in cooperation with the ministries, which are in charge of budget planning. It is noteworthy that the considerable influence of the CEA, especially the chairperson, is not just due to the concept of the board rather due to the presidential system in the US. The president makes decisions on all relevant issues. The Cabinet⁵ in the US, in contrast to Germany, only has an advisory function.

Despite the potential political influence of the CEA, there exists anecdotal evidence that this might not be the reality at all times. Harvard professor Martin Feldstein, CEA chair under the Reagan administration from 1982 to 1984, once stated: on the one hand, the job was interesting, but on the other hand, it was "extremely frustrating" to receive influence on economic policy issues. A reason for this assessment might be the fact that the president has another (private) economic advisor besides the CEA. Therefore, the influence of the CEA is depending on whether the chairperson and the personal economic advisor of the president have the same opinion.

Undoubtedly, the CEA members, despite the criticism by professor Feldstein, have more influence on political projects and decisions than the members of the GCEE. Moreover, the CEA members obtain a better internal perspective of the government and administration, which is an further advantage. Consequently, it is easier for

⁴Since 2013 the highly appreciated Professor of Economy, Jim Stock, for example is the Chief Economist in the CEA. Professor Stock, together with Professor Watson, shaped economic research for several years. I meet Jim Stock on the 50th anniversary of the GCEE in Berlin.

⁵The US-Cabinet does not meet regularly but this varies from president to president. In the US-President, according to their professional competence, appoints the members of the Cabinet.

CEA to develop reform proposals in line with the administration and the president. However, a disadvantage of this board structure is the political dependence, which could result in the refusal of efficient proposals owing to the interests of parties or ideological disagreements.

TABLE 1. ECONOMIC ADVISORY COMMITTEES IN AN INTERNATIONAL COMPARISON

| | Germany | US | France | Netherlands |
|------------------------|--|---|--|--|
| | Council of Economic Experts (GCEE) | Council of Economic Advisers (CEA) | Conseil d'analyse économique (CAE) | Centraal Planbureau – CPB |
| Legal basis | Law over the formation of a Council of Economic Experts for the assessment of the overall economic development (SVRG); (14.8.1963) | Employment Act of 1946 (20.2.1946) | Law 97-766 on the formation of a Conseil d'analyse économique; (22.7.1997) | Foundation on 15.9.1945. "Law Concerning the Preparation of the Central Economic Plan"; (21.4.1947) |
| Legal order | <ul style="list-style-type: none"> - Analysis of the overall economic development and growth forecast - Examination how to establish a stable price level, high employment and a trade balance with steady growth - Analysis of the distribution of income and wealth - Illustration of anomalies and possibilities for their prevention and removal | <ul style="list-style-type: none"> - Council supports the creation of the "Economic Report of the President" - Creation of proposals, recommendations, economic studies, reports to the president or on request of the president - Analysis of economic development & trends - Development of measures to strengthen the free market economy and to prevent business fluctuations | <ul style="list-style-type: none"> - Publication of analyses demanded by the Premier Minister - Description of economic alternatives and the different assumptions | <ul style="list-style-type: none"> - Creation of economic analyses - Production of studies requested by the government, the parliament, unions or employer unions - quarterly economic forecast as well as a mid-term forecast for the election cycle - scientific evaluation of reforms and analysis of the election manifestos |
| Composition and tenure | <ul style="list-style-type: none"> - Five board members (Professors) and a scientific staff (10 Senior Economists) - Tenure of 5 years with the possibility | <ul style="list-style-type: none"> - Three members (Professors), amongst a chair as well as scientific staff (20-30 Senior Economists) - Tenure usually 2 years with the possibility of | <ul style="list-style-type: none"> - approx. 30 members (Professors). Staff: 10 Senior Economists. - Tenure of 2 years with the possibility of | <ul style="list-style-type: none"> - One director, 8 consultants and a scientific staff of approx. 100 Senior Economists - Tenure of 3 to 15 years |



| | of reappointment | possibility of extension or dismissal | extension | |
|-------------------------------|---|---|--|--|
| Frequency of council meetings | - 2 days a month (Dec. to Aug.) and fulltime (Sep. to Nov.) - Part-time employment | - Permanent - Fulltime employment | - Monthly plus additional meetings - Part-time employment | - Permanent, consultants meet at least twice a year - Fulltime employment |
| Publications | - Annual reports - Special reports | - Economic Report of the President - Economic indicators - CEA White Papers - Presidential Briefings - Public statements and hearings | - Reports on specific topics - Monthly Letter - Working Papers | - Central Economic Plan - Special reports - Working Papers - White Papers |
| Independence (rating) | High | Low | average | rather low |

An advisory board consisting of highly regarded academics could also be a disadvantage. Firstly, the academics do not have administrative experiences and secondly, the short tenure gives the CEA little continuity in dealing with long run or generational issues e.g. reform of the health care system.

The Conseil d'Analyse Économique (CAE) was founded in 1997. This committee consists of approximately 30 independent professionals, usually professors in economics. The members represent different fields of research and schools of thought. The CAE is rather pluralistic in comparison to all other international advisory boards. Like the GCEE, the members of the CAE are independent. However, due to the institutional setup of the board, they are closer to the political bodies and thus more susceptible to political influence. According to the former chair Christian de Boissieu, a problem of the CAE is the acquisition of new members because the job is not paid and part-time.

The task of the CAE is the publication of economic analyses on economic policy issues and the participation in economic debates.⁶ The CAE shall comment on recent economic challenges in order to close the gap between the view of the political administration and science. Lastly, the CAE publishes a report with policy conclusions, which are not necessarily unanimous agreements. Even though

⁶For example the CAE argued against the political project to reduce the working hours to 35 per week.

different opinions are tolerated, the members are prohibited from making official comments on behalf of the CAE. All reports are published and presented to the public through press conferences. The president of the CAE is the Premier Minister, whereby the CAE has a delegated president since 2001. The staff members of CAE consist of a general secretary and four economic experts. The CAE meets once a month for a general assembly in order to discuss certain issues on the Minister's demand. Afterwards the CAE publishes reports on the issues. The preparation of these (special) reports takes place in small groups. Those groups consist of business representatives, professionals and professors, who are not necessarily members of the CAE. The aim of such small groups is to provide strong expertise.

The Dutch model, "Central Planning Bureau" (CPB), has a different concept from the previous pluralistic model. The CPB was founded directly after the Second World War in September, 1945. The politics declared that the government needed scientific expertise and insights for the configuration of economic policy. At the beginning, the focus of the CPB was on better economic developments and high level of employment. The chairperson of the CPB has been famous economists, mostly leading professors in Netherlands. The CPB publishes a "Central Economic Plan" (CEP) on a yearly basis. This report provides an overview of the actual economic situation. Moreover, the CPB publishes short- and mid-term economic forecasts as well as special forecasts at the beginning of every election cycle. Apart from the economic forecasts, the CPB analyses the election manifestos of all parties, and conducts cost-benefit analyses of infrastructure projects proposed by the government or parties. Thus, the CPB makes explicit political recommendations on the consequences of reform proposals. In addition, the CPB conducts basic research. Research topics are the economic effects of the aging society, globalisation, financial crisis and regulation of markets. The level of independence of the CPB is rather low because it is part of the Ministry of Economic Affairs. The CPB's chairperson is appointed by the minister, through consultation with other members of the government. However, the daily work is completely independent. Moreover, the CPB has an independent counsellor.

Finally, it is noteworthy that, in some countries, advisory boards were abolished after some years of existence. For example, in 1993, the "Economic Council of Canada" was abolished after 30 years of operation. Another example is the Swiss advisory board ("Expertengruppe Wirtschaftslage") which was abolished after only three years of existence in 1980. The reasons for the abrogation of these advisory boards were not examined scientifically. However, there are some hypotheses, which I explain at a later part of the article. Interestingly, the demand for advice is still present even in the aforementioned countries. Thus, there are other scientific committees supported by public money in all advanced countries. In conclusion, the four advisory boards show similarities and differences. The major difference is the independence of the boards and its relation to the administration.



How does an efficient advisory board look like?

The question of efficient advice goes far beyond the advantages and disadvantages discussed so far. There exists even a literature, which is recognized (Kopits and Szymanski, 1998). It is important to note that the field of economic sciences has changed, similar to the technological change of the 21st century. In the 1960s, it was widely believed that economic policy could be easily developed by planning and rational decision-making. During that time, network effects, systemic risks, non-linear dynamics, strategic decision-making and psychological elements did not play a role. Thus, there was a simple technocratic 'zeitgeist' (spirit of time). Policy-makers believed that any objective advice by scientific boards would be helpful for the decision-making. Admittedly, this has been proved an erroneous perception today. Even with good empirical and theoretical models, we are still unable to understand everything in a highly globalized and interconnected world.

Once, Nobel laureate F. Hayek pointed out that we could never succeed in stimulating the economy through a planning board or "Computation machine" because market dynamics is too complex and non-linear (Brodbeck, 2004). A social science that deals with human aspects faces several challenges. Recent neuroscientific evidence demonstrates that the origin of erratic behaviour in financial markets is partly due to human evolution. In the end, modern economics agree that the economy is not a natural science. Even though the economy does not follow mathematical regularities, economic models still provide useful insights. Firstly, normative statements are abstracted in models and secondly, the models are long run oriented, i.e. beyond the electoral budget cycles. Of course, in order to enforce and implement reforms, policy-makers need to have parliamentarian majorities and not only good advice.

Every advice has shortcomings and limitations. All economic schools of thought, despite their eligibility, relay on fundamental assumptions. In economics, we mainly distinguish between short-run versus long-run or demand-side versus supply-side. Even if the assumptions are transparent, political decision-making is still challenging especially under the uncertainties of reality. In general, the major advantage of economic boards is their unique perspective – this is a constitutive feature of economic sciences. Economics compares alternatives in terms of efficiency. Thus, there is never a single solution to an economic problem. In fact, there could be many possibilities depending on political beliefs.

For instance, some years ago, there was a debate on a major tax reform in Germany. The scientific advisory board of the federal Minister for Economic Affairs preferred a progressive tax model (three-step-tariff). Other advisers for the federal ministry for

Financial Affairs were in favour of the linear-progressive model. Again, other experts such as professor Kirchhoff, preferred a flat-tax. All alternatives were economically sensible. However, all were based on different assumptions regarding the desired distribution effect. Nevertheless, politics was responsible for choosing the alternative with the distribution effect according to their belief.

Another problem is that political decision-making bears always the risks of uncertainty. The reunification of Germany in the early 1990s or the solution of the European sovereign debt crisis in 2010, are just two examples. Almost no economists had experience in the underlying problems beforehand. Nevertheless, the policy-makers had to make immediate decisions. Admittedly, economic advice, in such a situation, is often useless. However, this is the task of elected representatives. They have to make (rather insecure) decisions based on his or her beliefs in any situation. According to Max Weber (1922) this is political responsibility: "Because there are only two mortal sins in the field of politics: lack of objectivity and often, but not always identical, irresponsibility". Thus, political responsibility is more than the falsification of a theory.

So, what is an efficient interaction between politics and economic sciences? A key problem for an efficient interaction between both spheres is the diversity of interests. This problem explains why advisory boards, in Switzerland and Canada, were removed after some time. In countries based upon the principle of federalism, advisory boards have a more difficult standing (including Germany). Moreover, the interaction between politics and economics is often difficult because policy-makers commonly argue with market failures, while economists argue with policy failures (Coase, 1937). Certainly, both speak of truth but economists believe they are right due to their scientific approach. Admittedly, this is the-chicken-or-the-egg problem because markets as well as political failures are interdependent.

NEED FOR MODERNIZATION?

In the past, the relationship between economic sciences and policy was not always at ease. Even in Germany, some policy-makers suggested the abolition of the GCEE, e.g. a former German minister of Economic Affairs Otto Graf von Lambsdorff (Lambsdorff, 2003 and 2008; Kirchgässner, 2009). Thereby discussions concerning the future of advisory boards emerged in recent years (Scheide, 2005; Schmidt, 2006; Zimmermann, 2008). Certainly, economic advice and political demands have changed considerably. This development has already resulted in changes in the GCEE as previously explained. For instance, since 2007, the GCEE has been preparing special reports in spring in addition to the annual report in autumn. What are the reasons for this debate and what calls for a modernization?

Undoubtedly, in Germany, there is a huge variety of advisory committees, councils, boards, expert groups and government-funded economic research institutes. Over



the past 50 years, policy-makers implemented a multitude of boards without any strategy. At the same time, the workload of each advisory board increased without any compensation. Consequently, both sides of the coin are dissatisfied. Compared to international boards and professors in the Switzerland, the US, Canada, Italy and France, Germany offers low salaries and staff support. Furthermore, as explained above, in Germany economists are rather considered as troublemakers than advisors. This view has a long history, since Konrad Adenauer's regime. Nevertheless, it is a phenomenon in other countries as well. The American president Truman once wished a "one-handed" economist. He wanted economic advisory who do not argue on the one hand and on the other hand. Thus, he wanted to stay away from economists who seek alternatives (Wiegard, 2003).

There is definitely a need for constructive dialogs, which do not substitute politics but accompany and facilitate decisions. Another dilemma is that the public and politics often feel wrongly advised, whilst scientists often feel misunderstood. There are many reasons for all these dilemmas:

- a) Political debates are regularly driven by short-run news or election dates. This artificial time pressure encourages dependent boards to publish quick shots without enough self-reflection. We need solid research, even if it is not feasible to provide answers for any short-run problem. Scientific rigour requires time.
- b) Politics often ignores important opposing views. Thus, simplification does not only disappoint the scientists but also endangers public resistance to advice.
- c) The emergence of the private consultancy industry increased the competition between the political advisories, however, not at the same level playing field. Public financed institutions lack on manpower and money. Moreover, consultancy firms have not the same degree of independence. They follow profit interests and their suggestions could contain hidden interests.⁷
- d) The communication strategy of complex scientific proposals in a media driven and short-run focused world is more difficult too.
- e) Finally, politics does not always accept that "good or efficient" advice is never a single solution rather alternatives.

⁷Professor Martin Hellwig described this problem during an international conference on the "50 years of Sachverständigenrat" on the 20th of February 2013: Since a couple of years, we have in Germany a partly systematic concealment of important (economic) debates. This explains on the one hand the weak interest for the state-owned advisory committees, such as the "Sachverständigenrat" and the monopoly commission, since economic challenges are not even discussed in politics and the public. On the other hand, the legitimacy of these committees suffers because the public neither realize nor classify the good contributions of these independent entities.

Thus, I see the following enhancements and steps for a modernization:

- Avoid expert advice in a too ritualized format. Currently, we have in almost all parliaments many hearings that serve just an alibi mechanism.
- The independence of advisory boards is a valuable and important source. The advantage of independence is a frank assessment without hidden interests or normative views.
- Despite different scientific views, advisory boards should try to speak with one voice.
- Do not overburden existing advisory boards with ad hoc reports, even though there are many current challenges.
- Adapt the goals and tasks of advisory boards over time. New challenges or institutional changes need new or other advisory boards.
- Modern advisory boards have to study systemic risks, and thus have to widen the focus from domestic to international issues and interdisciplinary approaches.
- Facilitate an exchange of ideas between politics and science. This would enrich and improve the understanding of both sides.
- Economists should concentrate on the big picture. They have no comparative advantage in the development of legal proposals or even a final bill.

