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Earnings Management and Privatisations: Evidence from Pakistan

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This study examines the incidence of earnings management around the time of the privatisation of State Owned Enterprises in Pakistan during 1991-2005. Using the modified Jones model and a sample of large privatisations (minimum US$1 million), it shows that the sampled firms experienced increase in earnings, decrease in cash flows, and increase in current discretionary accruals in the year prior to and/or in the year of privatisation. The SOEs used both short term and long term accruals to inflate reported earnings. These accruals were reversed in the post-privatisation period. These findings suggest that managers of the firms slated for privatisation were engaged in earnings management to inflate their firms' financial worth to maximise the privatisation proceeds. Hence, we cannot reject the incidence of earnings management during privatisations in Pakistan. The results imply that the investors should carefully evaluate the to-be-privatised firms and keep in view the possibility of earnings management by the SOEs.

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Keywords: Earnings Management, Privatisations, SOEs, Pakistan, Accruals

1. INTRODUCTION

Earnings management involves manipulation of financial accounts by management to present a certain image of a firm's economic/operating performance [see, for example, Healy and Wahlen (1999); Kothari (2001); and other studies]. Financial accounts generally require judgment, and thus, provide managers with the scope for tampering [Schipper (1989)]. Recent evidence supports the incidence of earnings management around a diverse range of economic events [see, for example, Teoh, *et al.* (1998a, 1998b); Iqbal, *et al.* (2006, 2009)], and for a broad range of incentives during a firm's life cycle in both the developed (the US and the UK) and emerging markets (such as China and Malaysia) [see, for example, Teoh, *et al.* (1998); Ball and Shivakumar (2008); Cheng and Warfield (2005); Othman and Zegal (2006); Yanqiong (2011); Ahmad-Zaluki, *et al.* (2011)].

In addition, compared with outsiders, managers (insiders) know more about their business and its relevant risks and opportunities due to the existence of information

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asymmetries [Myers and Majluf (1984)]. Therefore, depending on the demands of the situation, their vested interests as well as the existence and/or the enforcement of relevant laws, it becomes possible for the insiders to manage earnings upwards or downwards or even smooth them.[1] The probability of such an occurrence is greater in Pakistan for several reasons, such as the inefficiency of judicial system and poor disclosure standards for the State Owned Enterprises (SOEs) [Guedhami and Pittman (2011)]. Furthermore, a critical event such as privatisation provides strong incentives to managers to either show their support (through upwards earnings management) or opposition (through downward earnings management) to it.

One can, therefore, hypothesise that strong incentives may exist for managing earnings at the time of privatising SOEs too.[2] Such a hypothesis derives rationale from the similarities between privatisations and Initial Public Offerings (IPOs), as one of the means for divestment of SOEs is through an IPO. Considerable amount of research, that tests the implications of earnings management hypothesis around the event of IPOs and seasoned equity offerings (SEOs), has been done [see for example, Aharony, *et al.* (1993); Teoh, *et al.* (1998); Ahmad-Zaluki, *et al.* (2011); among others]. However, to the best of authors' knowledge, this study is one of the few that tests earnings management hypothesis around the privatisation of SOEs. Thus, the main purpose of this study is to examine if the managers of SOEs manage earnings (upward or downward) around the privatisation of SOEs in Pakistan. The results of the study have important implications for policy makers and investors in view of the next wave of major privatisations that are expected during 2015-16 in Pakistan. These include Pakistan Steel, Pakistan International Airlines (PIA), and Oil and Gas Development Corporation (OGDC), to name a few.

The rest of the paper is organised as follows. Section 2 reviews the privatisation policy in Pakistan, while Section 3 explains the concept of earnings management, draws parallels between IPOs and privatisations, and develops the testable hypotheses. Section 4 outlines the criteria for sample selection and discusses the methodology. Section 5 presents empirical results followed by conclusion in the last section.

2. THE NATURE OF PRIVATISATION AND ITS OBJECTIVES IN PAKISTAN

This paper attempts to explore earnings management around the SOEs privatisation, a term defined in Megginson and Netter (2001) as the 'deliberate sale by a government of state-owned enterprises (SOE) or assets to private economic agents'. Privatisation programmes emerged in the 1960s, with the Adenauer government in Germany divesting a major stake in Volkswagen, followed by the massive privatisation invoked by the Thatcher government in the UK in 1980s. This policy then began to spread worldwide, adopted by the Latin American and European countries (especially Eastern Europe). The popularity of privatisation establishes its credibility as an event of

[1]Managers may use 'big bath accounting' [Jiang (2007)] or 'cookie jar reserves' [Badertscher, *et al.* (2009)] as possible tools to manage earnings. They may also defer current earnings to future years or recognise revenues earlier [Lin and Shih (2002)]. Barth, *et al.* (1999) argue that managers may have incentives to smooth income over different time periods.

[2]We provide details of earnings management incentives and the types of firms involved in managing earnings upwards or downwards in Section 3.

sufficient significance to be studied independently. This unique policy is not specific to a region but is present and practised around the world.

Cameroon (1997) and Kemal (1996) point out that the privatisation policy was adopted in Pakistan as an essential component of the structural adjustment programme, when the Privatisation Commission (PC) was established as part of the 1988 IMF/World Bank structural adjustment package [Cameroon (1997); Paddon (1997)]. Though Kemal (1996) claims that there was not much conviction behind its initiation on the part of the government, privatisation has continued to persist as a preferred economic policy option despite governments having different ideological hues and political dispensations [Kemal (2000); PC (1996a, 1997, 2000); Qureshi (1992)]. The fact is that in Pakistan, international financial aid was conditioned on the privatisation and restructuring of SOEs. Mirza (1995) gives a number of examples that highlight the role of international donors in privatisation in Pakistan.

According to Khan (2003), since privatisation was an imported phenomenon in Pakistan, it had no clearly spelled out objectives initially. The government reports on privatisation do not list even a single objective until 1992 [Qureshi (1992)]. It was as late as 1996, that the broad contours of privatisation policy and its objectives emerged [PC (1996b)].

According to the ex-Chairman, Privatisation Commission, the government programme for privatisation is based on "the principle of reducing its direct participation in commercial activities" and ensuring "equity and economic justice" [Asif (1998)]. PC (2000), states: "distorted prices, lack of competition, and poor government management of business have hindered economic development, introduced inefficiencies, generated unproductive and unsustainable employment, slowed down investment, reduced access to services by the poor, resulted in substandard goods and services, and contributed to fiscal bleeding". By privatising, the government intends to remove these impediments.

By the end of May 2011, the GOP had completed or approved 167 transactions.[3] This number also included some multiple transactions for the same unit. The gross privatisation proceeds stood at Rs 476.421 billion. Telecom and power sectors alone account for around 50 percent of all the proceeds.

3. EARNINGS MANAGEMENT OPPORTUNITIES

According to Healy and Wahlen (1999), earnings management occurs when managers use judgment and discretion in financial reporting and choose accounting methods to structure transactions to alter financial reports. This enables them to mislead stakeholders about the underlying economic performance of a company or to "influence contractual outcomes that depend on reported accounting numbers" (p. 8). Managers can exercise their discretion in case of discretionary part of the accruals, which involve estimation by the management and thus serve as a proxy for determining the level of earnings management [Healy and Wahlen (1999)].

3.1. Incentives for Upward Earnings Management

Recent research has identified a number of situations in which firms may engage in upward earnings management. These include period(s) leading to equity offerings

[3]http://www.privatisation.gov.pk/about/Completed%20Transactions%20(new).htm. Accessed on September 10, 2013.

(IPOs and SEOs—Seasoned Equity Offerings), increasing manager's compensations when they are linked to year-end earnings (e.g. bonus plans), and avoiding violating clauses within lending contracts, etc.

Ahmad-Zaluki, *et al.* (2011) and Smith, *et al.* (2001) argue that in times of an economic downturn, there is external pressure on firms to choose income increasing accounting methods. During the East Asian crisis in 1997-98, IPOs recorded a higher amount of discretionary accruals than they would have done otherwise. The managers were under pressure to maintain investors' confidence in IPOs, which affected the choice of accounting methods that showed upwards earnings. Thus, their studies establish a positive relationship between upward earnings management in IPOs and the periods of economic stress.

Earnings management is common during privatisation introduced at times of economic stress. Karatas (1995) finds instances of data manipulation in Turkey in the pre-privatisation period. Such data falsification is more likely to be present in situations where government is facing opposition to its privatisation policy and wants it to look good.

Putting these studies in the context of Pakistan and the period (1991-2005) under review, we find that Pakistan's economy was not faring very well. Arby (2001) noted that the recession in Pakistan started in the early 1990s and was expected to continue till 2004-05. Burki (2000) also argues that "the economy and state of Pakistan are in crisis… Pakistan has not faced a crisis of this magnitude in its entire 60-year history" (p. 152). Thus, the economic rationale would dictate that due to the economic downturn and a chronic fiscal budget deficit, the government should quickly privatise as many SOEs as possible. To achieve this, the government had the incentives to use income increasing accounting policies and positive discretionary accruals to achieve higher value for the firms, just as IPO firms would manage earnings upward in order to retain investors' confidence and avoid reduced stock trading. In such a situation, managers are expected to get along with the government rather than resist and face the consequences of refusing orders. The economic incentives apart, the political will behind a privatisation programme is also likely to affect the earnings management perspective.

Yarrow (1999) argues that the most common trigger for privatisation and SOE reform is fiscal pressure. This statement clearly applies to Pakistan where the government had a clear incentive to use privatisation proceeds as a substitute for taxes and to compensate for the pervasive tax evasion. This makes intuitive sense as we already know that one of the reasons for the privatisation of SOEs is the revenue that such a divesture would generate.[4] Weak democratic regimes followed by military rule made it even more difficult for the successive governments to introduce a stringent tax system.

Public debt also provides an incentive for upward earnings management; the goal would be to maximise the revenue to be generated from the privatised unit, which can then be used to finance public expenditure. In case of debt financing for SOEs, government could show through upward earnings manipulation the efficiency of its management.

[4]Pinheiro and Schneider (1994, 1995), however, show that ownership transfers are neutral from fiscal perspective and the privatisation proceeds are often too little and arrive too late to help in times of economic crisis. Hemming and Mansoor (1987) and Mansoor (1988b, 1988a) also argue that ideally, the change of ownership should have no effect on fiscal deficit due to the fair market price of SOEs.

Khan (2003) has also concluded that managers had incentives for upwards earnings management to increase the probability of privatisation. This is because after the initial shock of privatisation was over, they benefitted both in terms of better wages and increased employment opportunities. This is also evident from the study by De Luca (1997) and Martin and Parker (1997) which shows that managers mostly benefit from it, enjoying better pay and perks in the post privatisation period. According to Harris (1995), they either advocate it or at least show less stress and low uncertainty level [Nelson, *et al.* (1995); Cam (1999)].

The reasons outlined above provide sufficient incentives for upward earnings management in the years before privatisation. This leads to our first hypothesis,

H1: the management of state-owned enterprises (SOEs) is likely to engage in upward earnings management.

3.2. Incentives for Downward Earnings Management

A number of studies on IPOs and SEOs have found a negative relationship between pre-offer accruals and post-offer operating and stock returns performance[for example, Teoh, *et al.* (1998a) and (1998b); Iqbal, *et al.* (2006, 2009)]. This negative relationship (or conservative earnings management) can be important when privatised firms plan an IPO/SEO in the long run. For example, Ball and Shivakumar (2008) argue that the IPO firms which need subsequent rounds of financing tend to be conservative in their earnings management practices.

Another possible reason for conservative earnings management can be political dimension normally associated with privatisation. For example, politicians might want units under privatisation to be underpriced to gain political favours from investors. Thus conservative earnings management (i.e. underpricing) may be used to overcome political obstacles standing in the way of a successful privatisation [Megginson and Netter (2001); Laurin, *et al.* (2004); and Farinos, *et al.* (2007)]. Similarly, the state would like to avoid the risk of failure of privatising its SOEs. Its primary motive could be to sell rather than to maximise the sale proceeds. Thus, firms may resort to downward earnings management, which would enable the government to dispose-off SOEs as quickly as possible to show the success of its economic policy [Jones, *et al.* (1999); Chen, *et al.* (2011)].Conservative earnings management may also be used as a means to convince unions and labor that privatisation is the only viable option [Boubakri and Cosset (1998)]. The political dimension has been a broad consideration in Pakistan through different regimes. The sale/divestment of public assets has generally been construed as an indicator for the success of a privatisation effort. It is the output, not the outcome, which has mattered the most.

The privatisation process in Pakistan entails hiring a Financial Advisor or a valuator.[5]If the privatisation process is scrutinised by a third party, the incentive could be to follow conservative accounting practices to avoid any bad publicity. Financial advisers and chartered accountants themselves would be concerned with the loss of their reputation or risk facing civil law suits [Guedhami and Pittman (2011)] if they allow aggressive management of earnings. Zhou and Elder (2003) find that big auditing firms

[5]The valuator is a qualified Chartered Accountant in case of large transactions.

and industry specialist auditors have a high correlation with conservative earnings management.

Ahmad-Zaluki, *et al.* (2008) hypothesise that older companies do not engage in upward earnings management as they follow sound business practices and have a reputation for following prudent accounting practices. Since SOEs usually have a long history of existence, and are subject to public scrutiny by analysts and media, which reduces their scope for upwards or downwards earnings management.

Nagata and Hachiya (2006) argue that retained ownership by management in IPO firms creates competing motives between control and wealth creation. On the one hand, aggressive earnings management would lead to an overpriced IPO and wealth creation for shareholders. Whilst on the other hand, conservative earnings management would lead to underpricing of the IPO, oversubscription and a broader allocation of shares to the public, which would enable the management to retain control. This argument can be applied to units being privatised in stages as retained ownership in such firms would remain with the state and its agents, the managers.

Megginson, *et al.* (2004) study share issue privatisations (SIPs) and find that governments aim to establish and strengthen their equity markets through public market privatisations. While our study does not differentiate between asset sale and IPO privatisations, it can be hypothesised that in the light of the efficiency gains made by privatised firms, there may be an incentive to underprice units being privatised through lower discretionary accruals. A lower priced firm would seem a good investment by investors and would maintain capital investments within the country (like Pakistan) and discourage the flight of capital abroad.

Finally, in case of Pakistan where managers were not provided job security in the post-privatisation period, they may not want their companies privatised so as not to risk losing their jobs [Fluck, *et al.* (2007)].

Thus we argue that there may be incentives for firms to be more prudent and conservative in their use of accounting policies in the pre-privatisation period. Hence, our second hypothesis is,

> H2: the management of state-owned companies manages earnings downwards before privatisation as a result of conservative accounting practices.