In principle, efficient advice does not only require scientific rigour rather a mutual understanding. For instance, advisers must demonstrate humility in respect to the legal and practical challenges. Moreover, I do not deny the need of private consultancy firms, however, the analysis above demonstrates that neither external nor internal, neither independent nor commercial has absolute advantages. In brief, there is not a lack of advice but there is a lack of "serious" advice. Finally, I would like to emphasize that, also according to the law of the GCEE, efficient advice has to "assess" and not "advise". An efficient assessment must be objective and thus made by an independent council.

CONCLUSION

The German Council of Economic Experts (GCEE) has good reasons to celebrate its 50 years existence. Without doubt, in international comparison, its framework is unique and has an excellent reputation. Nevertheless, the world has changed and thus even the GCEE requires some changes in future. Politics should get efficient advice to tackle the future challenges ahead. It would definitely be wrong to reduce or abolish scientific boards despite current tensions between both spheres. An independent and rigorous assessment of economic issues remains essential in politics even in future.

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DYNAMIC FEEDBACK BETWEEN MONEY SUPPLY, EXCHANGE RATES AND INFLATION IN SRI LANKA

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Abstract

Macroeconomic theory postulates possible feedback between money growth, exchange rates and inflation. Empirical evidence derived, however, from various countries is mixed. While some finds strong feedback relationships in some countries, others find weak feedback. As there is dearth of empirical studies on this with reference to the case Sri Lanka, this paper examined long run dynamic feedback between money growth, exchange rates and inflation in Sri Lanka by using the Auto Regression Distributed Lag Model approach to cointegration. Possible short run dynamics were examined by using error correction model. The results are mixed. Monetary expansions have not lead to inflation during the period of estimation possibly because monetary expansions have been accommodated by capital inflows for foreign borrowing. Results also show that shocks in exchange rates lead to inflation in both short run and long run. Increase foreign prices lead to increase in inflation rate only in the short run. The results are useful for monetary policy makers for macroeconomic management in a small open economy like Sri Lanka.

Key words

Money Supply, Inflation, Exchange Rates, ARDL

INTRODUCTION

Sri Lanka, situated in the South Asian region, adopted market oriented economic policies in late 1970s. As a result, foreign trade and capital mobility was liberalized. Managed floating exchange rate regime was used in 1980s and 1990s, while the fully flexible exchange rates were adopted in early 2000. Sri Lanka experienced depreciating exchange rates for the past few decades in the long term, while periods of high and low inflations. During the liberalized period, shocks in one sector has seemingly spilled over to the other sectors.

Macroeconomic theory tends to postulate interlinkages between volatility in exchange rates, inflation and money supply. Excess money growth is thought to positively influence inflation. In the fiscal aspect, budget deficits are regarded to cause of inflation in countries with prolonged high inflation. In the balance of payments aspect, emphasis is placed on the exchange rate and the prices of imported products. The collapse of exchange rates brings about inflation either through higher import prices and increase in inflationary expectations, which are often accommodated, or through an accelerated wage indexation mechanism. Among many causes, structural factors are also believed to influence the rate of inflation.

These different approaches to explaining the causes of inflation have led to differing prescriptions about the appropriate policy responses. Those focusing on monetary factors have emphasized reducing government budget deficits and restraining credit to public enterprises, while advocating exchange rate depreciation to offset any over valuation resulting from past inflation and deterioration in the terms of trade. Those emphasizing the role of exchange rate depreciation, in contrast, have argued against further exchange rate adjustments, preferring instead a combination of incomes policies, price controls, and demand reduction measures. In addition, recent literature has begun to emphasize more on the linkages between exchange rate policy and other tools for macroeconomic management, noting that a fixed exchange rate can serve as a "nominal anchor" to an economy and thus limit inflation if supported by appropriate monetary and fiscal policies.

Empirical studies in different countries on interlinkages between money supply, exchange rates and inflation have generated mixed results. Marta et al. (2004) examining monetary policy in Albania during the transition period using a vector Auto Regression Model (VAR) of key macroeconomic variables including money growth, inflation, exchange rate, remittances and the trade balance, demonstrated a weak link between money supply and inflation. Niccolita and Edward (2001) updating and extending Friedman's (1972) evidence on the lag between monetary policy actions and the response of inflation found that money growth rates, inflation and interest rates are mutually determined in UK and USA. Clemens and Alex (2002) empirically estimated the relationship between exchange rate accommodation and the degree of inflation persistence using a non-linear autoregressive inflation equation for ten European countries and found evidence for the existence of a positive link between exchange rate accommodation and inflation persistence for most of the smaller and more dependent exchange rate mechanism (ERM) countries. Zettelmeyer (2004) and Kearns & Manners (2005) found that increases in interest rates have a significant appreciating effect on exchange rate. As Frankel (1999) observes, fixing the exchange rate has the advantage of providing an observable commitment to monetary policy. Atkinson and Kehoe (2001) believe that fixing the exchange rate has the advantage of providing an observable commitment to



monetary policy. However, these interlinkages have not been studied with reference to Sri Lanka. Moreover, these mixed empirical results in different countries and the fact that there is a dearth of studies in Sri Lanka provide the basis for examining the empirical linkages between money supply, exchange rates, and inflation in Sri Lanka.

MATERIALS AND METHODS

Possible interrelationships between money growth, exchange rates and inflation are explained by monetarist approach and structuralist approach. The importance of the link between money supply and inflation is emphasized by the monetarist's approach to the study of inflation.

We use the theoretical procedure following by Akinbobola (2012) to establish empirical equation to estimate interlinkages between growth of money, exchange rate and inflation in Sri Lanka. This procedure allows us to capture both monetary and structural factors that determine interlinkages between these macroeconomic variables. The linkages are based on demand shifts and the level of economic activity or unemployment. The theoretical link can be specified as:

$$P = f(M, S, U) \quad (1)$$

where:

M = Money supply

S = Demand shifts

U = Unemployment.

The structuralist approach states the role played by deficit financing or government expenditure, export earnings variations, import prices, demand shifts, agricultural bottlenecks and availability of foreign reserves. This implies that the export earnings variation could be an explanatory of availability of foreign reserves. The latter is a good proxy for ability to import. Deficit financing is an important explanatory of the growth of money supply. Thus, the structuralists are inadvertently emphasizing money supply when they emphasize deficit financing. Import prices stands on its own as it explains the contribution of imported inflation. Demand shifts in the structuralists school do not differ from that of the monetarist school. The level of economic activity is already subsumed in the structuralists theory since their theory pertains to developing economies where full employment is yet to be attained. One could therefore econometrically specify the structuralist theory of inflation as:

$$P = f(DF, EXR, PM, S, A, R, U) \quad (2)$$

where:

DF= deficit finance,

EXR = exchange rate,

PM = import prices,

S = demand shifts,
 A = agricultural bottlenecks,
 R = foreign reserves availability
 U = level of economic activity respectively.

By removing DF and substituting M (Money supply), we have:

$$P = f(M, EXR, PM, S, A, R, U) \quad (3)$$

A synthesis of the Monetarists and the Structuralist specifications would give us an integrated specification since M, S, and U are common to both, and R, Pm and A are particular to the structuralists. Our model for identifying the factors responsible for price increases in Sri Lanka in the period under review is an adaptation of this latter specification:

$$P = f(M, EXR, PM, S, A, R, U) \quad (4)$$

where:

M = money supply, defined as currency outside banks plus private sector demand deposits in the banking system.

PM = Foreign prices;

A = agricultural bottleneck, which could be measured by food prices.

S = demand shift

R = the ability to import are yet to be acceptably specified. As such, they cannot be used in the model.

U = Unemployment

A better specification of the level of economic activity could be the level of real output. This datum, represented by Y, measures how much all the factors of production in an economy are producing at a given time and therefore a good indicator of the level of economic activity. Also included in the model is expected rate of inflation (P_{t-1}). Thus, the model becomes:

$$P = f(M, EXR, P^f, Y, P_{t-1}) + \varepsilon \quad (5)$$

$$f(M) > 0; f(EXR) > 0; f(P_f) > 0; f(Y) < 0; f(P_{t-1})$$

where ε is the error term.

Sequel to the model developed from our theoretical framework, the general price level can be expressed as a weighted average of the price of tradable goods (PT) and non-tradable goods (PN):

$$\log P = \theta(\log P^N) + (1 - \theta)(\log P^T) \quad (6)$$

where $0 < \theta < 1$

The price of tradable goods is determined in the world market and depends on foreign price P^f and on the exchange rate (e). In domestic currency terms, P_T can be depicted by the following expression:



$$\log P_T = \log e + P_f \quad (7)$$

Equation 7 states that both an increase in the exchange rate and a rise in foreign prices leads to an increase in domestic prices. The price of non-tradable goods is assumed to be determined in the domestic money market, where it is assumed that the demand for non-tradable goods moves in line with the overall demand in the economy. Accordingly, the price of non-tradable goods is determined by the money market equilibrium condition, where real money supply M^s/P equals real money demand M^d :

$$\log P_N = \beta(\log M^s - \log M^d) \quad (8)$$

where β is a scale factor illustrating the relationship between economy-wide demand and demand for non-tradable goods.

It is assumed that the demand for real balances is a function of real output (y) and inflationary expectations π^e . Due to relatively underdeveloped financial markets in Sri Lanka, it is assumed that the relevant substitution is between goods and money and not among different financial markets. Consequently, the opportunity cost of substitution between goods and money is the expected inflation rate.

$$M^d = f(y, \pi^e) \quad (9)$$

Being a developing economy and highly imperfect markets, the expected rate of inflation is assumed to be determined by inflation in the previous period following adaptive expectations hypothesis:

$$\pi^e = \Delta \log P_{t-1} \quad (10)$$

The theory predicts that an increase in real income will lead to an increase in money demand, while an increase in expected inflation will lead to a decrease in money demand. Substituting and rearranging, we obtain the following estimable equation:

$$\log P_t = \alpha + \beta \log M_t + \gamma \log y_t + \gamma \log P_{t-1} + \omega \log e_t + \varphi \log P^f + \epsilon_t \quad (11)$$

where,

$$\alpha > 0; \beta < 0; \gamma > 0; \gamma > 0; \omega > 0; \varphi > 0$$

α = constant

P_t = rate of inflation

M_t = growth in money supply

y_t = growth in real output measures in terms of real GDP

P_{t-1} = expected rate of inflation

e_t = US dollar versus SL rupee exchange rate

P^f = foreign prices

ϵ_t = stochastic error term

Theory predicts that an increase in money supply, expected inflation, the exchange rate and foreign prices will drive prices up, while an increase in real output will lead to a decline in the inflation rate. Adding the effect of lagged prices to the equation can capture the effect of sluggish adjustment due to rigidities and inertia in imperfect markets. The inflation equation considers the monetarists variables in addition to exchange rate. Thus, inflation is hypothesized to depend on growth in money supply, real output (measured by real GDP), expected rate of inflation, exchange rate changes and foreign prices.

A series of studies by Pesaran and Shin (1996), Pesaran and Pesaran (1997), Pesaran, Shin and Smith (1998) and Pesaran et al. (2001) have introduced an alternative cointegration technique known as the 'Autoregressive Distributed Lag (ARDL)' bound test. This technique has a number of advantages over Johansen cointegration technique. First, the ARDL model is the more statistically significant approach to determine the cointegration relation in small samples (Ghatak and Siddiki 2001), while the Johansen co-integration technique requires large data samples for validity. Second advantage of the ARDL approach is that while other cointegration techniques require all of the regressors to be integrated of the same order; the ARDL approach can be applied whether the regressors are I(1) and/or I(0). This means that the ARDL approach avoids the pre-testing problems associated with standard cointegration, which requires that the variables be already classified into I(1) or I(0) (Pesaran et al, 2001). Third, if we are not sure about the unit root properties of the data, then applying the ARDL procedure is the most appropriate model for empirical work. As Bahmani- Oskooee and Nasir (2004: 485) explains, the first step in any cointegration technique is to determine the degree of integration of each variable in the model but this depends on which unit root test one uses as different unit root tests could lead to contradictory results. For example, by applying conventional unit root tests such as the Augmented Dickey Fuller and the Phillips-Perron tests, one may incorrectly conclude that a unit root is present in a series that is actually stationary around a one-time structural break (Perron 1989, 1997). The ARDL approach is useful as it avoids these problems. Fourth, yet another difficulty of the Johansen cointegration technique which the ARDL approach avoids concerns the large number of choices which must be made: including decisions such as the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements as well as the order of VAR and the optimal number of lags to be used. The estimation procedures are very sensitive to the method used to make these choices and decisions (Pesaran and Smith 1998). Finally, with the ARDL approach, it is possible that different variables have different optimal number of lags, while in Johansen-type models this is not permitted.

According to Pesaran and Pesaran (1997), the ARDL approach requires the following two steps. In the first step, the existence of any long-term relationship among the variables of interest is determined using a F-test. The second step of the analysis is to



estimate the coefficients of the long-run relationship and determine their values, followed by the estimation of the short-run elasticity of the variables with the error correction representation of the ARDL model. By applying the ECM version of ARDL, the speed of adjustment to equilibrium will be determined.

Following Pesaran et al, (2001), we apply the bounds test procedure by modeling the long-run equation (6) as general vector autoregressive (VAR) model of order p , in t z :

$$z_t = c_0 + \beta_t + \sum_{i=1}^p \phi_i z_{t-i} + \epsilon_t \quad (12)$$

$$t = 1, 2, 3, \dots, T$$

with c_0 following vector equilibrium correction model (VECM) corresponding to (13)

$$\Delta z_t = c_0 + \beta_t + \pi z_{t-1} + \sum_{i=1}^p \tau_i \Delta z_{t-i} + \epsilon_t \quad (13)$$

$$t = 1, 2, \dots, T$$

where the $(k+1) \times (k+1)$ matrices $\pi = I_{k+1} + \sum_{i=1}^p \varphi_i$ and $\tau = -\sum_{j=i+1}^p \varphi_j$, $i = 1, 2, \dots, p-1$ contain the long-run multipliers and short-run dynamic coefficients of the VECM. $t z$ is the vector of variables $t \log IR$ and $t x$ respectively. $t \log IR$ is an I(1) dependent variable defined as $\log IR$ and $\log X_{t-1} = (\log MB, \log RGDP, \log FP, \log ER)$ which is a vector matrix of 'forcing' I(0) and I(1) regressors as already defined with a multivariate identically and independently distributed zero mean error vector $\epsilon_t = (\epsilon_{1t}, \epsilon'_{2t})'$ and a homoskedastic process.

Further, assuming the presence of a unique long-run relationship among the variables, the conditional VECM (2) now becomes:

$$\begin{aligned} \Delta \log IR_t = c_0 + \beta_t + \delta_{yy} \log IR_{t-1} + \delta_{xx} \log X_{t-1} + \sum_{i=1}^p \phi_i \Delta \log IR_{t-i} + \sum_{j=1}^q \omega_j \Delta \log X_{t-j} \\ + \varphi D_1 + \epsilon_t \end{aligned} \quad (14)$$

$$t = 1, 2, \dots, T$$

On the basis of equation (3), the conditional VECM of the relationship among inflation rate, exchange rate, broad money supply, foreign prices and real GDP can be specified as:

$$\begin{aligned} \Delta \log IR_t = c_0 + \delta_1 \log IR_{t-1} + \delta_2 \log RGDP_{t-1} + \delta_3 \log MB_{t-1} + \delta_4 \log FP_{t-1} + \delta_5 \log ER_{t-1} \\ + \sum_{i=1}^p \phi_i \Delta \log IR_{t-i} + \sum_{j=1}^q \omega_j \Delta \log RGDP_{t-j} + \sum_{l=1}^q \varphi_l \Delta \log MB_{t-l} + \sum_{m=1}^q \gamma_m \Delta \log FP_{t-m} \\ + \sum_{p=1}^q \vartheta_p \Delta \log ER_{t-p} + \varphi D_1 + \epsilon_t \end{aligned} \quad (15)$$

where, δ_t are the long run multipliers, c_0 is the drift and ϵ_t are white noise errors, D_t is a dummy variable. The reason for including this variable is to address possible structural breaks in time series data for inflation rate in Sri Lanka.

$$D_1 \left\{ \begin{array}{l} 1 = 1978-1986 \\ \quad 1992-2012 \\ 0 = \text{Otherwise} \end{array} \right.$$

The first step in the ARDL bounds testing approach is to estimate equation (15) by ordinary least squares (OLS) in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables, i.e.,

$$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$$

$$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0 .$$

We denote the test which normalize on $\log IR$ by $F_{\log IR}(\log IR / \log RGDP, \log MB, \log FP, \log ER)$. Two variables are cointegrated when the independent variables are I(d) (where $0 \leq d \leq 1$): a lower value assuming the regressors are I(0) and an upper value assuming purely I(1) regressors. If the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship can be rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic falls below the lower critical value the null hypothesis cannot be rejected. Finally, if the statistic falls between the lower and the upper critical values, the result is inconclusive. The approximate critical values for the F test were obtained from Pesaran and Pesaran (2007).