Our study combines H1 and H2 to formulate a single Hypothesis, H*, i.e. ‘earnings management exists around privatisations in Pakistan’. In addition, Privatisation Commission of Pakistan considered privatising both profit making (supposedly with inflated earnings) and loss making (supposedly with deflated earnings) SOEs [Naqvi and Kemal (1991)]. Therefore, we conduct an un-directional test for this hypothesis and evaluate the significance of (both upward/downward) earnings management.

4. METHODOLOGY AND DATA SELECTION

Prior to testing earnings management hypothesis (H*), we examine abnormal changes in earnings at or around privatisation of SOEs. For this purpose, we use return on assets (ROA), return on sales (ROS), and asset-scaled cash flow from operations (ACFO) of SOEs and of their matched firms [Barber and Lyon (1996)] from two years before to

two years after the privatisation. The matched firm is chosen from the same industry with the closest ROA from year –1 (the year preceding privatisation). While choosing a matched firm, we exclude firms that have been privatised in the previous two years to avoid any contamination effects.

Following the estimation of abnormal earnings (if any) in the years around the privatisation year, we estimate total accruals by subtracting CFOs from net earnings for each year. We use modified Jones model to estimate discretionary accruals that are an important tool for manipulating earnings and hence, to detect earning management.

Due to differences in the nature and operations of industries, a variation may exist in the 'normal' levels of discretionary accruals. Given the particular cycle an industry may be passing through, the industry wide 'normal' levels may also change and the absolute level of discretionary accruals may not tell us much about the existence of earnings management. We, therefore, use the accruals of the matched firm to ascertain whether the discretionary accruals of SOEs are significantly different from those of the matched firms.

The accrual-based model developed by Jones (1991) and modified by Dechow, *et al.* (1995) aims to measure earnings management by segregating total accruals (both short and long-term) into the discretionary and non-discretionary components. In this model, first coefficients for the components that are susceptible to managerial discretion (such as 'change in sales revenue' for current accruals and 'property, plant, and equipment' and 'change in sales revenue' for total accruals) are estimated for each industry using ordinary least square regressions. These coefficients are then used to calculate non-discretionary current and long-term accruals. Finally, the difference between the total current (long-term) accruals and the non-discretionary current (long-term) accruals provides discretionary current (long-term) accruals. This is explained in more detail in Appendix I. The 'discretionary component' is expected to be affected by the management's choice of accounting practices, and changes in this component are used as the basis for estimating earnings management around privatisations.

Based on the levels of actual total accruals, we deduct the non-discretionary portion to calculate the discretionary portion of the accruals. This is done separately for both the current and long term components to derive the level of discretionary current and long-term accruals for each event-year for the sample and the matched firms. The difference between the levels of accruals of two types of firms is the observations that we use to conduct the analysis and perform various tests.

Test observations =	Level of discretionary accruals in sample firm
less	Level of discretionary accruals in matched firm

Using this method, we obtain 'positive' or 'negative' values for each year. A positive value indicates a higher level of accruals for the event firm compared to the matched firm. This implies that the firm has recognised lower levels of expenses this year and/or has engaged in accelerating revenue recognition policies. The firm has, therefore, managed its earnings in an 'upward' direction. Similarly a 'negative' observation indicates that the firm has lower levels of discretionary accruals as compared to its matched firm. This would result in higher levels of expenses being recognised by the

event firm and/or delayed revenue recognition policies. This indicates 'downward' earnings management.

We use January 1991 to June 2005 as our sample period. Privatisation Commission privatised 158 state owned units during this period.[6] We also use the following additional criteria for sample selection,

(1) The privatised unit is a non-financial company;
(2) The minimum sale price of the unit is Rs 60 million (approximately US$1 million);
(3) The minimum ownership stake sold is 5 percent;
(4) Accounting data is available to apply the modified Jones model for the years –1 and 0.

The first criterion is imposed due to the distinct financial reporting requirements of financial companies that lead to the exclusion of 17 firms. In order to draw meaningful conclusions from the event of privatisation, it is vital to keep two main characteristics of the sample in mind i.e. materiality and controlling ownership as noted in criterion 2 and 3 above. The larger the amount of the transaction, the greater is the incentive for manipulation. Similarly, the larger the stake being sold, the greater is the incentive for earnings manipulation as the management would have lesser control over future decisions of the firm. The application of these two criteria further reduces our sample to 67 event firms. No information was available on the privatisation of two companies that left us with 65 event firms.

Prior studies [such as Teoh, *et al.* (1998)] use a limit of 10 firms to form the relevant industry sample to estimate the regression coefficients from the modified Jones model. Given the low levels of public listing in Pakistan, this is a difficult condition to satisfy for each and every sample firm. To address this, we form broader industry groups similar to Level-3 SIC codes used in the U.S. This classification allows us to increase the size of the relative industry and helps in easing the data restrictions we face. We impose the restriction of minimum six firms [Iqbal, *et al.* (2006, 2009)] in each industry to apply the modified Jones model. This restriction further reduces our sample size to 40 firms. Table 1 and Table 2, respectively, report the distribution of sample firms by industry and year, and the industrial and yearly distribution of the amount raised from privatising SOEs.

We examine earnings and accruals over a five year period around the event year, that is, two years before to two years after privatisation. Hence, we test the hypotheses by analysing the time-series of earnings and discretionary accruals from event years –2 to +2 for all the firms. It is for this reason that we examine the operating and accruals performance from 1989 till 2007.

[6]List of Privatisations from 1991 to 2005, available at http://www.privatisation.gov.pk/. In addition, according to the Privatisation Commission of Pakistan website (checked on 18 March 2015), there are only five further privatisation transactions over the period 2006-2014 in the non-financial sectors. This further suggests that our study did not leave out significant amount of data. We would not have gained significant information even if we had extended our sample period to 2012, as we needed two further years of accounting data after the privatisation to examine their performance.

Table 1

Distribution (Industrial and Yearly) of Sample Firms, 1991–2005

Industry / Year	Auto	Cement	Chemical/Fertiliser	Fuel/ Energy	Edible Oil	%age of Sample	Total
1991	1					2.5%	1
1992	4	8	4		2	45%	18
1993	1					2.5%	1
1994				1		2.5%	1
1995		1	1			5%	2
1996		1		2		7.5%	3
1997							
1998							
1999							
2000				1		2.5%	1
2001				1		2.5%	1
2002			2	5	1	20%	8
2003		1				2.5%	1
2004		1			1	5%	2
2005		1				2.5%	1
%age of the sample	15%	32.5%	17.5%	25%	10%		100%
Total	6	13	7	10	4	100%	40

The table provides yearly and industrial distribution of the 40 selected sample firms that were privatised during the period January 1991 to December 2005. It also reports the percentage of the privatised firms in each year and industry.

Table 2

Distribution (Industrial and Yearly) of Proceeds (Millions of Pakistan Rupees) Raised from Privatisations during 1991–2005

Industry / Year	Auto	Cement	Chemical/Fertiliser	Fuel/ Energy	Edible Oil	%age of Sample	Total
1991	105.60					0.35%	105.60
1992	904.80	5013.70	1407.90		216.30	25%	7542.70
1993	69.20					0.22%	69.20
1994				102.40		0.34%	102.40
1995		110.00	399.50			1.68%	509.50
1996		2415.80		10151.00		41.55%	12566.80
1997							0.00
1998							0.00
1999							0.00
2000				369.00		1.22%	369.00
2001				142.00		0.47%	142.00
2002						14.90%	
			2150.90	2259.40	94.00		4504.30
2003		255.00				0.8%	255.00
2004		793.00			80.70	2.89%	873.70
2005		3204.90				10.60%	3204.90
%age of total sample	3.57%	39%	13.08%	43.06%	1.29%		100%
Total	1079.60	11792.40	3958.30	13023.80	391.00	100%	30245.10

The table provides yearly and industrial distribution of the proceeds raised from the 40 sample firms that were privatised during the period January 1991 to December 2005. The proceeds are reported in millions of Pakistani Rupees. It also reports the percentage of the amount raised from the sample firms in each year and industry.

5. RESULTS AND DISCUSSION

We report operating performance (median and mean) results in Table 3 for 33 SOEs, as we could not find suitable matched firms for the remaining seven. The results show that the SOEs start to experience an improvement in their matched-firm adjusted operating performance from year –1, with a peak in year 0 and then deterioration in year +1. This pattern is observed for the matched firm adjusted ROA and ROS (mean and median) measures of operating performance. At the same time, matched firm adjusted asset-scaled cash flow from operations (ACFO) do not show any such pattern. This suggests that SOEs may be using income increasing accounting accruals to inflate reported earnings at the time of privatisations, as the increase in earnings measures is not supported by ACFO. These results are consistent with Teoh, *et al.* (1998a, 1998b) for U.S equities and Iqbal, *et al.* (2006, 2009) for U.K. equity issues. This warrants further analyses of accruals and its components.

Table 3

Operating Performance of SOEs Around Privatisations

Year	–2	–1	0	+1	+2
Performance Matched Non-issuer's Adjusted ROA					
Median	–0.43	0.89[b]	1.45[c]	–1.24[b]	–1.18[c]
Mean	–1.83[c]	1.88[b]	2.28[b]	–1.93[b]	–2.63[c]
Observations	29	33	33	30	28
Performance Matched Non-issuer's Adjusted ROS					
Median	–0.36[c]	0.77[c]	1.08[b]	0.45	–1.24[b]
Mean	–1.21[b]	1.87[b]	2.06[b]	–1.96[b]	–1.51
Observations	29	33	33	30	28
Performance Matched Non-issuer's Adjusted ACFO					
Median	0.91[b]	0.73	0.54	1.06[c]	1.17[b]
Mean	1.17[c]	1.08	0.89	1.65[c]	1.98[b]
Observations	29	33	33	30	28

The table reports mean and median values of three matched-firms adjusted operating performance measures based on time series. These are return on assets (ROA–net income divided by beginning of year total assets); return on sales (ROS–net income over total sales); and asset-scaled cash flow from operations (ACFO–cash flow from operations divided by beginning of year total assets). Matched firm is chosen from the same industry as the privatised firm, with the closest ROA from year t-1 (the year preceding the privatisation year). While choosing a matched firm, we exclude firms that have been privatised in the previous two years to avoid any contamination effects. Mean values are tested using conventional t-test and medians are tested using Wilcoxon sign-rank test. Superscripts b and c represent significance at the 5 percent and 10 percent levels.

Panel A of Table 4 reports average matched firm adjusted discretionary current and long term accruals during two years after and before the privatisation year (year 0). It shows that discretionary current accruals are positive and statistically significant in the year prior to privatisation (at 1 percent level) and in the year of privatisation (at 5 percent level). However, this trend is reversed in the two years after privatisation, which is consistent with the reversal of these accruals. Long term accruals are negative and marginally significant in years –1, 0 and +1 and show a trend opposite to that of current accruals.

Table 4

Discretionary Current and Long Term Accruals of SOEs Around Privatisations

Panel A: Matched Firm Adjusted Discretionary Current and Long Term Accruals

Year (t)	–2	–1	0	+1	+2
Discretionary Current Accruals					
Mean	0.041	0.049[a]	0.055[b]	–0.121[b]	–0.042[c]
SE	0.030	0.019	0.026	0.060	0.024
p-value	0.181	0.016	0.046	0.054	0.091
Discretionary Long-term Accruals					
Mean	0.043	–0.073	–0.197[c]	–0.148 [c]	0.169[a]
Standard Error	0.049	0.054	0.108	0.086	0.056
p-value	0.384	0.187	0.076	0.096	0.005

Panel B: Number of Positive and Negative Values of Matched Firm Adjusted Discretionary Current and Long Term Accruals

	–2	–1	0	+1	+2	Total
Discretionary Current Accruals						
No. of Observations	29	33	33	30	28	153
No. of Positive Observations	17	24	23	10	13	87
Percentage Positive	59%	73%	70%	33%	43%	56%
No. of Negative Observations	12	9	10	20	15	66
Percentage Negative	41%	27%	30%	67%	57%	44%
Discretionary Long-Term Accruals						
No. of Observations	29	33	33	30	28	153
No. of Positive Observations	16	13	13	10	16	68
Percentage Positive	55%	39%	39%	33%	57%	44%
No. of Negative Observations	13	20	20	20	12	85
Percentage Negative	45%	61%	61%	67%	43%	56%

Panel A of the Table reports mean values, standard errors, and p-values of matched-firm adjusted discretionary current and long term accruals, estimated using the modified Jones model (as explained in Appendix I), for 2 years before and after the privatisation event. Statistical significance of mean values is tested using conventional t-test. Superscripts a, b, and c represent significance at 1 percent, 5 percent, and 10 percent levels. Panel B reports the number and percentages of positive and negative observations of these matched-firm adjusted mean discretionary current and long term accruals for each event year.

Panel B of Table 4 shows that out of the 153 sample observations that are available over the testing period, we find that, for discretionary current accruals, 87 values are positive and 66 are negative. Further examination for each event years shows a tendency towards upward earnings management. For example, in year –1 (year prior to privatisation), we find that 73 percent (24 out of 33 points) show 'upward' earnings management (positive level of difference between the sample and its matched firm). This pattern is reversed in year +1 (year following privatisation) where only 33 percent of firms show upward and 67 percent show downward earnings management. This ties in with the general observation that earnings management that takes place before an event is reversed in the future years, which is reflected in the downward earnings management in the post-event years [Teoh, *et al.* (1998a,1998b)].

Similarly, if we analyse the long term discretionary accruals (those accruing after one year) comprising of provisions for depreciation and bad debts, the pattern is pointed more towards downward earnings management through the long-term component of discretionary accruals. Out of total 153 sample observations, 56 percent (85) show negative earnings management. In year –1, we find that 20 (61 percent) out of the 33 sample points are negative. This could be explained as an attempt to overstate the book value of assets in the years preceding privatisation. However in year +1, we see that 20 out of 30 sample points show downward earnings management. Downward management of these components will have a positive effect on the value of assets in the balance sheet. Generally, firms try to avoid using long term accruals to manipulate earnings as they are relatively easier to identify.

Given a relatively smaller sample size, we do not draw our results only using mean values and conventional tests (for example t-test). As an alternative, we use median values of matched-firm adjusted (discretionary current and long term) accruals and Wilcoxon's sign-rank test. The results of this test are reported in Panel A, Table 5. It shows that discretionary current accruals are positive and significant in year –1 and year 0, and negative and significant in year +1, which is an indication of the reversal of pre-privatisation discretionary current accruals. The significance in year –1 of discretionary current accruals is directly in line with our earlier discussion that the incentives for earnings management are most intense in the year before privatisation. Even with a one-tail test for upward earnings management, the above value is significant. This shows that there is strong evidence of earnings management via current discretionary accruals in the year prior to privatisation. These findings are consistent both with the information asymmetry model of Mayers and Majluf (1984) and the implications of studies by Healey and Wahlen (1999) and Kothari (2001).