In the second step, once cointegration is established the conditional ARDL $(p_1, q_1, q_2, q_3, q_4)$ long-run model for $t \log IR_t$ can be estimated as follows:

$$\begin{aligned} \log IR_t = & \emptyset + \sum_{i=1}^{p_1} \delta_1 \log IR_{t-i} + \sum_{i=0}^{q_1} \delta_1 \log RGDP_{t-i} + \sum_{i=0}^{q_2} \delta_3 \log MB_{t-i} + \sum_{i=0}^{q_3} \delta_4 \log FP_{t-i} \\ & + \sum_{i=0}^{q_4} \delta_5 \log ER_{t-i} + \varphi D_1 + \epsilon_t \end{aligned} \quad (16)$$

where, $\varphi, \delta_1, \delta_2, \delta_3, \delta_4$ are long run dynamic coefficients.

This involves selecting the orders of the ARDL $(p_1, q_1, q_2, q_3, q_4)$ model in the variables using Akaike information criteria (AIC).

In the third and final step, this paper obtains the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta \log IR_t = \mu + \sum_{i=1}^p \emptyset_i \Delta \log IR_{t-i} + \sum_{j=1}^q \omega_j \Delta \log RGDP_{t-j} + \sum_{l=1}^q \varphi_l \Delta \log MB_{t-l} + \sum_{m=1}^q \gamma_m \Delta \log FP_{t-m} + \sum_{p=1}^q \beta_p \Delta \log ER_{t-p} + \vartheta ecm_{t-1} + \epsilon_t \quad (17)$$



where, $\emptyset, \omega, \varphi, \gamma, \beta$, are short run dynamic coefficients of the model's convergence to equilibrium and ϑ is the speed of adjustment.

This study used annual data from 1961 to 2012. These data for all the variables have been taken from annual reports and published statistical appendix of the Central bank of Sri Lanka for different years and World Development Indicators. These variables have been converted into a natural log form (Table 1).

TABLE 1. DESCRIPTION OF VARIABLES FOR EMPIRICAL TESTS

| | |
|------|---|
| RGDP | Real Gross Domestic Product. |
| MB | Broad Money Supply: Time deposits plus savings deposits of Commercial Banks |
| IR | Rate of inflation: growth rate of Colombo Consumer Price Index |
| ER | USA dollar-Sri Lankan rupee nominal exchange rate |
| FP | Foreign prices: measured by export price index and import price index |

RESULTS AND DISCUSSION

Results of ADF and PP tests for level variables are summarized in Table 2. Unit root test results of all eleven variables are presented. Maximum lag length proceeds down appropriate lag by examining the Schwarz Criterion (SBC) and AIC. ADF and PP tests are conducted with 1 lag. Results show that only the variable LRGDP is stationary in level from, and is known as the I(0) variable in this study. The remaining variables were processed to test the unit root in the 1st difference (Table 3).

Results of the 1st difference show that LMB, LIR, LFP and LER are significant, and I (1) in all three methods. Among the variables selected, both I (0) and I (1) are found. Results show that all the variables are either I (0) or I (1). Therefore, the ARDL approach to cointegration was used to test the relationship between the variables over long term.

TABLE 2. RESULTS OF UNIT ROOT TESTS ON LEVELS

| Variables | Test with a constant | | Test with a constant and a trend | |
|-----------------|----------------------|-----------|----------------------------------|-----------|
| | ADF | PP | ADF | PP |
| LMB | -2.644 | -4.933*** | -2.914 | -5.376 |
| LRGDP | -2.723 | -5.604*** | -4.283*** | -6.147*** |
| LIR | -2.625 | -3.113 | -3.143 | -3.711 |
| LFP | -0.349 | -0.011 | -1.775 | -2.265 |
| LER | -0.655 | -0.511 | -1.436 | -1.708 |
| critical 1% *** | -3.574 | -3.568 | -4.163 | -4.154 |
| value 5% ** | -2.920 | -2.919 | 3.500 | 3.498 |

TABLE 3. RESULTS OF UNIT ROOT TESTS ON 1ST DIFFERENCE

| | Test with a constant | Test with a constant and a trend |
|--|----------------------|----------------------------------|
|--|----------------------|----------------------------------|

| Variables | ADF | PP | ADF | PP |
|-------------------|-----------|------------|-----------|-----------|
| LMB | -6.959*** | -13.371*** | -6.837*** | 13.204*** |
| LIR | -6.156*** | -8.386*** | -5.983*** | -8.164*** |
| LFP | -3.77*** | -6.148*** | -4.414*** | 6.961*** |
| LER | -4.704*** | -6.917*** | -4.706*** | 6.871*** |
| | | | | |
| Critical value 1% | -3.381 | -3.574 | -4.173 | -4.163 |
| ** , 5% * | -2.927 | -2.924 | -3.511 | -3.50 |

TABLE 4. RESULTS OF BOUNDS TESTS ON EQUATION 22

| Dependent Variable | AIC lags | F- statistics | Probability | Results |
|--|----------|---------------|-------------|----------------|
| f_{LOGIR} ($LOGIR/LOGRGDP, LOGMB, LOGFP, LOGER$) | 1 | 4.033 | 0.0000 | Integrated |
| $f_{LOGRGDP}$ ($LOGRGDP/LOGIR, LOGMB, LOGFP, LOGER$) | 1 | 3.78 | 0.005 | Integrated |
| f_{LOGMB} ($LOGMB/LOGI, LOGRGDP, LOGFP, LOGER$) | 1 | 4.49 | 0.0000 | Integrated |
| f_{LOGFP} ($LOGFP/LOGIR, LOGRGDP, LOGMB, LOGER$) | 1 | 1.788 | 0.07 | Not integrated |
| f_{LOGER} ($LOGER/LOGIR, LOGRGDP, LOGMB, LOGER$) | 1 | 0.674 | 0.710 | Not integrated |

Note: Asymptotic critical value bounds are obtained from Table F in Appendix C, Case III, 'unrestricted intercept and trend', k=6 of Pesaran and Pesaran (1997: 478), lower bound I(0)=2.39 and upper bound I(1)= 3.38 at 1% significance level.

In the first step of the ARDL analysis, this paper tested for the presence of long-run relationships. This paper used the AIC to select a maximum lag order of 3 for the conditional ARDL VECM. Following the procedure in Pesaran and Pesaran (1997), we first estimated an OLS regression for the first differences and then tested for the joint significance of the parameters of the lagged level variables when added to the first regression. Table 4 reports the results of the calculated F-statistics when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions.

The calculated F-statistics f_{LOGIR} ($LOGIR/LOGRGDP, LOGER, LOGMB, LOGFP$) is 4.033 which is higher than the upper-bound critical value 3.38 at the 1% level. The calculated F statistics is 4.033 and critical value for 1% level of significance is given by 2.39 to 3.38. Since the F statistics exceed the upper bounds of critical value, a null hypothesis is rejected. This clearly shows that LOGIR has a long term relationship with LOGRGDP, LOGMB, LOGFP and LOGER that they move together. Also, f_{LOGMB} ($LOGMB/LOGIR, LOGRGDP, LOGER, LOGFP$) is 4.49 which is higher than the upper bound critical value, 3.38. Thus, the null hypothesis of no cointegration is rejected implying that long-run cointegration relationships are present amongst the variables, when the regressions are normalized on LOGIR and LOGMB variables



(Table 4). According to these bound test results, we conclude that there is a joint long-run cointegration relationship among inflation rate, broad money supply, exchange rate, foreign price, and real GDP in Sri Lanka.

TABLE 5. ARDL (4 1 4 2 3) MODEL LONG-RUN RESULTS (DEPENDENT VARIABLE: LOGIR)

| Regressor | Coefficient | Standard error | t value | P value |
|-----------------|-------------|----------------|---------|---------|
| $\log IR_{t-1}$ | -0.3115 | 0.20118 | -1.5484 | 0.1822 |
| $\log IR_{t-2}$ | 0.3518 | 0.2254 | 1.5607 | 0.1793 |
| $\log IR_{t-3}$ | 0.2464 | 0.1593 | 1.5468 | 0.1826 |
| $\log IR_{t-4}$ | 0.8529 | 0.3322 | 2.5668 | 0.0502 |
| $\log RGDG_t$ | 1.1877** | 0.3326 | 3.5708 | 0.0160 |
| $\log MB_t$ | 0.9379*** | 0.1981 | 4.7328 | 0.0052 |
| $\log MB_{t-1}$ | 0.7502** | 0.1941 | 3.8642 | 0.0118 |
| $\log MB_{t-2}$ | 0.7966* | 0.3747 | 2.1258 | 0.0118 |
| $\log MB_{t-3}$ | 0.6573** | 0.1991 | 3.3016 | 0.0869 |
| $\log MB_{t-4}$ | 0.4597* | 0.1960 | 2.3449 | 0.0214 |
| $\log ER_t$ | 12.056** | 3.252 | 3.7068 | 0.0139 |
| $\log ER_{t-1}$ | -2.726 | 2.4371 | -1.1186 | 0.3141 |
| $\log ER_{t-2}$ | -8.0035** | 2.0028 | -3.9961 | 0.0104 |
| $\log FP_t$ | 0.1909 | 0.2119 | 0.9007 | 0.4090 |
| $\log FP_{t-1}$ | 0.8173** | 0.234 | 3.4931 | 0.0174 |
| $\log FP_{t-2}$ | -0.1875 | 0.2402 | -0.7809 | 0.4702 |
| $\log FP_{t-3}$ | 0.877*** | 0.1787 | -4.9052 | 0.0045 |
| D_1 | -2.9275*** | 0.6742 | -4.3421 | 0.0074 |
| C | -11.0341** | 3.4406 | 3.2069 | 0.0238 |

(critical value ***-1% , **-5% , *- 10% $R^2 = 0.8544$ SER= 0.223 AIC= -0.168 SBC= 0.806 DW= 2.39 F=8.41
(prob 0.013)

The test statistics in Table 5 show that the coefficient and sign of $\log MB_t$, $\log RGDG_t$, $\log ER_t$ are consistent with theoretical predictions, as they are significant at 5% level of significance. This proves the long term impact of $\log RGDG_t$, $\log MB_t$ and $\log ER_t$ on $\log IR_t$. The estimated coefficient of the long run relationship shows that broad money supply has a very high significant impact on inflation rate. A 1% increase in broad money supply at time t leads to approximately 0.93 increase in inflation rate at time t, all things being equal.

The real GDP variable is positive and significant at 5% level indicating that there is a relationship between $\log IR$ and $\log RGDG$. Table 5 shows that there is a positive relationship between LIR and LRGDP. The relationship between real gross domestic product and inflation rates is negative, showing that a 1% increase in LRGDP leads to approximately 1.18% decrease in LIR, all things being equal.

Considering the impact of exchange rate to inflation rate, it is significant at 5% level and it has the expected negative impact on inflation rate. A 1% increase in exchange rate at time t leads to a 12.05% decrease in real money demand. There is a positive relationship between exchange rate at time t and interest rate.

This analysis also found that the coefficient of broad money supply at time t has a negative impact on inflation rate and is significant at 5% level. A 1% increase in broad money supply leads to 1.12 decrease in inflation rate. The real gross domestic product is positive and significant at the 1% level. A 1% increase in real gross domestic product at time t leads to approximately 1.44% increase in inflation rate, all other being equal. The exchange rate has a positive impact on inflation rate in short run.

TABLE 6. ARDL (4 3 1 2 2) MODEL ECM RESULTS (DEPENDENT VARIABLE: DLOGIR)

| Regressor | Coefficient | Standard error | t value | P value |
|----------------------|-------------|----------------|---------|---------|
| $d(\log IR_{t-1})$ | -0.3745 | 0.1911 | -1.9601 | 0.1073 |
| $d(\log IR_{t-2})$ | -0.5593** | 0.1536 | -3.6414 | 0.0149 |
| $d(\log IR_{t-3})$ | 0.1482 | 0.2129 | 0.6958 | 0.5175 |
| $d(\log IR_{t-4})$ | 0.4150 | 0.2298 | 1.8058 | 0.1308 |
| $d(\log RGDP_t)$ | 1.4400*** | 0.323 | 4.4579 | 0.0042 |
| $d(\log RGDP_{t-1})$ | 0.100 | 0.4454 | 0.2245 | 0.1974 |
| $d(\log MB_t)$ | -1.1275** | 0.2267 | -4.9731 | 0.0101 |
| $d(\log MB_{t-1})$ | -0.4989 | 0.3357 | -1.4859 | 0.7677 |
| $d(\log MB_{t-2})$ | -1.2098** | 0.3007 | -4.0231 | 0.0067 |
| $d(\log MB_{t-3})$ | -0.0985 | 0.3159 | -0.3119 | 0.8312 |
| $d(\log ER_t)$ | 13.376** | 3.4795 | 3.8442 | 0.0892 |
| $d(\log ER_{t-1})$ | 3.7429 | 2.3932 | 1.5639 | 0.0019 |
| $d(\log ER_{t-2})$ | -2.3289 | 2.3885 | -0.9750 | 0.0881 |
| $d(\log FP_t)$ | 0.4914* | 0.2334 | 2.1046 | 0.0121 |
| $d(\log FP_{t-1})$ | 1.6425*** | 0.2741 | 5.9923 | 0.1786 |
| $d(\log FP_{t-2})$ | 0.8218* | 0.3886 | 2.1146 | 0.3743 |
| ecm_{t-1} | -0.884** | 0.8727 | -2.9616 | 0.0315 |
| C | -1.051*** | 0.2484 | -4.2332 | 0.0082 |

(critical value ***-1% , **-5% , *- 10% & $\bar{R}^2 = 0.848$ SER= 0.327 AIC= 0.6414 SBC= 1.53 DW= 1.76 F=8.257
 (prob 0.014)

The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the ECM equation 12 are given in table 6. Table 6 shows that the ECM (-1) is statistically significant with a correct sign, although the coefficient of -0.88 suggests that about 88% of the disequilibria of the previous year's shock is adjusted back to the estimated equilibrium correction coefficient by -0.88(0.03) which is highly significant and tend to have the correct sign and implies a high speed of adjustment to equilibrium after a shock. Approximately 88% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

CONCLUSION

The estimation results show that increase in broad money supply will lead to decrease in inflation in both long run and short run. Furthermore, increase in real GDP and exchange rates will lead to increase in inflation in both short run and long run. Increase foreign prices will lead to increase in inflation rate only in the short run.