Table 5

Results of Wilcoxon's Sign-rank Test and Spearman Rank Correlation

Panel A: Wilcoxon Sign-rank Test

Year	–2	–1	0	+1	+2
Discretionary Current Accruals					
Z-score	1.16	1.963[b]	1.842[c]	–1.846[b]	–1.431[c]
Observations	29	33	33	30	28
Discretionary Long Term Accruals					
Z-score	0.892	–1.937[b]	–1.863[b]	–1.410	1.767[c]
Observations	29	33	33	30	28

Panel B: Spearman Rank Correlation

	ROA		
	0	+1	+2
DCA_{-1}	–0.198[a]	–0.236[a]	–0.228[a]
$DLTA_{-1}$	–0.103[c]	–0.128[b]	–0.082

Panel A of the table reports z-scores and relevant significance using Wilcoxon sign-rank test for matched-firm adjusted discretionary current and long-term accruals for five years around the privatisation year (year 0). Panel B reports Spearman rank correlation between discretionary current and long term accruals for year –1 and change in matched-firm adjusted return on assets (ROA) for years 0, +1, and +2. Superscripts a, b, and c represent significance at the 1 percent, 5 percent, and 10 percent levels.

In addition, discretionary long term accruals are significantly negative in year −1 and year 0, and positive and significant in year +2 but without showing any specific pattern of earnings management. This positive significance of the long term accruals in year +2 is, however, harder to understand. This could primarily be attributed to the reversal of previous long term accruals or to the discretion available to the post-privatisation management while restructuring long term provisions. In privatisations, the state shortlists firms for divesture a few years in advance. Given a longer time frame and the demand made on the short-listed firms to prepare for privatisation, a substantial amount of restructuring can be undertaken. These factors naturally affect the long term portion of accruals instead of just current accruals. The management makes sufficient provisions for restructuring and exercises its discretion in estimating these amounts. Thus, it is not only the current accruals, which may be tampered with, but also the long term accruals which provide an opportunity for earnings management.

Finally, we perform Spearman rank correlation test between discretionary current and long term accruals from year −1 and the change in performance matched ROA from years 0, +1, and +2. The results reported in Panel B of Table 5 show that the pre-privatisation discretionary current accruals are significantly negatively related to change in performance adjusted ROA from years 0, +1, and +2. This further strengthens our results that SOEs use discretionary current accruals in year −1 to inflate reported earnings.

It is important to note that Pakistan's economy did not undergo any structural change during the period 2005–2013 [Pakistan (2014)]. The share of agriculture and manufacturing in the GDP was 23 percent and 20.6 percent during 2005-06, which slightly changed to 21 percent and 20.8 percent during 2013-14 respectively. Following a similar pattern, the share of service sector increased from 56 percent to 58.1 percent during the same period. This shows that the results presented and discussed above are current and relevant even today.

6. CONCLUSION

This study tests earnings management hypothesis around privatisations in Pakistan. Our results support the hypothesis that SOEs use upward earnings management around the privatisation event. Due to a smaller sample size, we have not been able to perform a regression analysis of pre-privatisation accruals and post-privatisation earnings. In addition, though our study covers a period from 1991-2005, there have been only five further non-financial-sector related privatisations. We feel that the results of our study, though limited to a certain time period, are still pertinent to the future cases of privatisations. The paper highlights an entirely different dimension in the context of privatisation and should help the Government of Pakistan in better valuation of its public sector units offered for privatisation. None the less, this paper makes a significant contribution to a field that has not been explored as yet, especially in the context of Pakistan. Future studies can draw upon the rationale that we have provided, as the incentives are in place for accounting manipulations by the management of SOEs. The limitations faced in our study can be attributed to the availability of relevant data, the size of each privatised unit, and the number of firms in the industry being studied. Future research could be carried out to empirically test the hypothesis in other countries where such limitations can be addressed.

Our results show that earnings management occurs around privatisations, but it is somewhat different from the usual pattern of earnings management reported in prior literature. Numerous studies have established the current component of discretionary accruals as being the relevant indicator of earnings management, and time and again it has been the current accruals component that has been tampered with by the management. While this is the case for privatised firms as well, we also find the long term accrual component to be understated in our sample. This is due to the long term restructuring provisions that are created before privatisation. Most firms have the leeway to adjust the current portion of accruals, but in the case of privatisations, the intention to privatise is made clear in advance, so that such provisions provide ample time and scope for earnings management. Thus, our paper establishes earnings management in the case of Pakistani privatisations via manipulation of both the short term and the long term accruals.

The ability to manage earnings depends strongly on the regulatory structure and the degree of information asymmetry. Stricter scrutiny of firms identified for privatisation (such as OGDC, Pakistan Steel, and PIA to name a few) by autonomous regulatory bodies can ensure that it is more difficult for firms to manage their earnings and hence, window dress their financial statements. Decision makers (bidders) need to be aware of the potential for firms to misrepresent their financial situation and engage in closer assessment at the time of sale (purchase). Establishing an independent review committee and subjecting public sector firms to greater accountability could also reduce the degree of earnings management thereby, reinforcing public investor confidence in SOEs and in the privatisation policy.

APPENDIX I

THE MODIFIED JONES MODEL

The modified Jones model segregates the accruals into its current and long term components. Each of these components is then tested via a two-step process to determine the level of discretionary current and long term accruals for each year. The first step involves estimating the coefficients through regressions (1) and (2) on the data for each industry and the results for the current and long term portions are presented in Table 4:

$$\frac{CAC_{j,t}}{TA_{j,t-1}} = \alpha\left(\frac{1}{TA_{j,t-1}}\right) + \beta\left(\frac{\Delta REV_{j,t}}{TA_{j,t-1}}\right) + \varepsilon_{j,t} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (1)$$

where:

$CAC_{j,t}$ = Current accruals, scaled by beginning total assets for firm j in year t,
$TA_{j,t-1}$ = firm j's book value of total assets at the beginning of year t,
$\Delta REVj,t$ = firm j's change in revenues from year t–1 to year t.

$$\frac{TAC_{j,t}}{TA_{j,t-1}} = a\left(\frac{1}{TA_{j,t-1}}\right) + b_1\left(\frac{\Delta REV_{j,t}}{TA_{j,t-1}}\right) + b_2\left(\frac{PPE_{j,t}}{TA_{j,t-1}}\right) + \varepsilon_{j,t} \qquad \ldots \qquad \ldots \qquad (2)$$

$TAC_{j,t}$ = Total accruals, scaled by beginning total assets for firm j in year t,

$PPE_{j,t}$ = firm *j*'s gross value of property, plant and equipment at the end of year *t*

The second step involves using the same variables for our event firms and matched firms to estimate their levels of non-discretionary accruals based on the industry coefficients determined in the first step. The modified Jones model adjusts for changes in the levels of accounts receivables. The equation used to find the firm's non-discretionary accruals is shown below for the current and long-term portions:

$$NDCAC_{j,t} = \hat{\alpha}\left(\frac{1}{TA_{j,t-1}}\right) + \hat{\beta}\left(\frac{\Delta REV_{j,t} - \Delta REC_{j,t}}{TA_{j,t-1}}\right) \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where:

$NDCAC_{j,t}$ = Non-discretionary current accruals, scaled by beginning total assets for firm *j* in year *t*,

$\Delta REC\,j,t$ = Net receivables in year t minus net receivables in year *t*–1, and

$\hat{\alpha}$, $\hat{\beta}$ = Estimates of α, β_1 obtained from Equation (1).

$$NDTAC_{j,t} = \hat{a}\left(\frac{1}{TA_{j,t-1}}\right) + \hat{b}_1\left(\frac{\Delta REV_{j,t} - \Delta REC_{j,t}}{TA_{j,t-1}}\right) + \hat{b}_2\left(\frac{PPE_{j,t}}{TA_{j,t-1}}\right) \quad \ldots \quad (4)$$

$NDTAC_{j,t}$ = Non-discretionary total accruals, scaled by beginning total assets for firm *j* in year *t*, and

$\hat{a}$, $\hat{b}_1, \hat{b}_2$ = Estimates of *a*, b_1, and b_2 obtained from Equation (2).

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Are Our Export-Oriented Industries Technically More Efficient?

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This paper makes a comparison of technical efficiency scores between groups of exporting and non-exporting industries. Using data from Census of Manufacturing Industries in Pakistan (2005-06), technical efficiency scores of 102 large scale manufacturing industries are estimated. Stochastic Frontier Analysis as well as Data Envelopment Analysis technique are used to estimate technical efficiency scores. In Stochastic Frontier Analysis Translog and Cobb-Douglass Production Functions are specified, whereas in Data Envelopment Analysis technique, efficiency scores are computed under the assumptions of Constant Returns to Scale as well as Variable Returns to Scale. Industries showing high technical efficiency include Tobacco Products, Refined Petroleum Products, Carpets and Rugs, and Meat and Meat Products. Industries showing low technical efficiency include Refractory Ceramic Products, Electricity Distribution and Control Apparatus, Fish and Fish Products, Basic Precious Metals and Aluminum and its Products. Comparison of mean efficiency scores between exporting and non-exporting industries does not indicate any significant difference between efficiency scores across types of industries.

JEL Classification: D24, L6, O14, F14
Keywords: Manufacturing Industries, Technical Efficiency, Stochastic Frontier Analysis, Data Envelopment Analysis, International Trade

1. INTRODUCTION

It is generally believed that export-oriented industries are better able to exploit economies of scale due to widening of markets and their exposure to international competition is a major driving force in their adoption of advanced production and marketing techniques. Opportunity cost of idle capacity for these industries is higher, which induces managers to use inputs up to full capacity. On the other hand non-exporting industries (industries with relatively smaller proportion in national exports) work in relatively more protected environment in the form of tariffs and quotas, have small domestic market to sell their products, and their production and marketing techniques are not well up-to-date. These factors may make export-oriented industries more efficient than import-substitution industries.

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These arguments seem plausible but the superiority of export-oriented industries in terms of technical efficiency is an empirical question. The theory of international trade suggests that international trade is driven by factors like comparative advantage and relative factor endowments and factor intensities *across countries*. On the other hand technical efficiency determines how optimally a producer uses inputs in the production of outputs in a group of producers, usually *within a country*. Therefore the only way to check whether exporting industries in a country are comparatively more efficient than non-exporting industries is to test the hypothesis against real data. Empirical evidence contrary to above hypothesis is not difficult to find [see for example Walujadi (2004)]. In this paper we aim to estimate/compute technical efficiency scores for large-scale manufacturing industries in Pakistan. Once these scores are obtained, statistical techniques can be applied to test the hypothesis that export-oriented industries are technically more efficient.

The objective of this paper is two-fold: First, it aims to provide a comparison between technical efficiency scores between groups of exporting industries and non-exporting industries. Second, it identifies the most efficient and least efficient industries in terms of technical efficiency among all manufacturing industries reported in the Census of Manufacturing Industries in Pakistan. More specifically, we compute the technical efficiency scores for the large scale manufacturing industries in Pakistan and employ statistical techniques to test the hypothesis that export-oriented industries are technically more efficient.[1] In the literature technical efficiency is typically estimated/computed by comparison of input-output combination of a Decision Making Unit (industry in this case) with reference to a production frontier, which can be found through various techniques including Stochastic Production Frontier and Data Envelopment Analysis.

The remainder of this paper is structured as follows: Section 2 presents a theoretical review of efficiency measurement. Recent empirical literature on efficiency of manufacturing firms and industries is reviewed in Section 3. In Section 4 methodology and data are discussed. Empirical results are given in Section 5, and Section 6 concludes the discussion.

2. A THEORETICAL REVIEW OF EFFICIENCY MEASUREMENT

Koopmans (1951, p. 60) defines a producer as technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output. In other words, with a given technology a producer is technically efficient if it is not possible to produce more output from the same inputs nor the same output with less of one or more inputs without increasing the amount of other inputs. Debreu (1951) and Farrell (1957) define technical efficiency as one minus the maximum equi-proportionate reduction in all inputs that still allows continued production of given outputs (or alternatively, equi-proportionate expansion in outputs with given inputs). A score of unity would imply that the producer is technically efficient and a score of less than one would indicate the extent of technical inefficiency.

[1]Burki and Khan (2005) and Din, *et al*. (2007) address the issue of technical efficiency but these studies do not test for differences between exporting and non-exporting industries.

Although Koopman's definition is theoretically more stringent, in empirical studies the definition proposed by Debreau and Farrell is more commonly used. The reason is that technical efficiency thus defined can be described in terms of a distance function.[2]

An output distance function is defined as:

$$\text{Do}\,(x,y) = \min\{\gamma : y/\gamma \epsilon\, P(y)\}$$

Where x and y are input and output vectors respectively, and $P(y)$ is the feasible production set. In other words output distance function measures how much outputs can be radially expanded for given level of inputs while still remaining within the feasible production set.

Similarly input distance functions can be defined as follows:

$$\text{Di}\,(y,x) = \max\{\delta : x/\ \delta \epsilon\, L(y)\}$$

Where x and y are again input and output vectors respectively, and $L(y)$ is the input requirement set. This function measures radial contraction in inputs for a given level of output while still remaining within the input requirement set.

Estimation of Technical Efficiencies

The pioneering work for measurement of technical efficiency was done by Farrell (1957).[3] This measurement involves the estimation of a frontier against which the performance of productive units can be compared. Following these early works, many writers tried different techniques to estimate/compute the production frontier and efficiencies. Broadly, these techniques can be divided in two major groups:

- Parametric Techniques, and
- Non-Parametric Techniques

Choice of Techniques

Parametric Techniques are based on econometric regression models. Usually a stochastic production, cost, or profit frontier is used, and efficiencies are estimated with reference to that frontier. Parametric techniques require a functional form, and random disturbances are allowed for in the model. Usual tests of significance can be performed in these models. Non-parametric techniques on the other hand do not require a functional form; do not allow for random factors; and all deviations from the frontier are taken as inefficiencies. Consequently, inefficiencies in non-parametric techniques are expected to be higher than those in parametric techniques. Moreover, tests of significance cannot be performed in non-parametric techniques.

The commonly used parametric efficiency techniques are the stochastic frontier analysis (SFA), the thick frontier approach (TFA), and the distribution-free approach (DFA). Whereas, among non-parametric techniques, data envelopment analysis (DEA)

[2]Distance functions were introduced by Malmquist (1953) and Shephard (1953). For a detail discussion on use of distance function for efficiency measurement, see Shephard (1970), and Russell (1985, 1990). The description given here is adapted from Coelli, *et al*. (2005), pp. 47–49.

[3]Farrell actually proposed measurement of input-oriented technical efficiency (explained below). He also introduced the idea of "allocative efficiency", which involves production decisions given output prices. The "technical efficiency" and "allocative efficiency" combined are termed as "economic efficiency" [Coelli, *et al.* (2005), p. 51].

and free disposable hull (FDH) are more commonly used. Unlike SFA, which can be applied on cross-sectional as well as on panel data, DFA requires panel data for estimation. Since data on manufacturing industries in Pakistan is not a panel dataset, DFA becomes unsuitable. Likewise FDH is quite stringent regarding input substitution. As pointed out by Berger and Humphrey (1997):

> "DEA presumes that linear substitution is possible between observed input combinations on an isoquant (which is generated from the observations in piecewise linear forms). In contrast, FDH presumes that no substitution is possible so the isoquant looks like a step function formed by the intersection of lines drawn from observed (local) Leontief-type input combinations."

Since we are using industry-level data, the assumption of no substitution between inputs would not be quite reasonable. The major issue with Thick Frontier Technique (TFA) is that it does not provide a set of individual efficiency scores, which is, in fact, one of the key objectives of this paper. With these considerations, this study uses two most commonly used techniques, one parametric and one non-parametric technique viz. Stochastic Frontier Analysis (SFA), and Data Envelopment Analysis (DEA). These techniques are explained below, but first we shall briefly review the concepts of Input- and Output-Orientation of technical efficiency measurement.

Output- and Input-Orientations

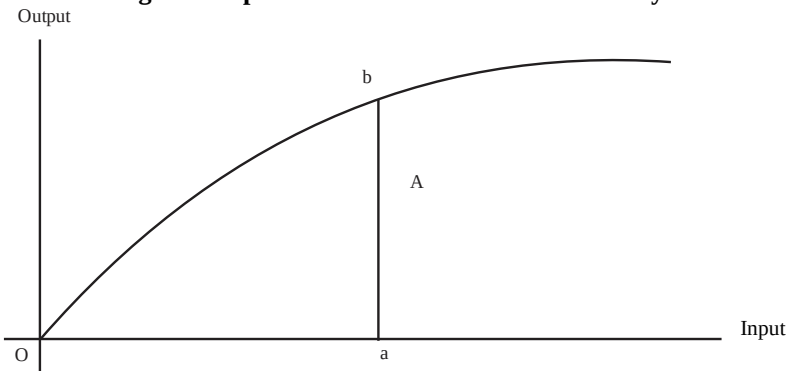
Technical efficiency can be defined either with input-orientation or with an output-orientation. The input-oriented approach defines technical efficiency in terms of proportional reduction in inputs while holding output level constant. The output-oriented approach, on the other hand measures technical efficiency in terms of proportional increase in output while holding input levels constant. This study uses output oriented measure of technical efficiency.

Graphical Representation of Technical Efficiency

Technical efficiency measures how optimally a producer is using inputs in relation to output. In Figure 1 the curve represents the production frontier. For production point A, the output-oriented measure of technical efficiency is given by:

Technical Efficiency = aA/ ab

Fig. 1. Output Measures of Technical Efficiency



This measure of technical efficiency equals the output distance functions [Coelli, *et al*. (2005), pp. 53,56].

Stochastic Frontier Analysis

The SFA is an econometric technique introduced independently by Aigner, Lovell, and Schmidt (1977) and Meeusen and Broeck (1977). In this technique the error term of the model is divided into two components, random noise and inefficiency component. Being a parametric technique, SFA requires a functional form, and usual tests of significance can be performed with this technique.

A stochastic production frontier model can be written in general form as:

$$y_i = f(x_i, \beta) + v_i - u_i$$

Where:

y_i is the observed scalar output of the producer i, $i=1,..I$,
x_i is a vector of N inputs used by the producer i,
$f(x_i, \beta)$ is the production frontier,
β is a vector of technology parameters to be estimated.
v_i is the random error, and
u_i is the non-negative random variable associated with technical inefficiency.

In literature different assumptions have been used about distribution of inefficiency term, u_i. Afriat (1972) assumes u_i to have a gamma distribution; Stevenson (1980) uses truncated normal distribution; and Greene (1990) uses two-parameter gamma distribution. Exponential distribution was suggested by Aigner, Lovell, and Schimidt (1977), and Meeusen and Broeck (1977). However, as pointed by Coelli, *et al.* (2005), p. 252, rankings of predicted technical efficiencies are quite often robust to distributional choice. In this study we assume u_i to follow exponential distribution.[4]

The Ordinary Least Square estimation of the above model provides consistent estimates of, slope parameters but not of intercept. More importantly, we cannot obtain efficiency estimates through OLS [Kumbhakar and Lovell (2000), p. 73]. This issue is resolved by applying maximum likelihood estimation technique to obtain consistent parameter estimates as well as efficiency scores. The estimated model forms the basis for computing a predictor of technical efficiencies. The estimates of technical efficiency are obtained as a mean of the conditional distribution of u_i given ε_i, where $\varepsilon_i = v_i - u_i$ [Kumbhakar and Lovell (2000), p. 82].

The next step is to check the significance of inefficiencies estimated by the model, i.e. to test the null hypothesis of no inefficiencies against the alternative hypothesis that inefficiencies are present. As suggested by Coelli (1996), a one-sided likelihood ratio test with a mixed chi-square distribution ($\bar{\chi}^2 = \frac{1}{2}\chi_0^2 + \frac{1}{2}\chi_1^2$) is appropriate here. Therefore, the null hypotheses will be rejected if $LR > \bar{\chi}^2$

Once technical efficiency scores are obtained, we can test whether mean efficiency scores of exporting and non-exporting industries are statistically same or not. We can

[4] Other distributions have also been tried but results from exponential distribution are found to be better in terms of parameter estimates and likelihood ratio test.

divide industries in two groups i.e. exporting and non-exporting industries. Then the following t-test can be applied to test the equality of mean efficiency score of these two groups.

$$t = (\overline{x_1} - \overline{x_2})/\sqrt{[S_p^2/n_1 + S_p^2/n_2]}$$

Where s_p^2 is the pooled variance of two groups, given by the formula:

$$s_p^2 = \{(n_1 - 1)S_1^2 + (n_2 - 2)S_2^2\}/(n_1 + n_2 - 2)$$

$\overline{x_1}$ and $\overline{x_2}$ are average efficiency scores of two groups,

s_1^2 and s_2^2 are variances of average efficiency scores of two groups, and n_1 and n_2 are respective number of industries in two groups.

Data Envelopment Analysis

The Data Envelopment Analysis (DEA) is a mathematical programming technique for the construction of a production frontier. It is an alternative technique for efficiency measurement and possesses certain advantages of its own. It can handle multiple outputs and multiple inputs, and it places no restriction on the functional form of the relationship among inputs and outputs. DEA has some limitations as well. Being a non-parametric technique, DEA is not amenable to direct application of tests of significance and statistical hypothesis testing, and statistical noise is not allowed for.

The DEA models differ in the assumptions that are made about the technology set. The most important assumptions are: free disposability, convexity, returns to scale, and additivity. The free disposability assumption implies that unnecessary inputs and unwanted outputs can be freely discarded. The assumption of convexity assumption implies that any convex combination of feasible production points is feasible as well. The assumption of returns to scale implies possibility of rescaling. The additivity assumption implies that when some production plans are feasible, their sum will also be feasible.[5]

We have applied DEA under two possible returns to scale assumptions: (i) Constant returns to scale, and (ii) Variable returns to scale.

The constant returns to scale model is attributed to Charnes, Cooper, and Rhodes (1978). The model was modified by Banker, Charnes, and Cooper (1984) by imposing an additional convexity constraint to obtain VRS model.

Data Envelopment Analysis can be employed by adopting either of two approaches, viz. output-oriented approach or input-oriented approach. The efficiency scores obtained from these two alternative approaches are identical if constant returns to scales (CRS) are assumed, but are different under the assumption of variable returns to scale (VRS) [Coelli, *et al*. (2005), p. 180]. Moreover, "output- and input-oriented DEA will estimate exactly the same frontier and therefore, by definition, identify the same set of firms as being efficient. It is only the efficiency measures associated with the inefficient firms that may differ between the two methods." [Coelli (2005), p.181].

[5]For details on these assumptions, see Bogetoft and Otto (2010), pp. 85–86.

Fig. 2. Production Frontier under the Assumption of CRS and VRS

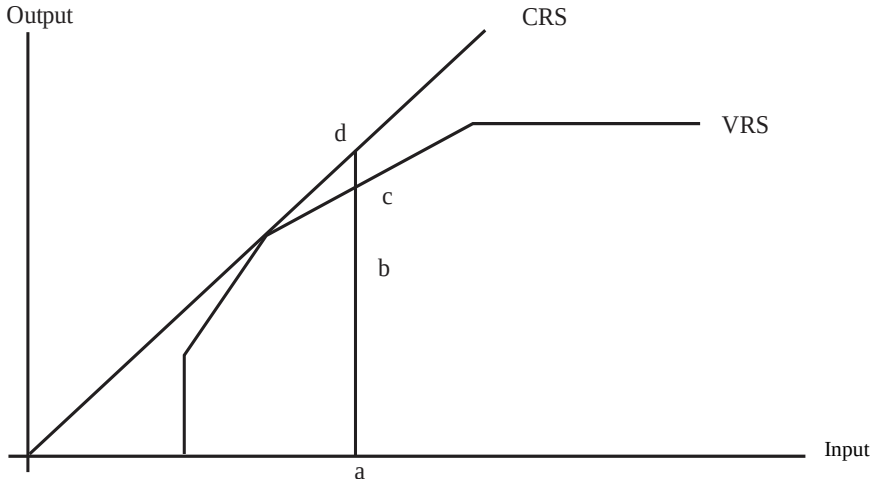


Figure 2 depicts production frontiers under the assumption of CRS and VRS. These are in fact optimal combinations of inputs and outputs. For an industry producing at point b, technical efficiency under CRS will be the ratio ab/ad. Whereas under the assumption of VRS, the technical efficiency measure will be the ratio ab/ac. VRS model gives higher efficiency scores since the frontier fits data more tightly than in the case of CRS.

It is assumed that there are n industries ($j = 1,2,\ldots,n$), each using m different inputs ($h = 1,2,\ldots,m$) and producing a single output. Moreover, it is assumed that $x_{hj} \geq 0$ and $y_j \geq 0$ so that each industry uses at least one positive input and produces positive output. The analysed industry is indicated with subscript i. The objective and the constraint of the industry i are given by:

$$max_{u,v} \; uy_i/vx_i$$
$$\text{s.t.} \quad uy_j/vx_j \leq 1 \qquad j = 1,2,\ldots N$$
$$u,v \geq 0$$

The vectors u and v represent weights with the restriction that these weights are non-negative. Consequently, neither an output nor an input can be negative. These weights are computed in such away that the efficiency of the analysed industry i is at a maximum and becomes smaller for any other value of u and v. The above objective function is not actually used to compute technical efficiencies. Rather, it is converted into the following linear programming problem:

$$min_{u,v} \; vx_i$$
$$\text{s.t.}$$
$$uy_j - vx_j \leq 0 \qquad j=1,2,\ldots n$$
$$uy_i = 1$$
$$u,v \geq 0$$

The duality property of linear programming can be used to convert the above problem into the following envelopment form:

$$Max_{\Phi,\lambda}\ \Phi$$
s.t.
$$-\Phi\ y_i + Y\lambda \geq 0$$
$$x_i - X\lambda \geq 0$$
$$\lambda \geq 0$$

Where Φ is a scalar, and λ is a vector of constants. X and Y represent input and output matrices for all industries. The scalar Φ is the largest factor by which all outputs of industry i can be raised. The reciprocal of Φ is the technical efficiency of the ith industry. It represents the proportional increase in output that could be achieved by the ith industry, with inputs being held constant.

The above programme is for CRS model. For VRS additional convexity constraint ($e`\lambda=1$) is imposed in the model. The VRS model is written as:

$$Max_{\Phi,\lambda}\ \Phi$$
s.t.
$$-\Phi\ y_i + Y\lambda \geq 0$$
$$x_i - X\lambda \geq 0$$
$$\lambda \geq 0$$
$$e`\ \lambda = 1$$

Where $e`$ is a vector of ones.

The convexity constraint ensures that an inefficient industry is only "benchmarked" against industry of a similar size. That is, the projected point for that industry on the DEA frontier is a convex combination of observed industries [Coelli, (2005), p. 172].

3. A REVIEW OF EMPIRICAL LITERATURE

A detailed review of studies regarding performance of manufacturing sectors in developing countries has been done by Tybout (2000). In the following pages we shall present a brief review of some recent empirical studies, which specifically address the issue of efficiency of manufacturing industries.

Mukherjee and Ray (2004) analyse state level data to study the efficiency dynamics of individual states in India. The study uses data from Annual Survey of Industries for the period 1986-87 to 1999-00. Data Envelopment Analysis technique is used to construct super-efficiency ranking the states in terms of their performance. Stability of efficiency ranking is checked as well as effect of economic reforms introduced in the 1990s. Although considerable variations in efficiency scores are found across the states, no major change is observed in the efficiency ranking of states after the reforms. The study also finds that there is no evidence of convergence in the distribution of efficiency in the post-reform period.

Tripathy (2006) examines efficiency gap between foreign and domestic firms in eleven manufacturing industries of India during 1990-2000. Two different techniques, i.e. SFA and DEA are used to measure efficiency of the firms. The study assumes a Cobb-Douglas technology and estimates stochastic production and cost frontier in each industry to measure technical efficiency and cost efficiency of each firm as well as to obtain some inference on allocative efficiency.

Alvarez and Crespi (2003) explore differences in technical efficiency in Chilean manufacturing firms applying Data Envelopment Analysis technique on plant level. The study uses a sample of 1,091 observations covering all industrial sectors in Chilean Industry according to ISIC three digits. The firms are classified in small, medium and large categories in terms of their annual sales. The efficiency scores indicate that medium firms perform better than the small or large firms. "Professional and scientific equipment" and "Non-metallic mineral products" turn out to be most efficient, whereas, "Agro-industry" and "Textiles" are least efficient. Further, regression analysis is performed to identify some determinants of firms' efficiency. Firms' characteristics like experience are not found to be related with efficiency. On the other hand input quality variables, such as worker experience, product differentiation, and modernisation of capital, are found to positively affect the efficiency of firms.

Ikhsan-Modjo (2006) examines the patterns of total factor productivity growth and technical efficiency changes in Indonesia's manufacturing industries over the period 1988-2000. The study uses the data incorporating both the liberalisation years and the crisis/post crisis years sourced from an annual panel survey of manufacturing establishments. A translog frontier production function is estimated. Gross output is regressed on inputs like the cost of capital, wages, intermediate inputs and energy, and the study finds that technical progress is the most important factor in explaining TFP growth in the Indonesian manufacturing sector.