These results imply that exchange rate, growth rate of real GDP, foreign prices have remained the main causal factors of the persistent increase in price level in Sri Lanka. The evidence from studying the exchange rate fluctuation shows that it has more influence on inflation dynamism. The fact that exchange rate is appreciating as a result of both imported and domestically produced goods continue to experience rise in prices. This estimation results show that exchange rate fluctuation has more positive and significant influence on inflationary pressure in Sri Lanka. Finally, concluded that there is demand pull and import based inflation situation faced in Sri Lanka. The results indicate that monetary policy formulation and implementation is Sri Lanka needs to take into account both domestic and external factors along with the multi-faceted bi-causal relationships between various macroeconomic variables.

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THE STATE OF GHANA'S CAPITAL MARKET

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Abstract

This paper presents the analysis of the views of capital market regulators, market managers, and market operators on the state of the capital market in Ghana. In this, the level of development of the capital market, the extent of participation in capital market activities, problems militating against its development and the suggested measures that can propel the overall development of the market are discussed. Primary data was mainly used for the study and was analysed by frequency distribution techniques. The study found that the market in Ghana is still developing, illiquid, because of inadequate participation in market activities by companies and individual investors. The market is also dominated by institutional and foreign investors. Market regulators, managers, and market operators are admonished to develop attractive products and implement appropriate policies to guide its development. The government of Ghana must ensure a stable macroeconomic environment to promote private participation in the market.

Key words

Ghana; Capital Market Development; Ghana Stock Exchange; Market Regulators; Market Managers; Market Operators.

INTRODUCTION

Capital markets authorities, managers, and operators undertake activities fundamental to the growth and development of capital markets in every country that operates a capital market. Their activities include policy formulation, policy implementation, product developments, investor education, and public awareness campaigns, market surveillances, market inspection, as well as offering investor protection. All these activities and many others should lead to improving market performance, development and integrity. Surveillance involves undertaking pre-emptive measures aimed at detecting fraud and deterring potential market abuse including market and price manipulations through insider trading and front running.

In Ghana the Securities and Exchange Commission (SEC), the Bank of Ghana (BoG), the Ghana Stock Exchange (GSE), the Ministry of Finance and Economic Planning (MoFEP) and Stock brokerage firms form the bedrock of market regulation, management and operations. Ghana successfully established a stock exchange in 1989. Yet, actual trading activities began in 1990. The establishment of the stock exchange, and fir that matter, the capital market stemmed from the fact that a well-functioning capital market was seen as a catalyst for accelerating Ghana's economic growth and development. As noted by Sowa (2003), after a woeful performance in the 1980's, Ghana liberalized its financial system under the Financial Sector Adjustment Program (FINSAP) to include the establishment of capital market as part of its overall 1988 macroeconomic adjustment program.

Progressively, the market is making inroads on the African continent. The capital market in Ghana was adjudged as the world's best performing market at the end of 2004 with a year return of 144 per cent in US dollar terms compared with a 30 per cent return by Morgan Stanley Capital International Global Index (Databank Group, 2004). After the official listing of Tullow Oil PLC on the exchange on Wednesday July 27, 2011, the GSE was reported to be the third largest capital market in Sub-Saharan Africa, after South Africa and Nigeria (Seidu, 2011). In 2012, the stock market seemed very vibrant for equity investors. This is shown by improvement in the All-Share Index in 2012 which increased by about 23.81%. By the end of December, 2012, the Ghana Stock Exchange had thirty-four (34) listed companies. The turnover volume for the reviewed year was GH₵218,134,338 (\$121,185,743), representing a decline in growth of about 48.04% compared with the figure of GH₵419,791,082 (\$278, 007, 339) in 2011 (ISSER, 2013). It must be borne in mind that the cedis conversions to dollars were based on the exchange rates for the respective years. They are as follows: December, 2010 (GH₵1.43 to \$ 1.00); December, 2011 (GH₵1.51 to \$ 1.00); December, 2012 (GH₵1.80 to \$ 1.00); and December, 2013 (GH₵1.97 to \$ 1.00).

Despite some of the successes chalked by the market, some reports suggest that it has a small market size, low market liquidity, and low market participation by the public (Acquah-Sam & Salami, 2013). This study sought to find out from the capital market regulators, market managers, and market operators their views on the current state of the market with regard to the effect of their policies, surveillance, inspection, management of day-to-day activities on the market, the problems militating against the development of the market, and the recommendations for future development of the market. The findings are expected to inform the decisions of researchers, prospective investors and policy makers and stock brokers for the overall economic development of the market and Ghana as a whole. The next section looks at the literature reviewed on some of the functions of capital markets, the role of market regulators, market managers, and market operators in capital market activities.



LITERATURE REVIEW

The capital market is a place for the buying and selling of equity and debt securities, which have maturity periods exceeding one year. Levine (1997) attests to the fact that countries with better-developed financial systems experience faster economic growth than those without it. The World Bank (2013) adds that the development of an economy's financial markets is closely related to its overall development. Well-functioning financial systems provide good and easy access to information. This lowers transaction costs, which in turn improves resource allocation and boosts economic growth.

A well-developed financial market ensures the flow of funds from surplus spending units (those who spend less than their incomes) to deficit spending units (those who spend more than their incomes – household, business or investors and governments) in the society. There are people who lack the business acumen to run their own businesses or may be risk averse, but may have unused funds at their disposal. These groups of people save their excess funds with financial institutions (either by buying securities or time deposits). The two basic reasons people invest are their wish to reallocate consumption over time and the desire to become wealthy. These institutions, banks, capital markets, nonbank financial institution, in turn make the funds available at a fee to those who need capital for business activities. Thus, the financial system transfers savers' funds to borrowers and provides savers with payments for the use of their funds. When such funds are put into productive sectors of an economy, the economy grows to improve the welfare of the citizenry.

An efficient capital market requires continual development and implementation of appropriate policies, infrastructural development, periodic analysis and understanding of market conditions and the demands of enterprises seeking capital, and educating potential investors by the appropriate government agencies responsible for capital market activities and development.

The major areas that government impact upon the capital market relates to the creation of status and regulations, the monetary policies of government and the central bank; the supervisory functions of a securities commission or similar supervising authority. In order for the public to have confidence that the capital market is being run in a transparent manner, government officials must be involved in a continual process of understanding how the capital market operates; the principal problem areas faced by private companies; the major concerns of potential investors; the variety or forms of financial instruments in the market; the impact of regional and international development; the relationship between public and private sector finance; the most effective means of enforcement and sanctions (UNITAR/DFM, 2005). The Securities and Exchange Commission (SEC) is a

government regulatory agency responsible for enforcing the rules governing the trading of securities and for approving new issues. The ministry of Finance also is in charge of government fiscal policies.

The key role of the central bank is in regulating interest rate, the money supply, and overall monetary policies of a country. The interest rate that the central bank sets for government treasury notes and other government debt obligations directly influence the capital market. Treasury bills and other government debts compete in the market for investors. If the central bank sets interest rate at high levels, investors will be more likely to put their money into government securities rather than private companies' securities. The more funds that go into government securities, the less there is available for private companies to secure capital for growth. Moreover, high interest rates for government debt securities necessarily will drive up the interest rate for company notes. The result will be that companies may find it very difficult to compete with the government and if they are able to match or exceed the government rate, the companies might find themselves under severe financial problems.

METHODOLOGY

This study employed both quantitative and qualitative research techniques. The study was done in Accra, Ghana. The study used questionnaires to obtain the data that was analysed. Questionnaires are the most commonly used instrument in gathering and measuring primary data because they present the same questions to all respondents thereby providing a comparable basis for assessment. The questionnaire method is also appropriate because of its convenience in giving the respondents the independence and free will to express their thoughts and opinions.

The population and sample for the study were drawn from among the staff of the Securities and Exchange Commission (SEC), Ghana Stock Exchange (GSE), Bank of Ghana (BoG), Ministry of Finance and Economic Planning (MoFEP), and the twenty-one (21) Licensed Dealing Members (Stockbrokers) of the Ghana Stock Exchange. The main categories of respondents from the various organizations ranged from Directors, Managers, Deputy Managers, Stock Brokers and Dealers, Market Analysts, Financial Controllers, Budget Analysts, Heads of Departments, Fund Managers and Custodians. These answered the questionnaires based on their positions and direct involvement in capital market activities.

Forty (40) questionnaires were distributed to the above-mentioned respondents however, only twenty four (24) questionnaires were received for analysis. Convenience sampling method was used to select respondents for the study. Responses from stock dealers and brokers were obtained when questionnaires were distributed to them after one trading session at the Ghana Stock Exchange. On the average every organization completed one questionnaire. The reason was that the answers provided by the employees who completed the questionnaires represented



the views of their organizations. The responses of the respondents were analysed and presented in simple percentages and frequency distribution tables by the use of SPSS version 20. In this study, the researcher put in place measures recommended by Morse (2002), and Golafshani (2003) to ensure that the findings are both reliable and valid.

ANALYSIS

The Level of Development of Ghana's Capital Market relative to the Development of other Capital Markets in Sub-Saharan African Countries

The views of respondents on the level of development of Ghana's capital market relative to the development of capital markets in other Sub-Saharan African countries were sought by the researcher for the study. One (1) respondent out of the twenty four (24) respondents, representing 4.2% of the total number of respondents, stated that Ghana's capital market is developed. Again, two (2) respondents, representing 8.3% stated that the market in Ghana is underdeveloped because it still has many challenges to deal with. Furthermore, the remaining twenty-one (21) respondents, representing 87.5% of the total number of respondents stated that capital market activities and other developments within the market show that the market in Ghana is still developing despite the challenges which militate against its development. Some studies have it that although the Ghana Stock Exchange (GSE) has been a source of mobilizing capital for many corporations, it still remains small and illiquid. Trading is discontinuous, the total value traded is less than 1 percent of GDP, and turnover is below 4 percent (Bawumia et al, 2008). That means that the state of the market in Ghana is not quite different from what pertains in many African countries. Yartey and Adjasi (2007) report similar characteristics of capital market activities for majority of Africa's stock markets. Irrespective of its challenges, the stock market in Ghana was reported to be the best stock market in Africa in 2013 in dollar terms and came second behind Malawi's stock exchange in terms of the local currency. The Accra Bourse returned 56.14 and 78.81% profit respectively to investors in dollar and Cedi terms. The Malawi Stock Exchange on the other hand returned 56.08 and 108% growth to investors. The Managing Director of the GSE, Mr. Kofi Yamoah, was reported to have attributed the good performance to the excellent performance of listed companies for the whole of 2012 as well as the first, second and third quarters of 2013 (Radioxyz, January 8, 2014).

THE BONDS MARKET

With regards to the performance of the bonds market in Ghana, respondents stated that the bonds market in Ghana has had a relatively good performance over the past

years. However, all the twenty-four (24) respondents stated that the bonds market is dominated by government bonds with a few private corporate bonds issued to the market. This may be due to reluctance on the part of companies to raise capital through the bonds market. Again, the reason may be that government bond securities tend to be risk free and offer higher returns as compared to corporate securities. This has reduced public and corporate interest in private companies' bond securities. ISSER (2013) has it that more government bonds were listed in 2011 than 2012. Listed government bond in 2012 were equivalent to GH₵5,939.13 million (\$3,299.52 million). There was no corporate bond listed during 2012. The Graphic Business in 2013 reported that according to the Ministry of Finance and Economic Planning of Ghana, the government of Ghana in January 10, 2013 issued a bond which recorded inflows to the tune of GH₵ 2.2 billion (\$1.12 billion), translating into 450% oversubscription. The government however, accepted GH₵402 million (\$204.1 million) at a coupon rate of 16.73%. It further adds that about 99% of the bids came from foreign investors and the remaining 1% from firms and institutions, commercial banks and individuals within the country. In July 2012, the government issued a medium term bond which was oversubscribed at GH₵775.14 million (\$430.63 million), entitling the government to accept GH₵534.16 million (\$296.76 million). The over subscription of government of Ghana debt instruments shows the confidence foreign investors have in the Ghanaian economy.

TYPES OF INVESTORS IN THE CAPITAL MARKET

The study also found that the capital market is domination by institutional and foreign investors. Nineteen (19) respondents, representing 67.9% of the total number of the respondents, indicated that the capital market is dominated by institutional investors. Again, eight (8) respondents, representing 28.6% of the respondents, also indicated that apart from institutional investors, the market is also tilting in the direction of foreign investors. The institutional investors are mainly pension funds, mutual funds, and insurance companies. This has contributes negatively to the liquidity and depth of the market because the institutions buy securities in bulk and hold them for a long time. The introduction of partial capital account liberalization in 2006 under the Foreign Exchange Act opened up the longer end of the market to nonresident investors and has helped accelerate development of Ghana's domestic bond market. However, one person (1), representing 3.6% of the respondents, indicated that the participation of local individual investors also needs commendation.

One major advantage in foreign domination is that the country can get access to the much needed foreign exchange to augment foreign exchange reserves of the country for infrastructural development. However, exponents of capital markets sometimes express worry about the rising interest of foreign investors in local capital markets. According to them, if the market is not adequately shared by local and retail



investors, any sudden exit of these foreign investors from the market may lead to market downturns or crush in the capital market when investors decide to leave the market. Ekwere (2013) writes that foreign investors controlled over 70% of transactions in the Nigerian capital market. During the global economic meltdown which occurred in 2007 and 2008, a lot of global and local firms were negatively affected. In Nigeria, the worse hit sectors were the financial and manufacturing sectors and the capital market. In that year alone, the capital market lost huge funds, as the Nigerian Stock Exchange's All-Share Index fell from a height of 66,000 basis points in March 2008 to less than 22,000 points by January 2009. Also, over 70% of the total market capitalization of the exchange was wiped out during this period. Analysts attributed the crash in the Nigerian capital market in 2008 to the massive exodus of foreign investors from the equities market.

Bekaert and Harvey (2000) writing on the role of foreign speculators in emerging equity markets write that throughout history and in many market economies, the speculator has been characterized as both a villain and a savior. Indeed the reputation of the speculator generally depends on the country where he does business. In well-functioning advanced capital markets, such as the United States, the speculator is viewed as an integral part of the free market system. In developing capital markets, the speculator, and in particular the international speculator, is looked upon with many reservations.

Grossman (1995), and Grossman and Stiglitz (1980) (in Bekaert and Harvey, 2000) are of the view that economic theory generally suggests that speculative activities enhances the informative and allocative roles of assets markets thereby making markets more efficient. They point to the fact that foreign speculative activities in emerging markets help to reduce the potential of market manipulation in small emerging markets and increase market liquidity. Also, opening the market to foreign speculators may increase valuation of local companies, thereby reducing the cost of equity capital. In segmented capital markets, the cost of equity capital is related to the local volatility of particular markets.

CHALLENGES FACING THE CAPITAL MARKET IN GHANA

Capital market problems prevent the market from contributing effectively to business, and economic growth and development. Some of the challenges militating against the development of the market in Ghana as revealed by the study are as follows:

Inadequate Participation in Capital Market Activities

The study revealed that there is inadequate participation in the capital market by both investors and business firms. Twenty-three (23) respondents, representing

95.8% of the twenty-four (24) respondents, gave this answer to the question of the extent of capital market participation. Only one (1) person, representing 4.2%, answered that there is adequate participation in the market looking at the size of the market capitalization relative to some markets in some sub-Saharan Africa. The researcher further asked the respondents why there is inadequate participation in the capital market. Table 1 summaries the answers given by respondents regarding the factors contributing to inadequate participation in the capital market.