Kneller and Stevens (2006) investigate whether absorptive capacity helps to explain cross-country differences in the level of technical efficiency. The study uses stochastic frontier technique to estimate a frontier. Industries' output is assumed to depend on four inputs viz. physical capital, effective labour supply (the number of workers adjusted for average hours per week), the stock of human capital and the stock of knowledge. Inefficiency effects are modelled as dependent variable and the independent variables are the level of investment in research and development, level of human capital and country specific dummies. The data consist of a sample of nine manufacturing industries in 12 OECD countries over the period 1973–91. The results indicate differences across countries in efficiencies. It is found that human capital plays a significant and quantitatively important role in explaining these differences.

Din, *et al.* (2007) analyse the efficiency of large scale manufacturing sector in Pakistan using the stochastic frontier as well as data envelopment analysis. The study compares the efficiency scores for the years 1995-96 and 2000-01. The results show that there has been some improvement in the average efficiency of the large scale manufacturing sector from the year 1995-96 to 2000-01. Stochastic frontier technique shows an improvement from 0.58 to 0.65, while for data envelopment analysis the efficiency scores increase from 0.23 to 0.42 (under the assumption of constant returns to scale) and 0.31 to 0.49 (under the assumption of variable returns to scale). However results are mixed at the disaggregated level. Whereas a majority of industrial groups have gained in terms of technical efficiency, some industries have shown deterioration in their efficiency levels including transport equipment, glass and glass products, other non-metallic mineral products, and other manufacturing.

Burki and Khan (2005) analyse the implications of allocative efficiency for resource allocation and energy substitutability. The study covers the period 1969-70 to 1990-91 and utilises pooled time series data from Pakistan's large scale manufacturing sector to estimate a generalised translog cost function. The study also computes factor demand elasticities and elasticities of substitution by using the parameters of the estimated generalised cost function. The results indicate strong evidence of allocative inefficiency leading to over- or under-utilisation of resources and higher cost of production. Input-mix inefficiency takes the form of over-utilisation of raw material and capital *vis-à-vis* labour and energy. The study finds that allocative inefficiency of firms has on average decreased the demand for labour by 0.19 percent and increased the demand for energy by 0.12 percent. Own price elasticities of factors of production imply that the demand for capital is much more sensitive to its own price than the demand for labour. However, the elasticity of substitution between all factors is found out to be positive, which implies that they are substitutes. This is attributed to installation of new but more energy-efficient capital. The new machinery and plants, although more energy-intensive and raw material saving, leave the share of capital and labour unchanged.

Some studies have utilised the Data Envelopment Analysis (DEA) to explore the question of industrial efficiency. Jajri and Rahmah (2006) analyse trend of technical efficiency, technological change and TFP growth in the Malaysian manufacturing sector. The data come from the Industrial Manufacturing Survey of 1984 to 2000 collected by the Department of Statistics, Malaysia. Input variables are capital and labour whereas value added is used as output. It is found that Total Factor Productivity Growth is mainly driven by technical efficiency. The industries that experienced high technical efficiency are food, wood, chemical and iron products. Analysis by industry shows that there is no positive relationship between capital intensity and efficiency, technological change and Total Factor Productivity growth.

Lee and Kim (2006) analyse the effects of research and development (R&D) on Total Factor Productivity growth in manufacturing industries, using a sample of 14 OECD countries[6] for the years 1982-1993. With the assumption of constant returns to scale technology, the Malmquist Productivity Index and its components are computed using two traditional inputs i.e. labour and capital; then the exercise is repeated with the stock of R & D capital as an additional input. Inclusion of R & D capital is found to be statistically significant and the introduction of R & D capital as an additional input reduces the TFP measures on average by 10 percent. This is attributed to "costly" R & D capital formation as opposed to "costless" productivity growth when only labour and fixed capital are considered. It is also found that it is technological progress rather than efficiency catch up that is driven by the accumulation of R & D capital. Spillovers of R & D capital are tested using regression analysis. Two types of spillovers are considered viz. domestic R & D spillovers across industries and international spillovers within a single industry. Domestic R & D capital stocks and foreign R & D capital stocks for different industries are used for this purpose. It is found that productivity gains in manufacturing industries depend significantly on R & D spillovers, especially for an economy that is more open to international trade.

[6]The sample consists of Canada, Denmark, Finland, France, Germany, Italy, Japan, Korea, Netherlands, Norway, Spain, United Kingdom, and United States.

4. METHODOLOGY AND DATA

This study uses both SFA and DEA techniques to measure technical efficiencies. For stochastic frontier two functional forms are tried viz. Translog and Cobb-Douglass production functions. The purpose is to check the sensitivity of the efficiency scores with reference to the functional form/estimation technique.

Model 1

The Stochastic Production Frontier of Translog form is given below:

$$Ln\ Y_i = \beta_0 + \beta_1\ ln\ L_i + \beta_2\ lnK_i + \beta_3\ ln\ RM_i + \beta_4\ ln\ Ener_i + \beta_5\ ln\ NIC_i + \frac{1}{2}\beta_6\ (ln\ L_i)^2 + \frac{1}{2}\beta_7\ (lnK_i)^2 + \frac{1}{2}\beta_8\ (ln\ RM_i)^2 + \frac{1}{2}\beta_9\ (ln\ Ener_i)^2 + \frac{1}{2}\beta_{10}\ (ln\ NIC_i)^2 + \beta_{11}\ ln\ L_i\ lnK_i + \beta_{12}\ ln\ L_i\ ln\ RM_i + \beta_{13}\ ln\ L_i\ ln\ Ener_i + \beta_{14}\ ln\ L\ ln\ NIC_i + \beta_{15}\ lnK_i\ ln\ RM_i + \beta_{16}\ lnK_i\ ln\ Ener_i + \beta_{17}\ lnK_i\ ln\ NIC_i + \beta_{18}\ ln\ RM_i\ ln\ Ener_i + \beta_{19}\ ln\ RM_i\ ln\ NIC_i + \beta_{20}\ ln\ Ener_i\ ln\ NIC_i + v_i - u_i$$

Where:

Y_i is the value of output,
L_i is the average number of persons engaged,
K_i is the amount of capital used
RM_i is the value of raw material used,
$Ener_i$ is the value of energy consumed,
NIC_i is the non-industrial cost,
v_i and u_i are two components of the error term with following distributional assumptions [Kumbhakar and Lovell (2000), p.80].

(i) $v_i \sim iidN(0, \sigma_v^2)$
(ii) $u_i \sim iid$ with exponential distribution
(iii) u_i and v_i are distributed independently of each other, and of the regressors.

The symmetric error term v_i is the usual noise component to allow for random factors like measurement errors, weather, strikes etc. The non-negative error term $u_i$is the technical inefficiency component. Subscript *i* stands for *i*th industry.

Model 2

The Cobb-Douglass function has the following form:

$$Ln\ Y_i = \alpha_0 + \alpha_1\ ln\ L_i + \alpha_2\ lnK_i + \alpha_3\ ln\ RM_i + \alpha_4\ ln\ Ener_i + \alpha_5\ ln\ NIC_i + v_i - u_i$$

The variables names and distributional assumptions of the composite random term are the same as in the case of the translog function.

The data are obtained from the Census of Manufacturing Industries (2005-06),[7] *In* all, 102 large-scale manufacturing industries are selected.

The following is a brief description of the variables:

[7]This is the latest available published CMI.

Output

CMI reports value added as well as contribution to GDP. Value added reported in CMI does not allow for non-industrial costs. So we have used contribution to GDP as output which equals value of production minus industrial cost minus net non-industrial cost.

Capital

Capital consists of land and building, plant and machinery and other fixed assets, which are expected to have a productive life of more than one year and are in use by the establishment for the manufacturing activity.

Labour

Labour includes employees, working proprietors, unpaid family workers and home workers. Labour data have been adjusted to allow for number of shifts as reported in CMI.

Raw Materials

As defined in CMI (2005-06) "Raw-materials include raw and semi-finished materials, assembling parts etc., which are physically incorporated in the products and by-products made. Chemicals, lubricants and packing materials, which are consumed in the production and spare parts charged to current operating expenses are included. Raw-materials given to other establishment for manufacturing goods (semi-finished and finished) on behalf of the establishment are included, whereas raw material supplied by others for manufacturing goods is excluded."

Energy

This input is obtained by adding cost on fuel and cost on electricity. Fuel is defined as "firewood, coal, charcoal, kerosene oil, petrol, diesel, gas and other such items which are consumed in generating heat and power."

Non-industrial Costs

These consist of payments for transport, insurances, copy rights/royalties, postage, telephone, fax and internet charges, printing and stationery, legal and professional services, advertising and selling services, traveling, etc.

Exporting and Non-exporting Industries

The distinction between exporting and non-exporting industries is made on the basis of shares of industries in total exports for the year 2005-06. The CMI data are based on ISIC classification. Data on exports could not be obtained in this classification. Exports Receipts, June 2006,[8] published by State Bank of Pakistan are used to identify exporting industries. These industries are manually matched with ISIC classification. List of all industries covered in this study is given in Appendix with top twenty exporting

[8]Now this publication is named as "Export of Goods and Services".

industries marked with "Ex". These twenty industries constitute the group of "exporting industries". Remaining industries are treated as "non-exporting industries". "Exporting industries" cover more than 88 percent of total exports.

Main focus of this paper is to determine whether major exporting manufacturing industries are technically more efficient than other industries. For this purpose industries are divided in two groups. Twenty exporting industries constitute group 1, and remaining industries constitute group 2. Separate mean efficiency scores and standard deviations of technical efficiency scores are computed for these groups of industries. Finally, t-test outlined in Section 2 is used to check the following null hypotheses:

$$MTE_1^{Trans} = MTE_2^{Trans}$$
$$MTE_1^{CD} = MTE_2^{CD}$$
$$MTE_1^{DEACR} = MTE_2^{DEACR}$$
$$MTE_1^{DEAVR} = MTE_2^{DEAVR}$$

Where *MTE* stands for mean technical efficiency score. Subscripts 1 and 2 denote two groups, and superscripts Trans, CD, DEACR and DEAVR indicate the techniques used i.e. Stochastic Frontier Translog, Stochastic Frontier Cobb-Douglass, Data Envelopment Analysis under constant returns to scale, and Data Envelopment Analysis under variable returns to scale respectively. The above four hypotheses are tested against the alternative hypotheses that mean efficiency scores are not equal, i.e. two-tail tests will be used to test the hypotheses.

Two different computer packages are used to obtain efficiency scores. For SF model the computer package STATA 9[9] is used, and for DEA model Win4DEAP[10] (Version 1.1.2) is used. Identification of output and inputs is same in both techniques.

5. RESULTS

Results of regression equation for SF are given in Tables 1 and 2. The results for Translog specification show that Raw Material and Non-Industrial Costs are highly significant in explaining output. Non-Industrial Costs variable is significant at almost 100 percent level, whereas significance of Raw Material is about 98 percent. Labour and Capital are significant at about 92 percent level. Significance of Energy is rather low, but it is still a relevant variable. Sign of capital turns out to be negative whereas square term of capital has a positive sign. This might be an indication of threshold point beyond which capital starts contributing positively to the output. Signs of product terms indicate complementarity among inputs. The variances of two error terms v_i and u_i are denoted by σ_v^2 and σ_u^2 respectively. In the log likelihood, they are parameterised as $\ln \sigma_v^2$ and $\ln \sigma_u^2$ respectively. The estimate of the total error variance which is sum of these two variances is denoted by σ^2 (i.e. $\sigma^2 = \sigma_v^2 + \sigma_u^2$). The parameter λ stands for the ratio of the

[9]STATA programme is a general-purpose statistical software package, developed by STATA Corp.

[10]Win4DEAP is a free software developed by Michel Deslierres. (Département d'économie Université de Moncton). It is available at http:/www.umoncton.ca/desliem/dea. This package is an extension of the computer programme DEAP, developed by Professor T. Coelli (for detail see "A guide to DEAP version 2.1: A Data Analysis Computer Programme." CEPA Working Paper 96/08).

variance of these two error terms (i.e. $\lambda = \sigma_u / \sigma_v$). These two parameterisations indicate relative importance of the two components of error term.

Mean Efficiency score is 0.7401 with standard deviation of 0.1346. Likelihood-ratio test indicates that the use of stochastic frontier approach is justified. The results of a likelihood-ratio test are reported at the bottom of the above Table. Here the null hypothesis is that there is no technical inefficiency component in the model, i.e.

$H_0 : \sigma_u = 0$

Against the alternative hypothesis

$H_1 : \sigma_u > 0$

The acceptance of null hypothesis would have implied that the stochastic frontier model reduces to an OLS model with normal errors. However in our case evidence is strong enough to reject the null hypothesis. The hypothesis of no technical inefficiency component in the model is rejected at less than 0.01 level of significance.

Table 1

Translog Production Frontier Results
(for Overall Dataset Covering 102 Industries)

	Coeff	z	P>z		Coeff	z	P>z
Constant	4.75	1.47	0.141	L*K	–0.11	–1.28	0.202
L	2.54	2.95	0.003	L*RM	–0.11	–0.85	0.395
K	–2.71	–3.09	0.002	L*Ener	–0.03	–0.24	0.809
RM	0.71	1.41	0.159	L*NIC	–0.12	–0.95	0.344
Ener	0.80	1.63	0.104	K*RM	0.04	0.41	0.681
NIC	.41	0.57	0.567	K*Ener	–0.22	–2.12	0.034
L^2	0.18	2.29	0.022	K*NIC	0.13	1.15	0.249
K^2	0.14	1.97	0.049	RM*Ener	–0.01	–0.08	0.938
RM^2	0.16	2.89	0.004	RM*NIC	–.36	–2.57	0.010
$Ener^2$	0.16	2.36	0.018	Ener*NIC	–.10	–1.05	0.296
NIC^2	0.21	2.63	0.009				
$\ln\sigma_v^2$	–1.99	–8.32	0.000				
$\ln\sigma_u^2$	–2.22	–5.07	0.000				
σ_v	0.37	.0442					
σ_u	0.33	.0721					
σ^2	0.24	.0421					
λ	0.89	.1018					

Likelihood-ratio test of $\sigma_u = 0$

$\bar{\chi}^2 = 7.34$

Prob $\geq \bar{\chi}^2 = 0.003$

Mean Efficiency score = 0.7401
SD of Efficiency scores = 0.1346.

In Cobb-Douglass specification (Table 2), all inputs are highly significant except $Ener_i$. Mean Efficiency score is 0.7412 with standard deviation of 0.1014. Again, the hypothesis of no technical inefficiency component in the model is rejected, however at a lesser level of significance than that of translog model. Here level of significance is about 0.06 for rejection of null hypothesis of no technical inefficiencies. Mean of efficiency scores and their standard deviation are found to be very close to those of translog model.