TABLE 1. FACTORS CONTRIBUTING TO INADEQUATE PARTICIPATION IN THE CAPITAL MARKET IN GHANA

| Factors | Responses | | Percent Cases |
|--|-----------|-------|------------------|
| | N | % | |
| Inadequate knowledge about capital market activities among Ghanaians | 20 | 35.1% | 87.0 |
| The Public's preference for money market instruments | 18 | 31.6% | 78.3 |
| The public's interest in real estate/landed properties | 9 | 15.85 | 39.1 |
| Low income levels of Ghanaians | 8 | 14.0% | 34.8 |
| Unwillingness to fully disclose information to the public | 2 | 3.5% | 8.7 |
| Total | 57 | 100% | 247.8 |

In Table 1, twenty (20) responses, representing 35.1% of total number of fifty-seven (57) responses, or 87.0% of the total number of respondents answered that inadequate knowledge about capital market activities is a major reason for inadequate participation in capital market activities. They concluded that proper education on market activities with appropriate incentives such as payment of dividends by companies at reasonable intervals to investors will go a long way to increase interest in capital market activities. The second major reason for inadequate participation in capital market activities is prospective investors' preference for money market instruments (such as 91-day treasury bills, fixed deposit, savings accounts etc) over shares and bonds. This constituted Eighteen (18) responses, representing 31.6% of the fifty-seven (577) responses, or 78.3% of the total number of respondents. The 91-day Treasury-bill of the government of Ghana is not only risk-free but also have attractive yield as compared to stocks which do not pay returns commensurate with the risk associated with them.

Furthermore, nine (9) respondents, representing 15.85% of the total number of responses, identified public interest in real estate/landed properties as a reason for inadequate participation in capital market activities. Landed properties appreciate in value within a short time and that people nowadays buy landed properties/real estates with a view to reselling them at higher prices in the future. Rent charges are very high in many big cities in Ghana so people now build houses for renting to earn incomes, which are relatively higher than the returns on capital market securities.



The fourth major factor contributing to inadequate participation in capital market activities is low income levels of Ghanaians. Eight (8) responses, representing 14.0% of the fifty-seven responses, or 34.8% of the total number of respondents, were of this view. As a result of the low incomes of Ghanaians many prospective investors find it difficult to save parts of their incomes in capital market securities. Though Ghana currently is said to be a middle income country, majority of Ghanaians are still poor. Many a Ghanaian lives from hands to mouth.

The last but not the least factor contributing to inadequate participation in capital market activities is that most business firms in Ghana are not willing to ensure full disclosure of information to the general public, and sometimes some structural disincentives in the market discourage most prospective participants from participating in the market. Only two (2) responses, representing 3.5% of the 57 responses or 8.7% of the total number of respondents, were in favour of this reason. The factors chosen by the respondents are in line with the findings of Acquah-Sam & Salami (2013).

Problem of Market Illiquidity

Respondents were asked about the level of liquidity of the capital market in Ghana. Sixteen (16) respondents, representing 66.7% of the respondents, indicated that the capital market in Ghana is illiquid. Trading takes place in a few securities and the rate at which trade takes place in most securities is low. Eight (8) respondents, representing 33.3% of the respondents, however, chose the option of low liquidity of the market rather than illiquidity. This supports the work of Bawumia et al, (2008). In Table 2 some possible causes of capital market illiquidity were specified by respondents.

In Table 2, sixteen (16) responses, representing 25.4% of the sixty-three (63) responses or 69.9% of the respondents, chose the option of inadequate knowledge and participation in capital market activities among Ghanaians as the major cause of market illiquidity or low market liquidity in Ghana. Again, fifteen (15) responses, representing 23.8% of the total number of responses, or 65.2% of the respondents chose the option of inadequate traded shares of listed companies as the second major cause of market illiquidity or low market liquidity in the capital market in Ghana. Furthermore, thirteen (13) responses, representing 20.60% of the responses, or 56.5% of the total number of respondents, were of the view that the major cause of market illiquidity is inadequate listed companies on the Ghana Stock Exchange. While there is a wide range of benefits that private companies and their shareholders can obtain from going public, there are also certain obligations that such companies must fulfill, particularly with regard to full disclosure of information to the public. This has discouraged many private companies from enjoying the benefits of going public.

Many private companies for personal reasons do not want outsiders to know the full details of what they do and the returns on their investments and that do not list on the GSE.

TABLE 2. FACTORS CONTRIBUTING TO ILLIQUIDITY OF THE CAPITAL MARKET IN GHANA

| Factors | Responses | | Percent Cases |
|---|-----------|--------|------------------|
| | N | % | |
| Inadequate knowledge and participation in capital market activities among Ghanaians | 16 | 25.4% | 69.9% |
| Inadequate traded shares of listed companies | 15 | 23.8% | 65.2% |
| Inadequate listed companies on the Ghana Stock Exchange | 13 | 20.60% | 56.5% |
| Inadequate public interest in capital market instruments | 10 | 15.9% | 43.5% |
| Most securities traded are dormant | 9 | 14.3% | 39.1% |
| Total | 63 | 100% | 273.9% |

Also, ten (10) responses, representing 15.9% of the total number of responses, or 43.5% of the respondents, indicated that inadequate public interest in capital market instruments has contributed to market illiquidity. Lastly, nine (9) responses, representing 14.3% of the total number of responses, or 39.1% of the respondents, were of the view that low market liquidity or illiquidity has resulted from dormant capital market securities on the GSE.

Despite the challenges faced by the capital market, the respondents were still optimistic about a bright future for the capital market in Ghana. Twenty-three (23) respondents, representing 95.8% of the respondents, stated that the future of the capital market in Ghana is bright, other things being equal. This is based on the successes chalked by the capital market in recent years and the positive impact of other regulatory measures that have been implemented. However, one respondent stated that if the problems militating against the development of the capital market are not addressed the future remains bleak for the capital market in Ghana.

CONCLUSIONS AND RECOMMENDATION

The study sought the views of capital market regulators, market managers, and market operators on the state of the capital market in Ghana and the ways forward. It employed frequency distribution techniques for analysis. The study found that the market in Ghana is still developing and has achieved significant successes on the African continent over the last decade. However, it has problems such as market illiquidity, inadequate participation in market activities by companies and individual investors. The market is also dominated by institutional and foreign participants. The market has a bright future if the players in the market will be committed to playing their roles effectively as well as the implementation of appropriate policies to guide its development.



The study recommends that there must be increased public education to increase awareness about capital market activities in the country. Market regulators, managers and operators must organise more symposia, workshops, staff durbars, on the benefits of investing in capital market instruments and businesses going public. The OTC market though exists in Ghana, but it is dormant. This area also needs a critical attention if the overall development of the capital market can be realised to impact positively on the economy of Ghana. Again, investment companies (brokerage firms) must arrange with employers and employees to deduct workers contributions toward the purchase of shares from their salaries on monthly basis. Investors must be made aware that investment in capital market securities must be based on long-term perspective rather than short-term. This must go hand-in-hand with the payment of appropriate incentives like dividends nonmonetary incentives to investors at reasonable intervals.

Furthermore, the Bank of Ghana must make it mandatory for banks operating in Ghana which are unable to meet their capital requirements to raise the additional capital from the capital market. These banks will not only have easier access to long-term capital by going public, but will also experience improvement in the financial position of their banks, enhance their status in the community, and increase their incentives for their employees. The Parliament of Ghana should pass a law that makes it mandatory for multinational corporations which operate in Ghana to list on the Ghana Stock Exchange (GSE) to attract investors into the market to raise market participation, liquidity, capitalization and depth to impact positively on economic growth in Ghana.

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CATCH-UP AND CONVERGENCE: MECHANISM DESIGN FOR ECONOMIC DEVELOPMENT*

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Abstract

This paper identifies factors that promote long-run sustainable economic growth and industrial catch-up in achieving superior performance. An informationally efficient mechanism design of the Hayek-Hurwicz type would contain as essential elements allocative efficiency with a limited state role, fostering of private entrepreneurship for high intensity dynamic competition through industry specific 'technological racing' within a supporting market structure, free trade and intellectual property rights (IPRs), flexible labour markets, low taxes on labour, capital income and profits. Emphasis on high value-added network industries directed toward increasing returns. If resource endowment among countries are similar these factors would eventually lead to convergence through catch-up performance, otherwise they would lead to divergence.

Key words

Catch-Up; Convergence; Mechanism Design; Economic Development

Taking a philosophical point of view, this may be seen as the mechanics for the implementation of Adam Smith's invisible hand: despite private information and pure selfish behavior, social welfare is achieved. All the field of Mechanism Design is just a generalization of this possibility. – Noam Nisan (2007)

INTRODUCTION

What are the major factors for economies to succeed on catching-up in terms of GDP or GDP per capita (of purchasing power parity PPP) as an indicator of prosperity? As has been broadly covered in the economic growth and development literature (Gottinger & Goosen, 2012), there have been convergence theories on advanced (developed) economies that have been partially verified for some OECD economies,

but equally there have been observations of divergence among some developed and developing (transitional) economies that appear to show a growing gap. Technology adoption within regions of a national economy (say, China) were a major factor of less developed regions to catch up. Catch-up metrics could also be identified in disaggregated form next to aggregates such as GDP (total), GDP per head, Human Development Index (HDI), for example, industry/technology index, infrastructure indicator (transportation, communication networks), R&D expenditure (government, private industry) and competitiveness (global market share of key industries). A process of catching up induced by industrial races may tend to converge over time within a bloc of similar countries if technological and educational endowment is similar as covered by Abramovitz' (1986) famous 'social capabilities', as key industries engage in more incremental and complementary innovation that through international trade and foreign direct investment (FDI) spread to emerging industries in likewise developing economies. In the post World War II history what was the mechanism that induced Japan to be on a path of catch-up growth in the 1960s and 1970s in terms of per capita income growth? As suggested in the Asian miracle (Krugman, 1994), one factor was input growth in key value-added industries through capital expansion, the other cumulative technological advancement through largely incremental innovation leading to superiority in some industries. But as soon as the technological frontier was close to be reached it became increasingly difficult to dominate the market. Also in a wide array of high-tech markets it became increasingly decisive to have integrative technologies to catch complementary and increasing returns markets.

The paper shows that catch-up processes should be primarily understood as technological races, establishing new industries that allow free flow of information through entrepreneurial activity and innovation. Under these circumstances, it is more likely that an economic mechanism design generating more information, choices, economic freedom and market transparency supported by democratic institutions, will have a better economic performance record, in a sustainably long run, than any other that fails on the information distribution and strategic incentive side, which would coincide with various types of socialist systems.

The content of the paper is as follows. Section 2 gives a brief historical outline on the interrelation between economic development and catching-up paths. Section 3 sketches the basic structure of algorithmic mechanism design (AMD) as it pertains to computational economic systems, in particular to superior performance of decentralized (distributed) dynamic systems. Section 4 shows the connection between industrial competition and its aggregation to macro competition on a national or regional level – in view of technological racing. Section 5 identifies technological frontiers on the firm level (FTF) as embedded on the industry level (ITF), amenable to a statistical profiling of technological evolution and innovation. It shows some rules of technological race behaviour resulting in statistical indicators



on an industry level. Sec. 6 looks at industrial (in)efficiencies in catch-up countries as benchmarked against the industrial leader. Conclusions follow and open problems are discussed in the last section.

A BRIEF HISTORICAL REVIEW

In a historical context, a catch-up process becomes multidimensional, emerging with England, moving to the US and a few European economies, Germany, France, later to Japan and the newly industrialized economies (NIEs) in Asia overlapping the BRICs. The argument is that due to expansion of trade through globalization the catch-up process is multidimensional and multispeed (Wan, 2004). Even for a few increasing in overall speed the benchmark of catch-up keeps shifting from one or a few to many more. For example, in the past WW II period, industrial and economic growth of Japan was driven toward the US economy less so toward Europe; the pattern of growth and catch-up of China hits many more emerging economies with significant potentials. We have modelled this by a more complex differential game as in Gottinger and Goosen (2012).

As a precursor of economic mechanism design, from an economic history perspective, we first identify Gershenkron (1962) who emphasized state action on industrialization setting free guided entrepreneurial activities through targeted industrial policy (along the line of Japan and later South Korea, Taiwan) (Lee, 2013). This compares to Abramovitz' (1986) and Abramovitz and David's (1992) catching up process where self-reinforcing, industry specific, competitive market forces, rather than state action, would initiate and sustain a technological race resulting in leadership positions across a range of industries. Here the roots of growth rest in the microeconomic industry structure and new industry creating high technology entrepreneurship as conceptionally and empirically explored by Scherer (1992, 1999).

The World Bank in the past takes a middle ground, propagating the state's role to develop social capital which then by itself creates social capability to induce an upward potential through market forces. A more activistic role has recently been favoured by Justus Lin (2013), the former Chinese Chief Economist of the World Bank. Amsden's development statism is a further extension of Gershenkron, catching-up as a process of learning how to compete through 'Late Industrialization' (Amsden, 1989). Other than the main catchup processes listed here have been reviewed by Burkett and Hart-Landsberg (2003), and Fagerberg and Godinho (2004).

In 'Achieving Rapid Growth' Sachs and Warner (1996), in comparing growing middle income countries identify major factors such as allocative efficiency (with government interaction low, markedly less regulation), high degree of competition, free trade, flexible labour markets, low taxes on labour, capital income and profits. While convergence among developing economies may be facilitated by becoming

more alike in terms of sources of growth such as technological progress, innovation, levels of physical capital, labour productivity, quality of human capital, extent of trade openness, industrial structure and institutional framework, one clear distinguishing factor may involve increasing returns mechanisms (IRMs). IRMs eliminate any kind of convergence and allow for ongoing quasi-linear growth. Anecdotal observations as put forward by Easterly and Levine (2002) can be summarized as stylized facts on growth mechanisms.

- (1) Factor accumulation does not account for growth differences but total factor productivity does for a substantial amount;
- (2) There are hugely growing differences in GDP per capita. On a global scale divergence and not conditional convergence is the major concern in development policy; and
- (3) Among developing economies growth is not persistent over time.

If movable through market forces all factors of production flow to the same places suggesting important externalities.

A SIMPLE MECHANISM DESIGN FOR CATCH-UP AND DEVELOPMENT

A simple mechanism design emanates from the following paradigmatic situation: Let there be k agents in an (Internet) economy that collectively generate demand competing for resources from a supplier. The supplier herself announces prices entering a bulletin board accessible to all agents (as a sort of transparent market institution). In a simple form of a trading process we could exhibit a "tatonnement process" on a graph where the agents set up a demand to the suppliers who advertise prices on a bulletin board which are converted to new prices in interaction with the agents.

The tatonnement process in economics is a simple form of an algorithmic mechanism design (AMD) (Nisan & Ronen, 2001), which in modern computer science (CS) emerges as an offspring to algorithmic game theory (Nisan et al, 2007).

Algorithmic ingredients apply to rational and selfish agents having well defined utility functions representing preferences over possible outputs of the algorithm. A payment ingredient motivates the agents. Mechanism Design Theory (MDT) aims to show how privately known preferences of the entire population can be aggregated towards a 'social choice' that drives the mechanism of the whole economy.

- (i) Each agent or group of agents have some private input represented by its type. Its type is embedded in public knowledge or resource endowment as the 'social environment';
- (ii) There is a production function (or output specification) that associates each type $t = t^1, \dots, t^n$ with a set of socially allowable outputs (productions) σO ; and



- (iii) Each agent's preferences are codified as real-valued utility functions noted by $u^i(t^i, o)$.

The universal function is specified in linear terms as $u^i = r^i + v^i(t^i, o)$ where $r^i \geq 0$ is the initial endowment (or resource), or the agent's wealth, which the agent attempts to optimize.

If we assume that the mechanism is truthful to the extent that the agents report their real type then truth-telling is the only dominant strategy. This is considered a truthful implementation. The societal objective function is simply the aggregation of all agents valuations. A 'maximizing mechanism design process' (MDP) is called utilitarian or 'Hayekian' if its objective function is the sum of all agents' utilities.

In the context of the internet economy an MDP would enable users of network applications to present their 'quality of service' demands via utility functions defining the system performance requirements (Gottinger, 2013). The resource allocation process involves economic actors to perform economic optimization given scheduling policies, load balancing and service provisioning.

Distributed algorithmic mechanism design (DMD) for internet resource allocation in distributed systems is akin to an equilibrium converging market based economy where selfish agents maximize utility and firms seek to maximize profits and the state keeps an economic order providing basic public goods and public safety (Feigenbaum et al, 2007). A distributed algorithmic mechanism design thus consists of three components: a feasible strategy space at the network nodes for each agent (or autonomous system), an aggregated outcome function computed by the mechanism and a set of multi-agent prescribed strategies induced by the mechanism.

For such DMDP in place an internet economy can be shown computationally and informationally efficient in the sense of Hurwicz and Reiter (2006), corroborated from a CS view by Conitzer and Sandholm (2002). Furthermore, for efficient macro-management it would satisfy 'moral hazard' and incentive based concerns, and in view of 'informational constraints', e.g. adverse selection, it may also be superior in performance since in a market based decentralized capitalistic system due to keen competition among operating managers - there will be more of higher type performing managers keeping truthful payoff-relevant information than in a comparative socialist planning system with plenty of lower type performing managers providing lower quality or less payoff relevant information.

A distributed algorithmic mechanism design (Feigenbaum et al, 2007) being computationally efficient in a large decentralized internet economy is a powerful paradigm to substantiate claims by Hayek (1945) that an industrialized economy

based on market principles has an overall better performance than socialist type economies of a similar nature and scale. It is a paradigm that even contemporary theorists of MDT seem to have partially missed (Myerson, 2008) and that puts historically the socialist planning debate in a new light which ironically, by some proposals, has been conducted on the basis of computational feasibility and superiority.

Such a Hayekian MDP also extends to a dynamic real economy which also invokes highly desirable properties of incentive structures (Myerson, 2008) and knowledge creation through hi-tech entrepreneurship. This suggests that an MDP of the Hayekian-Hurwicz type should be more likely to generate a long-run sustainable growth and development process with comparative greater welfare benefits than what any socialist type planning could achieve. This is in compliance with Hayekian development ideas as put forward recently by Easterly (2013).

The focus of this paper would be to explore growth and development generating structures and factors that are compatible with a Hayek-Hurwicz design scheme for the developing world.

INDUSTRIAL AND MACRO COMPETITION

The striking pattern that emerges in the innovative activities of firms is their rivalries for a technological leadership position in situations that are best described as races or hypercompetition (Harris & Vickers, 1987; Gottinger, 2006b). A race is an interactive pattern characterized by firms or nations constantly trying to get ahead of their rivals, or trying not to fall too far behind. In high-technology industries, where customers are willing to pay a premium for advanced technology, leadership translates into increasing returns in the market through positive network externalities. Abramovitz (1986), in explaining the catch-up hypothesis, lays stress on a country's social capability in terms of years of education as a proxy of technical competence and its institutions. Competing behaviour is also a dynamic story of how technology unfolds in an industry. In contrast to any existing way of looking at the evolution of technology, racing behaviour, though in character more 'a productivity race than a runner's race (Abramovitz & David, 1997), recognizes the fundamental importance of strategic interactions between competing firms. Thus firms take their rivals' actions into account when formulating their own decisions. The importance of this characterization is at least twofold. At one level, racing behaviour has implications for appreciating technology strategy at the level of the individual firm; at the other level, for understanding the impact of policies that aim to spur technological innovation in an industry or country.

On a national scale, simple catch-up hypotheses have put emphasis on the great potential of adopting unexploited technology in the early stage and the increase of self-limiting power in the later stage. However, the actual growth path of the



technological trajectory of a specific economy may be overwhelmingly constrained by social capability. The capability endogenously changes as states of the economy and technology evolve. The success of economic growth due to diffusion of advanced technology or the possibility of leapfrogging is mainly attributable to how the social capability evolves. In other words, which effects become more influential: growing responsiveness to competition or growing obstacles to it on account of vested interests and established positions?

Observations on industrial patterns in Europe, the US or Asia point to which type of racing behaviour is prevalent in global high-technology industries. The pattern evolving from such conduct could be benchmarked against the frontier pursuit type of the global technological leaders. Another observation relates to policy inferences on market structure, entrepreneurship, innovation activity, industrial policy and regulatory frameworks in promoting and hindering industry frontier races in a global industrial context. Does lagging behind one's closest technological rivals' cause a firm to increase its innovative effort? The term 'race' suggests that no single firm would want to fall too far behind, and that everyone would like to get ahead. If a company tries to innovate more when it is behind than when it is ahead, then 'catch-up' behaviour will be the dominant effect. Once a firm gets far enough ahead of its rivals, then the latter will step up their efforts to get closer. The leading company will slow down its innovative efforts until its competitors have drawn uncomfortably close or have surpassed it. Of course, the process of getting closer to may be much easier than surpassing the rival. This process repeats itself every time a firm gets far enough ahead of its rivals. Of course, catch-up may only consistently apply to the next rivals but will not impact the leader. This is called 'persistent leadership'. On a national level catchup processes like this may not lead to convergence.

An alternative behaviour pattern would correspond to a business increasing its innovative effort if it gets far enough ahead, thus making catch-up by the lagging companies increasingly difficult. For any of these businesses there appears to be a clear link to market and industry structure, as termed 'intensity of rivalry'.

We investigated two different kinds of races: one that is a frontier race between itself and the technological leader at any point in time ('frontier-sticking' behaviour), or it might try to actually usurp the position of the leader by 'leapfrogging' it. When there are disproportionately large payoffs to being in the technical lead (relative to the payoffs that a firm can realize if it is simply close enough to the technical frontier), then one would expect that leapfrogging behaviour would occur more frequently than frontier-sticking behaviour. Alternatively, racing toward the frontier creates the reputation of being an innovation leader hoping to maintain and increase market

share in the future. All attempts to leapfrog the current technological leader might not be successful since many lagging firms might be attempting to leapfrog the leader simultaneously and the leader might be trying to get further ahead simultaneously. Correspondingly, one could distinguish between attempted leapfrogging and realized leapfrogging.

Among the key issues to be addressed is the apparent inability of technology-oriented corporations to maintain leadership in fields that they pioneered. There is a presumption that firms fail to remain competitive because of agency problems or other suboptimal managerial behaviour within these organizations. An alternative explanation is that technologically trailing firms, in symmetric competitive situations, will devote greater effort to innovation, so that a failure of technological leaders to maintain their position is an appropriate response to the competitive environment. In asymmetric situations, with entrants challenging incumbents, research does demonstrate that startup firms show a stronger endeavor to close up to or leapfrog the competitors. Such issues highlight the dynamics of the race within the given market structure in any of the areas concerned.

We observe two different kinds of market asymmetries with bearing on racing behaviour: risk-driven and resource-based. When the incumbents' profits are large enough and do not vary much with the product characteristics, the entrant is likely to choose the faster option in each stage as long as he has not fallen behind in the contest. In view of resource-based asymmetries, as a firm's stage resource endowment increases, it could use the additional resources to either choose more aggressive targets or to attempt to finish the stage sooner, or both. Previous work has suggested that a firm that surges ahead of its rival increases its investment in R&D and speeds up, while a lagging firm reduces its investment and slows down. Consequently, preceding effort suggests that the lead continues to increase. However, based on related work for the US and Japanese telecommunications industry when duopolistic and monopolistic competition and product system complexity for new products are accounted for, the speeding up of a leading firm occurs only under rare circumstances. For example, a company getting far enough ahead such that the (temporary) monopoly term dominates its payoff expression, will always choose the fast strategy, while a company that gets far enough behind will always choose the aggressive approach. Under these conditions, the lead is likely to continue to increase. If, on the other hand, both monopoly and duopoly profits increase substantially with increased aggressiveness then even large leads can vanish with significant probability.

Overall, this characterization highlights two forces that influence a firm's choices in the various stages: proximity to the finish line and distance between the firms. This probability of reaping monopoly profits is higher the farther ahead a firm is of its rival and even more so the closer the firm is to the finish line. If the lead company is



far from the finish line, even a sizeable lead may not translate into the dominance of the monopoly profit term, since there is plenty of time for the lead situation to be reversed, and failure to finish first remains a probable outcome. In contrast, the probability that the lagging company will get to be a monopolist becomes smaller as it falls behind the leader. This raises the following question: what kind of actions cause a firm to get ahead? Intuitively, one would expect that a firm that is ahead of its rival at any time t , in the sense of having completed more stages by time t , is likely to have chosen the faster strategy more often. We will construct numerical estimates of the probability that a leading firm is more likely to have chosen a strategy faster to verify this intuition.

Moving away from the firm-led race patterns revolving in a particular industry to a clustering of racing on an industry level is putting industry in different geo-economics zones against each other and becoming dominant in strategic product/process technologies. Here racing patterns among industries in a relatively free-trade environment could lead to competitive advantages and more wealth creating and accumulating dominance in key product/process technologies in one region at the expense of others. There appears to be a link that individual races on the firm level induce similar races on the industry level and will be a contributing factor to the globalization of network industries.

Thus similar catch-up processes are taking place between leaders and followers within a group of industrialized countries in pursuit of higher levels of productivity. Supposing that the level of labour productivity were governed entirely by the level of technology embodied in capital stock, one may consider that the differentials in productivities among countries are caused by the 'technological age' of the stock relative to its 'chronological age'. The technological age of capital is the age of expertise at the time of investment plus years elapsing from that time. Since a leading state may be supposed to be furnished with the capital stock embodying, in each vintage, technology which was 'at the very frontier' at the time of investment, the technological age of the stock is, so to speak, the same as its chronological age.

While a leader is restricted in increasing its productivity by the advance of new technology, trailing countries have the potential to make a larger leap as they are provided with the privilege of exploiting the backlog in addition of the newly developed technology. Hence, followers being behind with a larger gap in technology will have a stronger potential for growth in productivity. The potential, however, will be reduced as the catch-up process goes on because the unexploited stock of technology becomes smaller and smaller. However, as new technologies arise and are rapidly adopted in a Schumpeterian process of 'creative destruction', their network effects induce rapid accelerating and cumulative growth potentials

which are catalyzed through industry competition. In the absence of such a process we can explain the tendency to convergence of productivity levels of follower countries. Historically, however, it fails to answer alleged puzzles as to why a country, such as the United States, has preserved the standing of the technological leader for a long time since taking over leadership from Britain in around the end of the nineteenth century and why the shifts have taken place in the ranks of follower states in their relative levels of productivity (i.e. technological gaps between them and the leader). Abramovitz (1986) poses some extensions and qualifications on this simple catch-up hypothesis in an attempt to explain these facts. Among other factors than technological backwardness, he lays stress on a country's social capability in terms of years of education as a proxy of technical competence and its political, commercial, industrial, and financial institutions. To become effective social capability may also include or expand to 'deep craft', a 'set of knowings' on technological performance and industrial techniques (Arthur, 2009). The social capacity of a state may become stronger or weaker as technological gaps close or grow and thus Abramovitz argues that the actual catch-up process does not provide itself to simple formulation. This view has a common understanding to what another economist, Olson (1996), expresses to be 'public policies and institutions' as his explanation of the great differences in per capita income across countries, stating that any poorer states that implement relatively good economic policies and institutions enjoy rapid catch-up growth.

The suggestion should be taken seriously when we wish to understand the technological catching-up to American leadership by Japan, in particular during the post-war period, and explore the possibility of a shift in standing between these two countries. This consideration will directly bear on the future trend of the state of the art which exerts a crucial influence on the development of the world economy (Juma & Clark, 2002; Fagerberg & Godinho, 2004). These explanations notwithstanding, we venture as a major factor for divergent growth processes the level of intensity of the racing process within the most prevalent value-added industries with cross-sectional spillovers. These are the communications and information industries which have been shaped and led by leading American firms and where the rewards benefited their industries and country. Although European and Japanese companies were part of the race they were left behind in core markets reaping lesser benefits. (Since ICT investment relative to GDP is only less than half in states such as Japan, Germany and France compared to the US, 2% vs. more than 4% in 1999, this does not bode well for a rapid catch-up in those countries and a fortiori, for the EU as a whole).

Steering or guiding the process of racing through the pursuit of industrial policies aiming to increase competitive advantage of respective industries, as having been practiced in Japan, would stimulate catch-up races but appears to be less effective in promoting frontier racing. Another profound reason lies in the phenomenon of network externalities affecting ICT industries. That is, racing ahead of rivals in



respective industries may create external economies to the effect that such economies within dominant industries tend to improve their international market position and therefore pull ahead in competitiveness vis-à-vis their (trading) partners. As Krugman (1991) observed: 'It is probably true that external economies are a more important determinant of international trade in high technology sectors than elsewhere'. The point is that racing behaviour in leading high-growth network industries by generating frontier positions, create critical cluster and network externalities pipelining through other sectors of the economy and create competitive advantages elsewhere, as supported by the increasing returns debate (Arthur, 1996). In this sense we can speak of positive externalities endogenizing growth of these economies and contributing to competitive advantage. All these characteristics lay the foundations of the 'Network Economy'.

The Network Economy is formed through an ever-emerging and interacting set of increasing returns industries; it is about high-intensity, technology driven-racing, dynamic entrepreneurship, and focused risk-taking through (free) venture capital markets endogenized by societal and institutional support. With the exception of pockets of activity in some parts of Europe (the UK and Scandinavia), and in specific areas such as mobile communications, these ingredients for the Network Economy are only in the early stage of emerging in Continental Europe, and the political mindset in support of the Network Economy is anything but prevalent. As long as we do not see a significant shift toward movements in this direction, Europe will not see the full benefits of the Network Economy within a Global Economy.

Racing behaviour on technological positions among firms in high-technology industries, as exemplified by the globally operating telecommunications and computer industries, produce spillover benefits in terms of increasing returns and widespread productivity gains. Due to relentless competition among technological leaders the network effects result in significant advantages in the value added to this industry contributing to faster growth of GDP, and through a flexible labour market, also to employment growth. This constitutes a new paradigm in economic thinking through network economies and is a major gauge to compare the wealth-creating power of the US economy over the past decade against the European and advanced Asian economies. It is interesting to speculate on the implications of the way companies in major high-technology markets, such as telecommunications, split clearly into the two major technology races, with one group of firms clearly lagging the other.

The trajectories of technological evolution certainly seem to suggest that firms from one frontier cannot simply jump to another trajectory. Witness, in this regard, the gradual process necessary for a firm in the catch-up race to approach those in the

frontier race. There appears to be a frontier 'lock-in', in that once a company is part of a race, the group of rivals within that same race are the ones whose actions influence that company's strategy the most. Advancing technological capability is a cumulative process. The ability to advance to a given level of technical capability appears to be a function of existing technical capability. Given this path dependence, the question remains: why do some firms apparently choose a path of technological evolution that is less rapid than others? Two sets of possible explanations could be derived from our case analysis, which need not be mutually exclusive. The first explanation lingers primarily on the expensive nature of R&D in industries like telecommunications and computers which rely on novel discovery for their advancement. Firms choosing the catch-up race will gain access to a particular technical level later than those choosing the frontier, but will do so at a lower cost.