Table 2

Cobb-Douglass Production Frontier Results
(for Overall Dataset Covering 102 Industries)

Independent Variables	Coefficients	z	P>z
Constant	2.51	4.63	0.00
L_i	0.15	1.73	0.08
K_i	0.16	1.76	0.08
RM_i	0.17	2.34	0.02
$Ener_i$	0.08	1.37	0.17
NIC_i	0.40	4.47	0.00
$\ln\sigma_v^2$	–1.14	–5.56	0.00
$\ln\sigma_u^2$	–2.31	–3.58	0.00
σ_v	0.57		
σ_u	0.31		
σ^2	0.42		
λ	0.56		

Likelihood-ratio test of $\sigma_u = 0$
$\bar{\chi}^2 = 2.31$
Prob $\geq \bar{\chi}^2 = 0.064$
Mean Efficiency score = 0.7412
SD of Efficiency scores = 0.1014.

Efficiency scores obtained from SF models are reported in Appendix (along with those of DEA model). In Cobb-Douglass as well as translog models of stochastic frontier, average efficiency is found to be about 0.74 with standard deviations of 0.13 and 0.10 respectively. This shows that efficiency scores of most of the industries cluster around the mean value in a very narrow band with a very small number of observations going to either extremes (Figures 4 and 5).

Fig. 4. Efficiency Scores from Translog Frontier

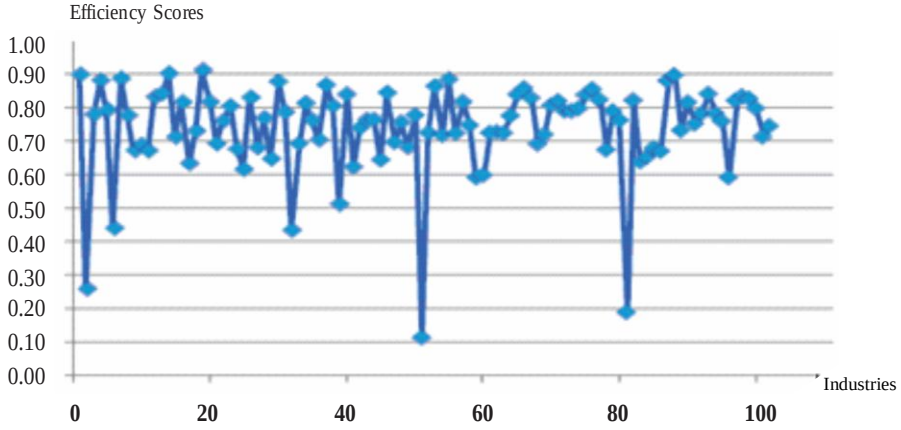
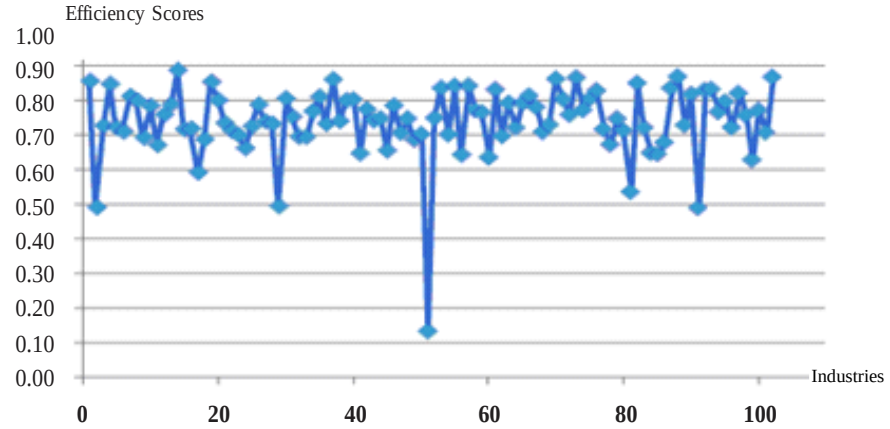


Fig. 5. Efficiency Scores from Cobb-Douglas Frontier



Efficiency scores of most efficient industries are reported in Table 3. As the scores indicate, most of the industries efficient in Translog Model are also efficient in Cobb-Douglass Model. These are Carpets and Rugs, Tobacco Products, Meat and Meat Products, Sound/video Apparatus of TV and Radio and Vegetable and Animal Oils and Fats, and Refined Petroleum Products.

Table 3

Most Efficient Industries (by SF Model)

Translog Frontier	Efficiency Scores	Cobb-Douglass Frontier	Efficiency Scores
Carpets and Rugs	0.91	Tobacco Products	0.89
Tobacco Products	0.90	Sound/video Apparatus of TV and Radio	0.87
Meat and Meat Products	0.90	Recycling	0.87
Sound/Video Apparatus of TV and Radio	0.90	Manufacture of Machine Tools	0.87
Starches and Starch Products	0.89	Ovens, Furnaces and Furnace Burners	0.86
Cutting, Shaping and Finishing of Stone	0.89	Refined Petroleum Products	0.86
Vegetable and Animal Oils and Fats	0.88	Meat and Meat Products	0.86
TV, Radio and Telegraphy Apparatus	0.88	Carpets and Rugs	0.85
Pulp, Paper and Paperboard	0.88	Insulated Wire and Cables	0.85
Refined Petroleum Products	0.87	Vegetable and Animal Oils and Fats	0.85

Efficiency scores of least efficient industries are reported in Table 4. Refractory Ceramic Products happens to be the least efficient industry by a wide margin in both models; its efficiency score being only 0.11. This indicates a very non-optimal utilisation of inputs. Next in the list are Electricity Distri. and Control Apparatus, Fish and Fish Products, and Basic Precious Metals and Aluminum and its Products; all these industries are relatively less efficient according to the both models.

Table 4

Least Efficient Industries (by SF Model)

Translog Frontier		Cobb-Douglass Frontier	
Industries	Efficiency Scores	Industries	Efficiency Scores
Refractory Ceramic Products	0.11	Refractory Ceramic Products	0.13
Electricity Distri. and Control Apparatus	0.19	Watches and Clocks	0.49
Fish and Fish Products	0.26	Fish and Fish Products	0.49
Other Articles of Paper and Paperboard	0.43	Other Products of Wood	0.49
Grain Mill Products	0.44	Electricity Distri. and Control Apparatus	0.54
Fertilisers and Nitrogen Compounds	0.51	Finishing of Textiles	0.59
Other First Processed Iron and Steel	0.59	Musical Instruments	0.63
Motorcycles	0.59	Basic Precious Metals and Aluminum and its Products	0.64
Basic Precious Metals and Aluminum and its Products	0.60	Other Non-Metallic Mineral Products	0.64
Luggage, Saddlery and Harness	0.62	Other Electrical Equipment n.e.c.	0.65

DEA model has been applied under two assumptions; (i) Constant returns to scale, and (ii) Variable returns to scale. Mean efficiency in DEA models turns out to be 0.43 and 0.51 with standard deviations of 0.27 and 0.29 respectively under these two assumptions. These scores are slightly less than that of SF models due to different assumptions regarding the inefficiency term. Industry-wise technical efficiency scores are given in Appendix. Like the SF case, we observe the pattern of clustering of efficiency score in a narrow band around the mean value in DEA models as well (Figures 6 and 7).

Fig. 6. Efficiency Scores from DEA (Constant Returns to Scale)

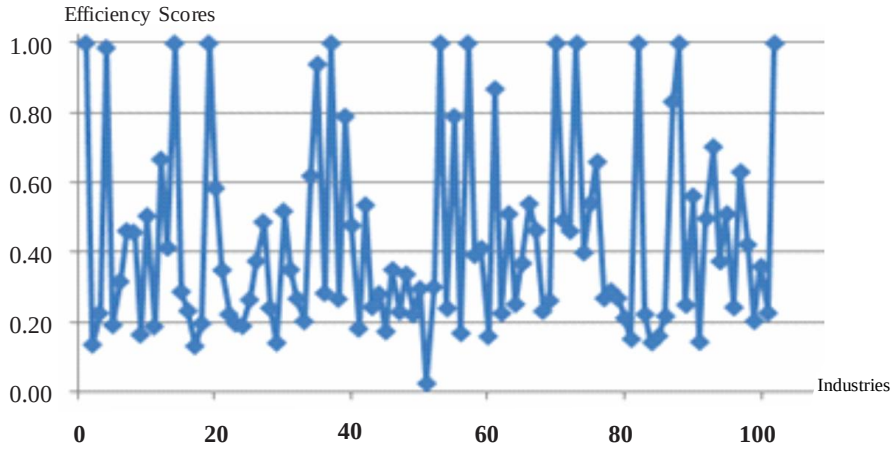
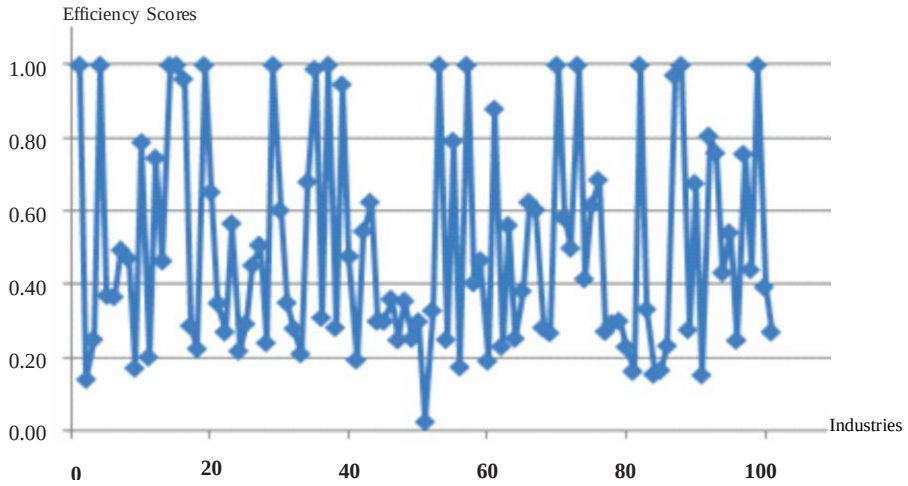


Fig. 7. Efficiency Scores from DEA (Variable Returns to Scale)



Ten most efficient industries in DEA models under assumption of constant returns to scale and variable returns to scale are reported in Table 5. Since DEA model does not allow for random error, the most efficient industries are likely to lie exactly on the frontier. All such industries reported in Table 5 have efficiency score of 1. Meat and Meat Products, Tobacco Products, Carpets and Rugs, Refined Petroleum Products, Cement, Lime and Plaster, Basic Iron and Steel, Ovens, Furnaces and Furnace Burners, are the sectors with relatively high efficiency scores under both the assumptions of DEA model. It should be noted that Meat and Meat Products, Tobacco Products, Carpets and Rugs, and Refined Petroleum products are efficient industries common in all models.

Table 5

Most Efficient Industries by DEA Model

Constant Returns to Scale	Variable Returns to Scale
Meat and Meat Products	Meat and Meat Products
Tobacco Products	Vegetable and Animal Oils and Fats
Carpets and Rugs	Tobacco Products
Refined Petroleum Products	Spinning of Textiles
Cement, Lime and Plaster	Carpets and Rugs
Basic Iron and Steel	Other Products of Wood
Ovens, Furnaces and Furnace Burners	Refined Petroleum Products
Manufacture of Machine Tools	Cement, Lime and Plaster
Insulated Wire and Cables	Basic iron and Steel
Sound/Video Apparatus of TV and Radio	Ovens, Furnaces and Furnace Burners

Least efficient industries under DEA model under the assumptions of Constant Returns to Scale and Variable Returns to Scale are given in Table 6. Again, Refractory Ceramic Products turned out to be least efficient industry with a very small score of 0.03. Fish and Fish Products, Electric Lamps and Lighting Equipment, Electricity Distribution

Table 6

Least Efficient Industries by DEA Model

Constant Returns to Scale		Variable Returns to Scale	
Industries	Efficiency Scores	Industries	Efficiency Scores
Refractory Ceramic Products	0.03	Refractory Ceramic Products	0.03
Finishing of Textiles	0.13	Fish and Fish Products	0.14
Fish and Fish Products	0.14	Watches and Clocks	0.15
Other Products of Wood	0.14	Electric Lamps and Lighting Equipment	0.16
Electric Lamps and Lighting Equipment	0.14	Electricity Distri. and Control Apparatus	0.16
Watches and Clocks	0.14	Other Electrical Equipment n.e.c.	0.17
Electricity Distri. and Control Apparatus	0.15	Bakery Products	0.17
Basic Precious Metals	0.16		
Aluminum and its Products		Other Non-Metallic Mineral Products	0.18
Other Electrical Equipment n.e.c.	0.16	Basic Precious Metals	
		Aluminum and its Products	0.19
Bakery Products	0.17	Pesticides and Agrochemical Products	0.19

and Control Apparatus, Basic Precious Metals and Aluminum and its Products are relatively less efficient industries under both the assumptions of scale. Refractory Ceramic Products, Fish and Fish products, Electricity Distribution and Control Apparatus, and Basic Precious Metals and Aluminum and its products are relatively less efficient in all the four models.

In general the efficiency scores computed through SFA turn out to be higher than those computed through DEA. This is due to the fact that SFA allows for random noise while estimating the frontier. Within DEA technique efficiency scores under CRS are, generally, lower than those under VRS. This occurs because under VRS assumption the frontier encloses the observations in a more compact way. So, observations become closer to the frontier. As pointed out by Din, *et al.* (2007), this is in line with the evidence suggested in the literature, e.g. Lin and Tseng (2005). This consistency of efficiency rankings again confirms that results are not sensitive to the technique employed. A direct comparison of theses individual efficiency scores with previous studies is not possible. As mentioned before Burki and Khan (2005) do not provide individual efficiency scores. Din, *et al.* (2007) do provide individual efficiency scores but they use a different industrial classification and aggregation level. So their efficiency scores are not directly comparable with the present study.

Next, we turn to the efficiency of exporting industries. Mean efficiency scores of exporting industries are compared with those of non-exporting industries by using t-test. The results of these tests are summarised in Table 7.

Table 7

Comparison of Mean Efficiency Scores between Exporting and Non-Exporting Industries

Technique	*t*-Values
Stochastic Frontier (CD)	–0.49
Stochastic Frontier (Translog)	–0.57
DEA (CRS)	–1.05
DEA (VRS)	–0.14

As the t-values suggest, there is no significant difference between mean efficiency scores of exporting and non-exporting industries. Therefore we do not reject the null hypotheses of equality of mean efficiency scores across exporting and non-exporting industries. In other words exporting industries are not performing better than non-exporting industries in terms of technical efficiency in a significant way. Rather, as the Table shows, mean efficiency score in all the four models is slightly *less* for exporting industries (though not in a significant way). This is against the common perception that exporting industries must be the most efficient ones. This may be an indication of inherent comparative advantage of exporting industries rather than more efficient performance as the main factor for exports. On the other hand it also indicates a significant margin for improvement in export performance if only technical efficiency of manufacturing industries could be improved through better use of given inputs.

Limitations of the Paper

The paper uses data of 102 industries groups defined at 4-digits level of aggregation. At this level of aggregation, many diversified industries are lumped within a broader industrial group, thus masking important characteristics specific to an industry. Benefits of broader analysis notwithstanding, an analysis based upon a more disaggregated dataset could bring these differences into focus. The second limitation is about the methodology. The estimated models provide technical efficiency scores, but do not go beyond any further. There remain unanswered questions about causes of differences in efficiency scores among different industrial groups. Many factors like protection, concentration, human resource development, institutional strengthening etc. are responsible for differences in technical efficiencies. Empirical testing is needed to determine direction and size of their respective effects. These limitations indicate potential for future work in this area.

6. SUMMARY AND CONCLUSIONS

In this paper technical efficiency levels of manufacturing industries are estimated by using SFA and DEA techniques. SFA technique is used to estimate Cobb-Douglass as well as translog production frontier. DEA technique is used under the assumptions of constant returns to scale and variable returns to scale. The results suggest that the overall efficiency of manufacturing industries is low and there is a substantial room for improvement. Industries showing high technical efficiency include Tobacco Products, Refined Petroleum Products, Carpets and Rugs, and Meat and Meat Products. Industries

showing low technical efficiency include Refractory Ceramic Products, Electricity Distribution and Control Apparatus, Fish and Fish Products, Basic Precious Metals and Aluminum and its Products.

Efficiency scores of exporting industries are statistically not better than other industries. This indicates that there is a scope for improving technical efficiency to gain a competitive edge in export markets.

APPENDIX

Efficiency Scores of Industries

S. No.	Industry Codes	Industries	Technical Efficiency Scores			
			SFA	SFA	DEA	
			Cobb	Trans	CRS	VRS
1	1511	Meat and meat products	0.86	0.90	1.00	1.00
2	1512	Fish and fish products (Ex)*	0.49	0.26	0.14	0.14
3	1513	Fruits, vegetables and edible nuts	0.73	0.78	0.23	0.25
4	1514	Vegetable and animal oils and fats	0.85	0.88	0.99	1.00
5	1520	Dairy products	0.72	0.79	0.19	0.37
6	1531	Grain mill products (Ex)	0.71	0.44	0.32	0.37
7	1532	Starches and starch products (Ex)	0.81	0.89	0.46	0.50
8	1533	Animal feeds (Ex)	0.80	0.78	0.46	0.47
9	1541	Bakery products	0.69	0.67	0.17	0.17
10	1542	Sugar	0.79	0.69	0.51	0.79
11	1543	Cocoa, chocolate and sugar confectionery	0.67	0.67	0.19	0.20
12	1549	Other farinaceous products n.e.c.	0.76	0.83	0.67	0.75
13	1551 &	Spirits; ethyl alcohol	0.79	0.84	0.41	0.47
	1553 &	Malt liquors and malt				
	1554	Soft drinks; mineral water				
14	16	Tobacco products	0.89	0.90	1.00	1.00
15	1711	Spinning of textiles (Ex)	0.72	0.71	0.29	1.00
16	1712	Textile fabrics (Ex)	0.72	0.82	0.23	0.96
17	1713	Finishing of textiles (Ex)	0.59	0.63	0.13	0.29
18	1721	Made-up textile articles, not apparel (Ex)	0.69	0.73	0.20	0.23
19	1722	Carpets and rugs (Ex)	0.85	0.91	1.00	1.00
20	1723	Cordage, rope, twine and netting (Ex)	0.80	0.82	0.59	0.65
21	1729	Other textiles n.e.c. (Ex)	0.74	0.69	0.35	0.35
22	1730	Knitted and crocheted fabrics	0.71	0.76	0.22	0.27
23	1810 &	Wearing apparel, except fur apparel	0.70	0.80	0.20	0.57
	1820	Articles of fur (Ex)				
24	1911	Tanning and dressing of leather (Ex)	0.66	0.68	0.19	0.22
25	1912	Luggage, saddlery and harness (Ex)	0.73	0.62	0.27	0.29
26	1920	Footwear (Ex)	0.79	0.83	0.38	0.45
27	2010	Sawmilling and planking of wood	0.74	0.68	0.49	0.51
28	2021	Plywood, panels and boards	0.73	0.77	0.24	0.24
29	2023 &	Wooden containers	0.49	0.65	0.14	1.00
	2029	Other products of wood				
30	2101	Pulp, paper and paperboard	0.81	0.88	0.52	0.60
31	2102	Containers of paper and paperboard	0.75	0.79	0.35	0.35
32	2109	Other articles of paper and paperboard	0.70	0.43	0.27	0.28
33	2211 &	Printing and publication of books etc.	0.70	0.69	0.20	0.21
	2212	Publishing of newspapers and journals				
34	2213 &	Publishing of music	0.77	0.81	0.62	0.68
	2219	Other publishing				

Continued—

Appendix—(*Continued*)

35	2221	Printing	0.81	0.76	0.94	0.99
36	2222	Service activities of printing	0.73	0.70	0.28	0.31
37	232	Refined petroleum products (Ex)	0.86	0.87	1.00	1.00
38	2411	Basic chemicals	0.74	0.81	0.27	0.28
39	2412	Fertilisers and Nitrogen compounds	0.80	0.51	0.79	0.95
40	2413	Plastics and synthetic rubber (Ex)	0.80	0.84	0.48	0.48
41	2421	Pesticides and agrochemical products	0.65	0.62	0.18	0.19
42	2422	Paints, varnishes, printing ink	0.78	0.74	0.54	0.55
43	2423	Pharmaceuticals	0.74	0.76	0.24	0.63
44	2424	Soaps and detergents	0.75	0.76	0.28	0.30
45	2429 &	Other chemical products	0.66	0.64	0.17	0.30
	2430	Man-made fibres (Ex)				
46	2511	Rubber tyres and tubes; retreading	0.79	0.84	0.35	0.36
47	2519	Other rubber products	0.71	0.70	0.23	0.25
48	2520	Plastic products	0.75	0.76	0.34	0.36
49	2610	Glass and glass products	0.69	0.68	0.22	0.25
50	2691	Non-refractory ceramic ware	0.70	0.78	0.30	0.30
51	2692	Refractory ceramic products	0.13	0.11	0.03	0.03
52	2693	Structural clay and ceramic products	0.75	0.73	0.30	0.33
53	2694	Cement, lime and plaster	0.84	0.86	1.00	1.00
54	2695	Articles of concrete, cement and plaster	0.70	0.72	0.24	0.25
55	2696	Cutting, shaping and finishing of stone	0.84	0.89	0.79	0.79
56	2699	Other non-metallic mineral products	0.64	0.72	0.17	0.18
57	2711	Basic iron and steel	0.84	0.82	1.00	1.00
58	2712	Tubes and tube fittings	0.77	0.75	0.39	0.41
59	2713	Other first processed iron and steel	0.77	0.59	0.41	0.47
60	2721 &	Basic precious metals	0.64	0.60	0.16	0.19
	2722	Aluminium and its products				
61	2724	Copper products	0.83	0.73	0.87	0.88
62	2731	Casting of iron and steel	0.70	0.73	0.23	0.23
63	2811	Structural metal products	0.79	0.72	0.51	0.56
64	2812	Tanks and containers	0.72	0.78	0.25	0.25
65	2892 &	Treating and coating of metals	0.79	0.84	0.37	0.38
	2893	Cutlery and general hardware				
66	2899	Other fabricated metal products n.e.c	0.81	0.86	0.54	0.63
67	2911	Engines and turbines	0.78	0.83	0.46	0.60
68	2912	Pumps, compressors, taps and valves	0.71	0.69	0.23	0.28
69	2913	Driving elements	0.73	0.72	0.26	0.27
70	2914	Ovens, furnaces and furnace burners	0.86	0.81	1.00	1.00
71	2915 &	Lifting and handling equipment	0.80	0.82	0.49	0.58
	2919	Other general-purpose machinery				
72	2921	Agricultural and forestry machinery	0.76	0.79	0.46	0.50
73	2922	Manufacture of machine tools	0.87	0.79	1.00	1.00
74	2923 &	Machinery for metallurgy	0.77	0.80	0.40	0.42
	2924	Mining and quarrying machinery				
75	2925	Machinery for food and tobacco processing	0.81	0.84	0.54	0.62
76	2926	Textile and leather production machinery	0.83	0.86	0.66	0.69
77	2927	Weapons and ammunition	0.72	0.82	0.27	0.27
78	2929	Other special-purpose machinery	0.67	0.67	0.29	0.30
79	2930	Electric domestic appliances	0.75	0.79	0.27	0.30
80	3110	DC motors, generators and transformers	0.71	0.76	0.21	0.23
81	3120	Electricity distri. and control apparatus	0.54	0.19	0.15	0.16
82	3130	Insulated wire and cables	0.85	0.82	1.00	1.00
83	3140	Accumulators, cells and batteries	0.72	0.64	0.22	0.33

Continued—

Appendix—(*Continued*)

84	3150	Electric lamps and lighting equipment	0.65	0.65	0.14	0.16
85	3190	Other electrical equipment n.e.c.	0.65	0.68	0.16	0.17
86	321	Electronic valves and tubes etc.	0.68	0.67	0.22	0.23
87	322	TV, radio and telegraphy apparatus	0.84	0.88	0.83	0.97
88	323	Sound/video apparatus of TV and radio	0.87	0.90	1.00	1.00
89	3311	Medical/surgical/orthopaedic equipment (Ex)	0.73	0.73	0.25	0.28
90	3312	Measuring instruments and appliances	0.82	0.82	0.56	0.68
91	332 & 333	Watches and clocks	0.49	0.75	0.14	0.15
92	3410	Motor vehicles	0.83	0.78	0.50	0.81
93	3420	Bodies for motor vehicles and trailers	0.83	0.84	0.70	0.76
94	3430	Parts and accessories for motor vehicles	0.77	0.78	0.38	0.43
95	3511 &	Building and repair of ships and boats	0.80	0.76	0.51	0.54
	3520 &	Railway locomotives and rolling stock				
	3530	Aircraft and spacecraft				
96	3591	Motorcycles	0.72	0.59	0.24	0.25
97	3592	Bicycles and invalid carriages	0.82	0.82	0.63	0.76
98	3610	Furniture	0.76	0.83	0.42	0.44
99	3691 &	Jewellery and related articles	0.63	0.83	0.20	1.00
	3692	Musical instruments				
100	3693 &	Sports goods	0.77	0.80	0.36	0.39
	3694	Games and toys (Ex)				
101	3699	Other manufacturing n.e.c	0.71	0.71	0.23	0.27
102	37	RECYCLING	0.87	0.75	1.00	1.00
		Mean Efficiency Scores	**0.7412**	**0.7401**	**0.4300**	**0.5050**

* (Ex) indicates an exporting industries.

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Re-estimation of Keynesian Model by Considering Critical Events and Multiple Cointegrating Vectors

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This study employs the Mundell (1963) and Fleming (1962) traditional flow model of exchange rate to examine the long run behaviour of rupee/US $ exchange rate for Pakistan economy over the period 1982:Q1 to 2010:Q2. This study investigates the effect of output levels, interest rates and prices and different shocks on exchange rate. Hylleberg, Engle, Granger, and Yoo (HEGY) (1990) unit root test confirms the presence of non-seasonal unit root and finds no evidence of biannual and annual frequency unit root in the level of series. Johansen and Juselious (1988, 1992) likelihood ratio test indicates three long-run cointegrating vectors. Cointegrating vectors are uniquely identified by imposing structural economic restrictions on purchasing power parity (PPP), uncovered interest parity (UIP) and current account balance. Finally, the short-run dynamic error correction model is estimated on the basis of identified cointegrated vectors. The speed of adjustment coefficient indicates that 17 percent of divergence from long-run equilibrium exchange rate path is being corrected in each quarter. US war with Afghanistan has significant impact on rupee in short run because of high inflows of US aid to Pakistan after 9/11. Finally, the parsimonious short run dynamic error correction model is able to beat the naïve random walk model at out of sample forecasting horizons.

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1. INTRODUCTION

Stability of exchange rate is crucial for economic development. It provides the macroeconomic links among the countries via goods and asserts market [Moosa and Bhatti (2009)]. In literature different approaches have been developed to analyse the behaviour of exchange rate. Among them, purchasing power parity (PPP) is the earliest approach for exchange rate determination, introduced by Swedish economist Gustav Cassel in 1920s. Empirical evidence of PPP theory has been rather mixed, In case of Pakistan, for example, Chisti and Hasan (1993) do not support PPP model to explain the exchange rate variations. Bhatti and Moosa (1994) argued that the failure of PPP under flexible exchange rate is due to the negligence of expectations in exchange rate determination. Bhatti (1997) investigated and proved the ex-ante version of PPP, in

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which exchange rate is explained not only by current relative prices but also by the expected real exchange rate. Moreover, Bhatti (1996), Qayyum, *et al.* (2004) and Khan and Qayyum's (2008) results do support the validity of relative form of PPP in Pakistan.

PPP theory is based on the concept of good arbitrage and ignores the importance of capital movements in exchange rate determination. To fill this gap Keynesian approach of exchange rate determination is initiated by introducing the capital flows into current account balance of payment approach [Mundell (1962) and Fleming (1962)]. The empirical validity of this structural model is tested by Bhatti (2001) for determining Pak rupee exchange rates against six industrial countries' currencies. He suggested that nominal exchange rate of Pakistan is determined by relative price level, relative income level and interest rates differentials. The relative version of exchange rate model assumes symmetry in the coefficients of domestic and foreign coefficients. However, no former information is available to assume this symmetry. Moreover, relative version of exchange rate models is unable to find the multiple cointegrating vectors. Multiple cointegrating vectors contain valuable information and should be carefully interpreted [Dibooglu and Enders (1995)]. In international literature a lots of studies are available that established and uniquely identified the multiple cointegrating vectors [see for example, Juselius (1995); Dibooglu and Enders (1995); Helg and Serati (1996); Diamandis, *et al.* (1998); Cushman (2007); Tweneboah (2009) among others]. This study, therefore, considesr the non-relative version of Keynesian exchange rate and test the symmetry among the domestic and foreign price level, output level and the interest rate. Keynesian model also incorporates the uncovered interest parity (UIP) and purchasing power parity (PPP) conditions. The identification of these parity conditions are also the aim of this paper.