TECHNOLOGICAL FRONTIERS

The evolution of a cross section of high technology industries reflects repetitive strategic interactions between companies in a continuous quest to dominate the industry or at least to improve its competitive position through company level and industry level technological evolution. We can observe several racing patterns across industries, each of which is the result of a subset of firms jockeying for a position either as a race leader or for a position near the leader constituting a leadership club. The identification and interpretation of the races relies on the fact that different firms take very different technological paths to target a superior performance level with the reward of increasing market shares, maintaining higher productivity and profitability. In a Schumpeterian framework such races cannot be interpreted in a free-riding situation where one firm expands resources in advancing the state of technology and the others follow closely behind. Such spillover interpretations are suspect when products are in the domain of high complexity, of high risk in succeeding, and different firms typically adopt different procedural and architectural approaches.

The logic underlying this evolution holds in any industry in which two broad sets of conditions are satisfied. First, it pays for a firm to have a technological lead over its rival; it also boosts its market image and enhances its reputational capital. Second, for various levels of technological complexity among the products introduced by various firms, technological complexity can be represented by a multi-criteria performance measure, that is, by a vector-valued distance measure. The collection of performance indicators, parameters, being connected with each other for individual companies form an envelope that shapes a 'technological frontier'. The technological frontier is in fact a reasonable indicator of the evolving state of knowledge (technical expertise) in the industry. At any point in time the industry technology frontier (ITF) indicates the degree of technical sophistication of the most advanced products carried by companies in that industry in view of comparable performance standards.



Firm level technology frontiers (FTF) are constructed analogously and indicate, at any point in time, the extent of technical sophistication achieved by the firm until that point in time. The evolution of company and industry level frontiers is highly interactive. Groups of company frontiers are seen to co-evolve in a manner that suggests that the respective firms are racing to catch up with, and get ahead of each other.

A data set could focus on a given set of products (systems) by major European, American or Asian enterprises in those industries for a sufficiently representative period of market evolution. In principle, we can identify at least two races in progress in the industries throughout a given period of duration. One comprises the world frontier race in each of those industries, the other, for example, the European frontier race which technically would constitute a subfrontier to the worldwide race. The aggregate technology frontier of the firms in a particular race (that is, ITF) is constructed in a manner similar to the individual FTFs. Essentially, the maximal envelope of the FTFs in a particular race constitutes the ITF for that race. The ITF indicates, as a function of calendar time, the best achievable performance by any firm in the race at a given date.

A statistical profiling of technological evolution and innovation relates to competitive racing among rival companies. Among the (non-exclusive) performance criteria to be assessed are: (1) frequency of frontier pushing; (2) technological domination period; (3) innovations vs. imitations in the race; (4) innovation frequency when behind or ahead; (5) nature of jumps, leapfrogging or frontier-sticking; (6) inter-jump times and jump sizes; (7) race closeness measures; (8) inter-frontier distance; (9) market leading through 'market making' innovations; and (10) leadership in 'innovation markets'.

A race may or may not have different firms in the leadership position at different times. It may be a tighter race at some times than at others, and in general, may exhibit a variety of forms of interesting behaviour. While analysis of racing behaviour is left to various interpretations, it is appropriate to ask why the firms are motivated to keep on racing at all. As access to superior technology expands the scope of opportunities available to the firms, the technology can be applied in a range of markets. However, leading edge technology is acquired at a cost. It seems unlikely that all the companies would find it profitable to compete to be at the leading edge all the time. Also not every firm has access to equal capabilities in leveraging a given level of technological resources. Firms may, for example, be expected to differ in their access to complementary assets that allows them to appropriately reap the benefits from their innovation. It is reasonable to assume that whatever the level of competence of a company in exploiting its resources it will be

better off the more advanced the technology. Based on this procedure an analysis will show how dynamic competition evolved in the past.

Unlike other (statistical) indicators (such as patent statistics) referring to the degree of competitiveness among industries, regions and countries concerned, the proposed measures cover behavioral dynamic movements in respective industries, and therefore are able to lend intrinsic predictive value to crucial economic variables relating to economic growth and wealth creation. The results are likely to provide strategic support for industrial and technology policy in a regional or national context and will enable policy makers to identify strengths and weaknesses of relevant players and their environments in those markets. While this process looks like a micro representation of dynamic technological evolution driving companies and industries into leadership positions, we may construe an analogous process that drives a region or a nation into advancement on a macro scale in order to achieve a higher level pecking order among its peers. This may allow using the micro foundations of racing as a basis for identifying clubs of nations or regions among them to achieve higher levels and rates of growth.

Catch-up or Leapfrogging

It was Schumpeter (1947) who observed that it is the expectation of supernormal profits from a temporary monopoly position following an innovation that is the chief driver of R & D investment. Along this line, the simplest technology race model can be explained as follows: A number of firms invest in R&D. Their investment results in an innovation with the time spent in R&D subject to some varying level of uncertainty. However, a greater investment reduces the expected time to completion of R&D. The model investigates how many firms will choose to enter such a contest, and how much they will invest. However, despite some extensive theoretical examination of technological races there have been very few empirical studies on this subject (Lerner, 1997) and virtually none in the context of major global industries, and on a comparative basis.

Technological frontiers at the firm and industry race levels offer a powerful tool through which to view evolving technologies within an industry. By providing a benchmarking roadmap that shows where an individual firm is relative to the other firms in the industry, they highlight the importance of strategic interactions in the firm's technology decisions. From the interactive process of racing could emerge various behavioural patterns. Does lagging behind one's closest technological rivals cause a firm to increase its innovative effort? The term 'race' suggests that no single company would want to fall too far behind, and that everyone would like to get ahead. If a firm tries to innovate more when it is behind than when it is ahead, then 'catch-up' behaviour will be the dominant effect. Once a firm gets ahead of its rivals noticeably, then rivals will step up their efforts to catch up. The leader will slow down its innovative efforts until its rivals have drawn uncomfortably close or have



surpassed it. This process repeats itself every time a company gets far enough ahead of its rivals. An alternative behaviour pattern would correspond to a firm increasing its innovative effort if it gets far enough ahead, thus making catch-up by the lagging firms increasingly difficult. This looks like the 'Intel Model' where only the paranoid survives (Grove, 1992). For any of these forms there appears to be a clear link to market and industry structure, as termed 'intensity of rivalry' by Kamien and Schwarz (1982).

We group two different kinds of races: one that is a frontier race among leaders and would-be leaders (first league) and another that is a catch-up race among laggards and imitators (second league). Though both leagues may play their own game, in a free market contest, it would be possible that a member of the second league may penetrate into the first, as one in the first league may fall back into the second. Another aspect of innovation speed has been addressed by Kessler and Bierly (2002). As a general rule they found that the speed to racing ahead may be less significant the more "radical" (drastic) the innovation appears to be and the more likely it leads to a dominant design. These two forms have been applied empirically to the development of the early Japanese computer industry (Gottinger, 2006a), that is, a frontier racing model regarding the struggle for technological leadership in the global industry between IBM and 'Japan Inc.' guided by MITI (now METI), and a catch-up racing model relating to competition among the leading Japanese mainframe manufacturers as laggards.

It is also interesting to distinguish between two sub-categories of catch-up behaviour. A lagging firm might simply try to close the gap between itself and the technological leader at any point in time ('frontier-sticking' behaviour), or it might try to actually usurp the position of the leader by 'leapfrogging' it. When there are disproportionately large payoffs to being in the technical lead (relative to the payoffs that a firm can realize if it is simply close enough to the technical frontier), then one would expect that leapfrogging behaviour would occur more frequently than frontier-sticking behaviour (Owen & Ulph, 1994). Alternatively, racing toward the frontier creates the 'reputation' of being an innovation leader facilitating to maintain and increase market share in the future (Albach, 1997). All attempts to leapfrog the current technological leader might not be successful since many lagging firms might be attempting to leapfrog the leader simultaneously and the leader might be trying to get further ahead simultaneously. Correspondingly, one should distinguish between attempted leapfrogging and realized leapfrogging. This phenomenon (though dependent on industry structure) appears as the predominant behaviour pattern in the US and Japan frontier races (Brezis et al, 1991). Albach (1993) cites studies for Germany that show otherwise.

Leapfrogging behaviour influenced by the expected size of payoffs as suggested by Owen and Ulph (1994) might be revised in compliance with the characteristics of industrial structure of the local (regional) markets, the amount of R&D efforts for leapfrogging and the extent of globalization of the industry. Even in the case where the payoffs of being in the technological lead are expected to be disproportionately large, the lagging companies might be satisfied to remain close enough to the leader so as to gain or maintain a share in the local market. This could occur when the amount of R&D efforts (expenditures) required for leapfrogging would be too large for a lagging firm to be viable in the industry and when the local market has not been open enough for global competition: the local market might be protected for the lagging local companies under the auspices of measures of regulation by the government (e.g. government purchasing, controls on foreign capital) and the conditions preferable for these firms (e.g. language, marketing practices).

When the industrial structure is composed of multi-product companies, as for example it used to be in the Japanese computer industry, sub-frontier firms may derive spill over benefits in developing new products in other technologically related fields (e.g. communications equipment, consumer electronic products). These companies may prefer an R&D strategy just to keep up with the technological frontier level (catch-up) through realizing a greater profit stream over a whole range of products.

What are the implications of the way firms split cleanly into the two technology races, with one group clearly lagging the other technologically? The trajectories of technological evolution certainly seem to suggest that firms from one frontier cannot simply jump to another trajectory. Witness, in this regards the gradual process necessary for the companies in the Japanese frontier to catch up with those at the global frontier. There appears to be a front line 'lock-in' in that once a firm is part of a race, the group of rivals within that same race are the ones whose actions influence the firm's strategy the most.

Advancing technological capability is a cumulative process. The ability to advance to a given level of technical capability appears to be a function of existing technical potential. Given this 'path dependence', the question remains: why do some firms apparently choose a path of technological evolution that is less rapid than others are? We propose two sets of possible explanations, which need not to be mutually exclusive. The first explanation hinges primarily on the expensive nature of R & D in industries like the computer industry, which rely on novel scientific discovery for their advancement. Firms choosing the subfrontier will gain access to a particular technical level later than those choosing the frontier, but will do so at a lower cost. Expending fewer resources on R & D ensures a slower rate of technical evolution. The second explanation relates mainly to technological spillovers. Following the success of the frontier firms in achieving a certain performance level, these become



known to the subfrontier firms. In fact, leading edge research in the computer industry is usually reported in patent applications and scientific journals and is widely disseminated throughout the industry. The hypothesis is that partial spillover of knowledge occurs to the subfrontier firms, whose task is then simplified to some extent. Notice that the subfrontier firms still need to race to be technological leaders, as evidenced by the analysis above. This implies that the spillovers are nowhere near perfect. Company specific learning is still the norm. However, it is possible that knowing something about what research avenues have proved successful (for the frontier firms) could greatly ease the task for the firms that follow and try to match the technical level of the frontier company.

Statistical Metrics of Industrial Racing Patterns

Statistically descriptive measures of racing behaviour can be established that reflect the richness of the dynamics of economic growth among competing nations. The point of departure for a statistical analysis of industrial racing patterns is the aggregate technological frontier represented by the national production function as a reasonable indicator of the evolving state of knowledge (technical expertise) in a nation or region which is the weighted aggregate of all industries or activities that themselves are represented by industry technology frontier (ITF). Firm level technology frontiers (FTF) are constructed analogously and indicate, at any point in time, the weighted contribution of that firm to the industry on standard industry classification.

In this context we define 'race' as a continual contest for technological superiority among nations or regions with key industries. Under this conceptualisation a race is characterised by a number of countries whose ITF's remain 'close' together over a period (T) of, say, 25 to 50 years. The distinctive element is that countries engaging in a competition have ITF's substantially closer together than those of any company not in the race. A statistical analysis should reflect that a race, as defined, may or may not have different countries in the leadership position at different times. It may be a tighter contest at some times than at others, and in general, may exhibit a variety of forms of industrial behaviour. We look for clusters of firms who's ITFs remain close enough throughout the duration (formal measures of closeness are defined and measured). We identify races to take place at any level of industrial performance between the very top and the very bottom throughout 50 years duration that is racing from the bottom to racing to the top.

One comprises the world frontier race in each of those industries, the other a subfrontier race (say, North America, Europe, East Asia, China, India, Latin America, Africa) which technically would constitute a subfrontier to the world, allowing under the best of circumstances for the subfrontier to be the frontier. Since

the level and breadth of industrial activity is reflected as an indicator for economic welfare, racing to the top would go parallel with economic growth and welfare enhancing, whereas racing from the bottom would correspond to poverty reduction and avoiding stationary (under)development traps.

Characterization of Statistical Indicators of Industrial Racing

While a variety of situations are possible, the extremes are the following: (a) one country may push the frontier at all times, with the others following closely behind, (b) some countries share more or less equally in the task of advancing the most value generating industry technology frontiers (ITFs). Depending on the situation the most value generating industries may be high technology based increasing returns or network industries that are able to induce complementary emerging industries with high potentials. Extreme situation (a) corresponds to the existence of a unique technological leader for a particular race, and a number of quick followers. Situation (b), on the other hand, corresponds to the existence of multiple technological leaders.

Assessment of Frontier Pushing: .The relevant statistics for the races relate to counting the times the ITFs are pushed forward by countries or regions at large within a global or regional frontier. Frontier pushing can be triggered through industrial policy by governments or well fostered entrepreneurship in an advanced capitalistic system

Domination Period Statistics: Accepting the view that a country/region has greater potential to earn income and build wealth from its technological position if it is ahead of its race suggests that it would be interesting to examine the duration of time for which a country can expect to remain ahead once it finds itself pushing its ITF. We statistically define the 'domination period' to be the duration of time for which a country leads its particular race. It is interesting to note that the mean domination period is virtually indistinguishable for the three races, and lies between three and four years. A difference of means test cannot reject the hypothesis that the mean years of domination tend to cluster but hardly converge. So countries in each of the races can expect to remain ahead approximately in proportion to their technological capability and more than the amount of time after they have propelled themselves to the front of their respective races. However, the domination period tends to be a more uncertain quantity in the world frontier race, to a lesser degree in the EU frontier race than in any smaller regional races (as evidenced by the lower domination period standard deviation).

Catch-up Statistics: If key industries of a country push to innovate more when they are behind than when they are ahead, then 'catch- up' behaviour will be the dominant effect. For each country/region, these statistics compare the fraction of the total innovations carried out by industries in that country (i.e. the fraction of the total number of times that their ITFs advance) when it was engaging in its race when lagging, with the fraction of times that the country actually led its race. In the



absence of catch-up behaviour, or behaviour leading to a country increasingly dominating its rivals, we would expect to see no difference in these fractions. Then the fraction of time that a country is ahead of its race could be an unbiased estimator of the fraction of innovations in its key industries that it engages in when it is ahead. Relevant data, however, suggest that this is usually not the case. They appear to show that the fraction of times a state leads its race at any development level in a group or club is larger than the fraction of innovations that occur when the country is ahead, i.e. more innovations occur when the country is lagging than would be expected in the absence of catch-up or increasing dominance behaviour. A major exception would arise if the country would act like an 'Intel Economy', where unchallenged leadership in key industries creates incentives to increase the lead to its rivals. Catch-up behaviour is supported by additional observations, as derivable from convergence and conditional convergence in the economic growth process that countries make larger jumps (i.e. the ITFs advance more) when they are behind than when they are leading the race

Leapfrogging Statistics: From this, the distinction emerges between two kinds of catch-up. A lagging country might simply try to close the gap between itself and the technological leader at any point in time (frontier-sticking behaviour), or it might try to actually usurp the position of the leader by 'leapfrogging' it. When there are disproportional larger incomes per head when being in the technical lead (relative to a situation that a country can realize if it is simply close enough to the technological frontier), then one would expect that leapfrogging behaviour would make it a more attractive incentive than frontier-sticking behaviour.

All attempts to leapfrog the current technological leader might not be successful since many lagging firms/industries might be attempting to leapfrog the leader simultaneously. Correspondingly, we observe both the attempted leapfoggings and the realized leapfoggings. It appears likely that the leapfrogging phenomenon would be more predominant in the premier league than in following up leagues.

Interfrontier Distance: How long does 'knowledge' take to spillover from frontier to subfrontier industries? This requires investigating "interfrontier distance". One measure of how much subfrontier industries' technology lags the frontier industries' technology could be graphed as "subfrontier lag" in terms of calendar time. At each point in time, this is simply the absolute difference in the subfrontier performance and the frontier performance time. The graph would clearly indicate that this measure has been declining or increasing more or less monotonically over the past 50 years to the extent that the subfrontier industries have been able/unable to catch up with the frontier industries. A complementary measure would be to assess the difficulty of bridging the lag. That is, how much longer does it take the subfrontier to

reach a certain level of technical achievement after the frontier has reached that level? Thus it might very well turn out that the interfrontier distance may be decreasing though the difficulty in bridging the gap is increasing.

Race Closeness Measure (RCM): None of the previous analyses tell us how close any of the overall races are over a period of time. The races are all distant/close by construction, however, some might be closer than others. We define 'a measure of closeness' of a race (RCM) at a particular time as follows:

$$RCM(t) = \sum_{i=1}^N [F_i(t) - F_j(t)]^2 / N(t) \quad (1)$$

where $F_i(t)$ is country's i ITF at time t, $F_j(t)$ is country's j comparable ITF at time $t = \max [ITF(t)]$ for each i, j and $N(t)$ is the number of active key value-generating industries at time t.

The measure (Equation 1) thus constructed has a lowest value of 0, which corresponds to a 'dead heat' race. Higher values of the measure correspond to races that are less close. Unlike the earlier characteristics (domination period length, innovation when ahead versus when behind, leapfrogging versus frontier-sticking) which investigate the behaviour of a particular feature of the race and of a particular industry in relation to the race frontier, the RCM is more of an aggregate statistic of how close the various racing parties are at a point in time. The closeness measure is simply an indication of parity, and not one that says anything per se about the evolution of the technological frontier. To see this, note that if none of the frontiers were evolving, the closeness measure would be 0, as it would be if all the frontiers were advancing in perfect lock-step with one another.

TABLE 1. ITF SHIFTS ACROSS AGGREGATED INDUSTRIES

| Aggregate Industries 1980- | ITF (max = 100) | 2010 | GDP (%) |
|----------------------------|-----------------|------|---------|
| US | 80 | 85 | 70 |
| EU | 60 | 75 | 60 |
| China | 15 | 60 | 50 |
| USSR | 30 | 35 | 40 |
| India | 25 | 40 | 30 |
| Brazil | 20 | 30 | 25 |
| Japan | 70 | 70 | 65 |

We talk about value-added increasing returns industries over a period of 30 years. The industries comprise ICT, Consumer Electronics, Chemicals and Materials, Automobiles, Pharma/Biotech, Machine Tools, Medical Instruments, Aerospace/Defense, Energy Technologies, and HT Transportation Systems. Industry sectors can be assigned to various countries/regions such as US, EU, China, Russia, India, Brazil, Japan (Table 1). We benchmark the industry technology frontiers (ITFs) accordingly, that is, highest 'state of knowledge' at time t is 100 pc. The countries' rank to the max ITFs is assessed as the share of the max ITF. The assessment intervals are spaced in five year intervals starting in 1980 until 2010.



Efficiency

Let's explore the inefficiency of the follower nations; i.e., the negative effect on the potential technology gap stemming from inefficient social and institutional factors. A good example of cross industrial inefficiencies over a historically representative period (1810-2000) is Russia that was hardly advancing economically against underdeveloped benchmark countries and falling behind leading economies, reinforced through the bolshevik revolution and its underperforming economic mechanism design (Gaidar, 2012). Increasing efficiencies deblock catch-up in lagging countries (Juma & Clark, 2002). Efficiency is found by dividing a nation's estimated fixed effect by the regional adoption rate. As defined here, it is quite robust to different estimations and samples. The relative efficiencies of the nations within regions appear to conform to common beliefs. For example, in Europe, the Netherlands, Belgium and Switzerland are the most efficient while Turkey, Portugal and Greece are the least efficient. In East Asia, Hong Kong is the most efficient while Indonesia and Thailand are the least efficient. Finally, in Latin America, Mexico and Argentina are at the top and Honduras and Bolivia at the bottom. Another way to discuss the findings is to consider the time required to catch-up. Previously, Parente and Prescott (2004) showed that countries with lower levels of relative efficiency will adopt modern technologies at much later dates. Conversely, one could argue that if those countries adopt modern technologies concurrently with their low level of relative efficiency then their rates of growth would stay at a subpar level of their potential.

One major source of efficiency generation for a country, according to Parente and Prescott (2004), is belonging to a 'free trade club' that improves efficiency through greater industrial competition. We calculate the required time period until the nations reach their frontier when only the catch-up term and inefficiency are allowed to vary across regions and countries. Two frontiers are considered: nations' inefficiency frontier and the leader nation's frontier. The latter requires that the inefficiency levels fade away in time which we assume occurs at the rate of ρ . The European countries, with the exception of Turkey, all seem to have reached their inefficiency reduced frontier. The same is true for most of the East Asian countries. Thus, these nations will not catch-up with the US without higher accumulation rates or improved efficiency. For Latin America, most countries are still catching-up with their inefficiency frontier, so that if accumulation rates were the same catch-up would still take place through diffusion of disembodied technology. Of course, if inefficiency levels remain then a follower could never completely catch-up with the leader by taking advantage of the technology gap alone. As an illustrative example, for the required time to catch-up with the leader if inefficiency levels were improving at the rate ρ much of Europe and Latin America could then approach the

frontier faster than East Asia on account of East Asia's lower rate of technology adoption. This begs the question of what determines these (in)efficiencies?

It is reasonable to expect a tradeoff between a general technology level (GTL) of a nation's leading industries and its institutional efficiencies (IE). Thus, using an aggregate score, (GTL, IE), say, a country may be in the top rank of GTL but weak on IE which may be surpassed in growth by one which is lower in GTL rank but strong on IE.

CONCLUSION AND FURTHER DISCUSSION

Economic growth over the long-run can only be achieved in the course of a real, sustainable value-creating process through industrial performance and open markets in which technology and innovation are the key facilitators. Nations with their industries engage in rival contests in what we term industrial races within a given international trade regime. This reflects a micro-economic based behavioral focus on economic growth (positive or negative). It builds a deeper foundation to explanations of economic growth than conventional macro-economic texts. It also uncovers the true sources of growth as a tool for growth diagnostics (Rodrik, 2007) allowing to embrace other observations on urban growth and non primarily economic factors. In an influential paper in Foreign Affairs entitled 'Can India overtake China' Huang and Khanna (2003) first looked at macro-economic factors, which favor China. They then considered micro-economic structures and behaviors such as competent indigenous entrepreneurship, a sound capital market, an independent legal system, property rights and a grass roots approach to development. The latter all favor India in the long run, say over the next fifty years.

In a widely covered empirical investigation on global growth patterns we concur with Easterly and Levins' (2002) finding that it is not factor accumulation, *per se*, but total factor productivity that explains cross-country differences in the level of GDP growth rates. This total productivity in turn is derived from technology (innovation) transfer and diffusion, its' supporting institutional characteristics and cultural dependence. Of course, on a deeper level, considerations of merely formal institutions may not suffice for explanations but instead forms of economic mechanism design may be called for that effectively deal with (enforce rules on) 'moral hazard' and 'adverse selection' issues (Myerson, 2006). Economic growth in a decentralized system would be fully supported by a Hayek-Hurwicz mechanism design.

Observations on firm-led racing patterns emerging in oligopolistic market structures of particular high tech industries, and the clustering of racing on an industry level are putting companies in different geo-economic zones against each other, becoming dominant in strategic product/process technologies. Here racing patterns among industries in a relatively free trade environment could lead to competitive



advantages and more wealth creating and accumulating dominance in key product / process technologies in one region at the expense of others. The question is whether individual contests on a firm level induce similar effects on an industry level and if so, what controlling effects may be rendered by regional or multilateral policies on regulatory, trade and investment matters? The point is that racing behaviour in leading high technology industries by generating frontier positions create cluster and network externalities pipelining through other sectors of the economy and creating competitive advantages elsewhere, as supported by the 'increasing returns' debate. In this sense we can speak of positive externalities endogenizing growth of these economies and contributing to competitive advantage.

We are about to show in the upcoming chapters how technological racing, rivalry and competition instigates a process of innovation, industrial and market evolution and how it extends to larger entities than firms and industries to regions and national economies or economy networks. It will show what drives economic growth and globalization, which industries are most significantly affected and how technological racing results in value generation in increasing returns and network industries. Furthermore, we consider how the emergence of selective managerial strategies is most likely to carry success in the pursuit of corporate and industrial policies.

Welfare enhancing technology racing as a constituent element of the capitalist process reinforced by globalization provides social benefits far exceeding the costs. Even more important, any alternative path, other than the competitive, would likely be inferior given the costs in that it would generate a less valued and less welfare producing technology portfolio. That is, even if the competitive process is wasteful, (for example, in parallel or correlated technology development) its unique high value innovation outcome far exceeds the benefits of any alternative path. There is historical, observational and analytical evidence given in Gottinger and Goosen (2012).

On a national scale simple catch-up hypotheses have put emphasis on the great potential of adopting unexploited technology in the early stage and the increase of self-limiting power in the later stage. However, an actual growth path of technological trajectory of a specific economy may overwhelmingly be constrained by social capability. The capability also endogenously changes as states of the economy and technology evolve. The success of economic growth due to diffusion of advanced technology or the possibility of leapfrogging is mainly attributable to how the social capability evolves (i.e., which effects become more influential: growing responsiveness to competition or growing obstacles to it on account of vested interests and established positions). Another observation relates to policy inferences

on market structure, entrepreneurship, innovation activity, industrial policy and regulatory frameworks in promoting and hindering industry frontier races in a global industrial context. Does lagging behind one's closest technological rivals cause an industry to increase its innovative effort?

On an industry level, among the key issues to be addressed is the apparent inability of technology oriented corporations to maintain leadership in fields that they pioneered. There is a presumption that firms fail to remain competitive because of agency problems or other suboptimal managerial behaviour within these organizations. An alternative explanation is that technologically trailing firms, in symmetric competitive situations, will devote greater effort to innovation, so that a failure of technological leaders to maintain their position is an appropriate response to the competitive environment. In asymmetric situations, with entrants challenging incumbents, research does demonstrate that start-up firms show a stronger endeavour to close up to or leapfrog the competitors. Such issues highlight the dynamics of the race within the given market structure in any of the areas concerned.

Catch-up processes are taking place between leaders and followers within a group of industrialized countries in pursuit of higher levels of productivity and economic growth. Supposing that the level of labour productivity were governed entirely by the level of technology embodied in capital stock, one may consider that the differentials in productivities among countries are caused by the 'technological age' of the stock used by a country relative to its 'chronological age'. The technological age of capital is a period of technology at the time of investment plus years elapsing from that time. Since a leading country may be supposed to be furnished with the capital stock embodying, in each vintage, technology which was 'at the very frontier' at the time of investment, 'the technological age of the stock is, so to speak, the same as its chronological age'. While a leader is restricted in increasing its productivity by the advance of new technology, trailing countries 'have the potential to make a larger leap' as they are provided with the privilege of exploiting the backlog in addition of the newly developed technology. Hence, followers being behind with a larger gap in technology will have a stronger potential for growth in productivity. The potential, however, will be reduced as the catch-up process goes on because the unexploited stock of technology becomes smaller and smaller. However, as new technologies arise and are rapidly adopted in a Schumpeterian process of 'creative destruction', their network effects induce rapid accelerating and cumulative growth potentials being catalyzed through industry racing.

In the absence of such a process, we can explain the tendency to convergence of productivity levels of follower countries. Historically, it fails to answer alleged puzzles of why a country, such as the United States, has preserved the standing of the technological leader for a long time since taking over leadership from Britain in



around the end of the nineteenth century and why the shifts have taken place in the ranks of follower countries in their relative levels of productivity (i.e. technological gaps between them and the leader). Abramovitz (1986) poses some extensions and qualifications on this simple catch-up hypothesis in the attempt to explain these facts. Among other factors than technological backwardness, he lays stress on a country's 'social capability' (i.e. years of education as a proxy of technical competence and its political, commercial, industrial, and financial institutions). The social capability of a country may become stronger or weaker as technological gaps close and thus, he states, the actual catch-up process does not lend itself to simple formulation. This view has a common understanding to what another economist, Olson (1996), expresses to be public policies and institutions as his explanation of the great differences in per capita income across countries, stating that any poorer countries that adopt relatively good economic policies and institutions enjoy rapid catch-up growth. The suggestion should be taken seriously when we wish to understand the technological catching-up to American leadership by Japan, in particular, during the post-war period and explore the possibility of a shift in standing between these two countries. This consideration will directly bear on the future trend of the state of the art, which exerts a crucial influence on the development of the world economy.

These explanations notwithstanding, we venture as a major factor for divergent growth processes the level of intensity of the racing process within the most prevalent value-added industries with cross sectional spillovers. These are the communications and information industries, which have been shaped and led by leading American firms and where the rewards benefited their industries and country. Though European and Japanese companies were part of the race they were left behind in core markets reaping lesser benefits. The IT investment relative to GDP, for example, used to be only less than half in countries such as Japan, Germany and France compared to the US. This does not bode well for a rapid catch-up in those countries. Steering or guiding the process of racing through the pursuit of industrial policies aiming to increase competitive advantage of respective industries, as having been practised in Japan, would stimulate catch-up races but appears to be less effective in promoting frontier racing. Another profound reason lies in the phenomenon of network externalities affecting IT industries. That is, racing ahead of rivals in respective industries may create external economies to the effect that such economies within dominant industries tend to improve their international market position and therefore pull ahead in competitiveness vis-a-vis their (trading) partners.

The point is that racing behaviour in leading high growth network industries by generating frontier positions create critical cluster and network externalities

pipelining through other sectors of the economy and creating competitive advantages elsewhere, as supported by the increasing returns debate (Arthur, 1996). In this sense we can speak of positive externalities endogenizing growth of these economies and contributing to competitive advantage.

All these characteristics lay the foundations of the 'Network Economy'. The latter is formed through an ever emerging and interacting set of increasing returns industries, it is about high-intensity, technology driven racing, dynamic entrepreneurship, focussed risk-taking through (free) venture capital markets endogenized by societal and institutional support.

Racing behaviour on technological positions among firms in high technology industries, as exemplified by the globally operating telecommunications, and computer industries, produce spillover benefits in terms of increasing returns and widespread productivity gains. Due to relentless competition among technological leaders the network effects lead to significant advantages in the value added to this industry, contributing to faster growth of GDP, and through a flexible labour market, also to employment growth. This constitutes a new paradigm in economic thinking through network economies and is a major gauge to compare the wealth creating power of the US economy against the European and advanced Asian economies.

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