One of the objectives of structural exchange rate models, like Keynesian flow model, is to explain the exchange rate variations and provide better forecast. In this regard, literature on exchange rate forecasting is divided into two categories. One which emphasises the importance of economic theory for exchange rate prediction and recommends a theory based on plausible channel to stabilise it [see, Khalid (2007); Abbas, *et al.* (2011)]. Similarly, Cushman (2007) empirically tested the out of sample forecasting performance of dynamic portfolio balance model of exchange rate with benchmark random walk by adopting Mark (1995) technique. On the basis of Root Mean Square Error (RMSE) and Diebold-Mariano (DM) test he suggested that structural model outperforms the random walk models at longer horizons. Likewise, MacDonald (1997), Hwang (2001), Korap (2008), and Anaraki (2007) have used multilateral cointegration technique and presented the superiority of fundamental models over random walk models. Cheung, *et al.* (2002) documented that the better performance of structural models are credited to the dynamic error correction model with stochastically varying coefficients and recursively updating the long run cointegrating vectors. On the other hand the promoters of random walk model argued that exchange rate is a random walk phenomenon. It efficiently analyses the exchange rate fluctuations and provides better future forecast such as Rashid (2006) and Malik (2011). According to these studies there is no need to worry about the macroeconomic variables of exchange rate determination. Meese and Rogoff (1983) and Najand and Bond (2000) suggested that the poor performance of structural models is characterised by unstable parameters. The stability of parameters is usually disturbed by the existence of outlier in the series. Therefore, it is

necessary to control the outliers in order to get better forecast [Balke and Famby (1994) and Dijk, *et al.* (1999)]. Therefore, to judge the out of sample forecasting performance of the dynamic error correction model of Keynesian model as compared to naïve random walk model is the other objective of this paper.

Brief overview of exchange rate systems confirms that currencies under flexible exchange rate system generally tend to depreciate more than currencies having fixed exchange rate system due to the occurrence of critical events [Ltaifa, *et al.* (2009)]. Pakistan had adopted a flexible exchange rate system since 2000 and its currency is freely floating against US dollar. Therefore, any shocks in US economy directly hit the Pakistan rupee. After 2001, nominal exchange rate of Pakistan is highly volatile, though, the other economic fundamentals remain the same. Its instability is attached to the happening of critical events during this era. 9/11 event and US war against terror in Afghanistan had appreciated the rupee against US dollar. This appreciation was driven by high inflows of remittances and foreign capital inflows into Pakistan. The trend of the appreciation of rupee was reversed into depreciation when Global Financial Crisis (GFC) occurred in 2007. In the period of GFC the foreign exchange reserves declined from $14.2 billion in 2007 to $3.4 billion in 2008. Pakistan rupee against US dollar lost its value by 21 percent during 2008. So far no study is available to test the significance of these critical events on the exchange rate in the framework of Keynesian model. This paper fills this gap by examining the effect of critical events on the exchange rate of Pakistan in terms of intervention dummies.

The rest of the study is organised as follows: Section 2 presents the theoretical framework of Keynesian model. Section 3 deals with the econometric methodology. Data and construction of variables is subject of Section 4. Section 5 describes the empirical results and Section 6 reports the out of sample forecasts. Section 7 concludes the study and identifies some policy implications.

2. THEORETICAL FRAMEWORK

The traditional Keynesian approach is developed by Mundell (1962) and Fleming (1962). They extended the Keynesian IS–LM framework to an open economy by incorporating the capital flows via balance of payments.

The objective of this section is to derive the reduced form equation of the equilibrium exchange rate under the Keynesian approach. In the literature a number of studies, for example Gylfason and Helliwell (1983), Pearce (1983), Bhatti (2001) and Moosa and Bhatti (2009), have derived the Keynesian equilibrium exchange rate model by utilising BOP Equation (1)

$$\Delta f = CA\left(\frac{SP^f}{P}, Y^f, Y\right) + K\left(i, i^f\right) \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$\overset{(+)}{\frac{SP^f}{P}}$, $\overset{(+)}{Y^f}$, $\overset{(-)}{Y}$, $\overset{(+)}{i}$, $\overset{(-)}{i^f}$

Equation (1) defines the balance of payments. Δf denotes the change in foreign reserves which equals zero under the flexible exchange rates. Current account (CA) is positively related to real exchange rate ($\frac{SP^f}{P}$), where S denotes nominal exchange rate measured by domestic currency per unit of foreign currency, P represents domestic prices and P^f the

foreign price level. An increase in foreign output (Y^f) and depreciation of domestic currency has favourable effect on the balance of trade (BOT) by enhancing the demand for domestic exports. However, it deteriorates due to an increase in domestic output level (Y). The traditional flow model also assumes that foreign and domestic assets are imperfect substitutes, which implies that interest rate differentials may causes finite capital flows into or out of a country. Thus, the net capital inflow (K) is a positive function of domestic interest rate (i) and negative function of foreign interest rate (i^f). To derive the fundamental equation of exchange rate, the BOP, Equation (1) can be written as:

$$BOP = a(\frac{SP^f}{P}) + b^f Y^f - bY + ci - c^f i^f \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

All variables of Equation (2) except interest rate are in logarithm form and denoted it by small letters. For simplicity a restriction $b^f = b$ and $c = c^f$ is imposed. The equilibrium exchange rate is determined when BOP is in equilibrium i.e. the net of current and capital account is zero and solving for nominal exchange rate 's', we have

$$s = (p - p^f) + \frac{b}{a}(y - y^f) - \frac{c}{a}(i - i^f) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

which explains that the equilibrium exchange rate is positively related to relative prices and relative incomes, but inversely related to relative interest rates. In general form, the above Equation (3) is written as:

$$s = f(\overset{+}{p}, \overset{-}{p^f}, \overset{+}{y}, \overset{-}{y^f}, \overset{-}{i}, \overset{+}{i^f}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

MacDonald (1995) defined the theory of long-run exchange rate modeling by relating the concepts of uncovered interest rate parity, absolute and efficient markets PPP to a standard balance of payments equilibrium condition. In order to link the absolute PPP with the current account balance he asserted that under a long-run net capital flows were zero when savings were at their desired level. This specification reduces the BOP account to current account balances. Thus we can write the Equation (3) as:

$$s = (p - p^f) + \frac{b}{a}(y - y^f) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

The current account balance approaches to PPP only when the difference between domestic and foreign income level i.e. $(y - y^f)$ tends to be zero. This would be possible if the price elasticity of domestic exports is infinitely large ($a \rightarrow \infty$) [MacDonald (1995) and Moosa and Bhatti (2009)], in this case the exchange rate is exclusively determined by the PPP that is:

$$s = (p - p^f) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

On the other hand, the non-zero value of $(y - y^f)$ is likely to be most important when comparing countries at different stages of development, but less important for countries at a similar level of development. Allowing a constant in Equation (6) would represent a permanent deviation from absolute PPP due to productivity differentials and other factors [MacDonald (1995) and Taylor and Taylor (2004)].

The efficient market view of PPP suggests that in a world of high or perfect capital mobility it is not goods arbitrage that matters for the relationship between an exchange rate and relative prices, but interest rate arbitrage. Hence, a slow speed goods market arbitrage causes a temporary deviation of the exchange rate from PPP. This requires that the exchange rate drifts in such a manner as to restore the relative PPP. Algebraically these deviations can be expressed as:

$$\Delta s = p - p^f - s \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

A perfectly mobile capital immediately diverts the attention to focus on the capital account of the balance of payments. The assumption of perfect capital mobility may be represented as:

$$\Delta s^e = i - i^f \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

Equation (8) represents the uncovered interest parity condition. This condition defines that the difference between the domestic interest rate (i) and foreign interest rate (i^f) produces an expected depreciation of the exchange rate. Frenkel (1978) and Juselius (1995) among others, argued that the fluctuations in exchange rate are attributed by both goods and assets market development. Therefore, PPP and UIP conditions may not be independent of each other in the long run. This allows us to substitute Equation (8) into Equation (7) to combine PPP with UIP and model the nominal exchange rate as:

$$s = p - p^f - i + i^f \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

The above discussion makes it clear that it is not worthwhile to empirically analyse the short run relationship between exchange rate, domestic and foreign price level, interest rate and output and ignore their long run associations (defined in Equations (5) to (9)). Hence, long run relationship(s) would be combined with the short run dynamics of exchange rate by employing the vector error correction mechanism.

3. EMPIRICAL METHODOLOGY

3.1. Unit Root Test

Cointegration analysis is based on the assumption that variables are integrated of same order. Pre-testing for unit root is necessary to avoid the problem of spurious regression. Hylleberg, Engle, Granger, and Yoo (HEGY) (1990) is used to test for non-seasonal zero frequency unit root and biannual and annual frequency seasonal unit roots in quarterly data.

HEGY provide following auxiliary regression equation:

$$\Delta_4 y_t = \mu_t + \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-1} + \pi_4 y_{3,t-2} + \sum_{i=1}^{l} \gamma_i \Delta_4 y_{t-i} + \varepsilon_t \quad \ldots \quad (10)$$

Where μ_t is a deterministic term which can include any combination of a drift term, trend term and a set of seasonal dummies. $y_{1,t}$, $y_{2,t}$, $y_{3,t}$, and $y_{4,t}$ are linearly transformed series as proposed by HEGY i.e., $y_{1,t} = (1 + B)(1 + B^2)\, y_t$, $y_{2,t} = -(1 - B)(1 + B^2)\, y_t$, $y_{3,t} = -(1 - B)(1 + B)\, y_t$, and $y_{4,t} = (1 - B^4)\, y_t$, where B is a lag operator such that $B^k\, y_t = y_{t-k}$. $\varepsilon_t \sim (0, \sigma_e^2)$ is

Gaussian error term and white noise $Cov(\varepsilon_t, \varepsilon_{t-i}) = 0$. The auxiliary regression (10), comes from the fact that $\Delta_4 = (1-B^4)$ can be decomposed as $(1-B)\times(1+B)\times(1-iB)(1+iB)$ where each term in bracket corresponds to non-seasonal zero frequency unit root 1, biannual frequency unit root –1 and annual frequency unit root $\pm i$.

HEGY method tests the significance of π_j (j=1,2,3,4) parameters. If $\pi_1 = 0$ is statistically significant then series contain non-seasonal zero frequency unit root. If $\pi_2 = 0$ is accepted this implies the presence of biannual frequency seasonal unit root. If $\pi_3 = \pi_4 = 0$, then series has seasonal unit root at annual frequency. The appropriate filter corresponding to the acceptance of each null hypothesis are (1–B), (1+B) and (1+B^2) required to make the series stationary. Critical values for one sided t-test for π_1 (t_{π_1}), π_2 (t_{π_2}) and for the joint F-test for π_3 and $\pi_4 (F_{34})$ are provided by HEGY.

3.2. Johansen and Juselius Cointegration Methodology

Johansen and Juselius (1990) cointegration technique is useful to construct a multiple long-run equilibrium relationships over multivariate system. Generally, this technique is applied to $I(1)$ variables. Johansen's method in k dimensional error correction (EC) form is presented as follows:

$$\Delta z_t = \sum_{i=1}^{l-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-1} + \phi D_t + \mu + \varepsilon_t \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

Where z_t is $(k\times1)$ is dimensional vector of $I(1)$ variables, D_t consists of centered seasonal dummies, intervention and policy dummies such that all are $I(0)$, μ is deterministic trend component, which consist of different combinations of constant and trend terms in the long-run cointegrating equation and short-run vector auto regressive (VAR) model, $\varepsilon_t^{ii} \sim N(0, \Sigma)$ is $(k\times1)$ vector of Gaussian random error terms and Σ is ($k \times k$) variance covariance matrix of error terms. (i = 1,2,……., l – 1) is the lag length. $\Gamma_I = -(I - A_1 - \ldots\ldots - A_i)$ is short-run dynamic coefficients. $\Pi = -(I - A_1 - \ldots\ldots - A_l)$ is $(k\times k)$ matrix containing long-run information regarding equilibrium cointegration vectors.

The number of cointegrating vectors (r) are determined by rank of Π matrix. If $0 < rank(\Pi) < k-1$ then it is further decomposed into two matrices i.e. $\Pi = \alpha\beta'$: α is a $(k\times r)$ matrix containing error correction coefficients, which measure the speed of adjustment to disequilibrium. β' is ($r \times k$) matrix of $r(\Pi)$ cointegrating vectors. The rank of Π matrix is measured by likelihood ratio trace and maximum eigenvalue statistics. In case of multiple cointegrating vectors Johansen and Juselius (1990) allow the imposition of linear economic restrictions on β matrix to obtain long-run structural relationships.

3.3. Short-Run Dynamic Error Correction Model

According to Granger (1983) Representation Theorem, if there is long-run stable relationship among the variables then there will be a short-run error correction relationship related with it. Short-run vector error correction representation is as follows:

$$\Delta z_t = \sum_{i=1}^{l-1} \Gamma_i \Delta z_{t-i} + \alpha(\beta' z_{t-1}) + \phi D_t + \mu + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (12)$$

$\beta' z_{t-1}$ is the error correction term. The traditional methodology uses the residuals from the identified cointegrating vector(s) to form $\beta' z_{t-1}$. α in dynamic error correction model measures the speed of adjustment toward equilibrium state. Theoretically speed of adjustment coefficient must be negative and significant to confirm that long-run relationship can be attained.

4. DATA AND CONSTRUCTION OF VARIABLES

This study considers quarterly data from 1982:Q1 to 2010:Q2. A start from 1982 is on account of implementation of flexible exchange rate policy in Pakistan. All variables are measured in the currency units of each country. The data are obtained from *International Financial Statistics* (IFS) and State Bank of Pakistan (SBP) *Monthly Statistical Bulletin* (Various Issues).

The nominal exchange rate is measured in terms of Pakistan rupee (PKR) per unit of US dollar (US $). Real Gross domestic product (GDP) is commonly used as a measure of real output level. Quarter wise real GDP of US is accessible from IFS. In case of Pakistan only annual real GDP is available. Quarterisation of annual real GDP is done by using the methodology of Kemal and Arby (2004). Consumer price index (2000=100) is used as a proxy of domestic and foreign price level. Call money rate for Pakistan and federal fund rate for US are used as a measures of interest rates. During the analysis period exchange rate of Pakistan is also influenced by the critical events such as 1998 Pakistan's nuclear test, 9/11 event, US war against terror in Afghanistan after 9/11, 2005 stock market crash and recent global financial crisis (2007). Dummy variables D_{98} (0 for t < 1998: Q2 and 1 for t 1998: Q2), D_{911} (1 for t = 2001:Q3 and 0 otherwise), D_{afgwar} (0 for t < 2001:Q4 and 1 otherwise), D_{SMC} (1 for t = 2005: Q1 and 0 otherwise) and D_{fc} (0 for t < 2007:Q1 and 0 otherwise) are used to capture the influence of these events on the exchange rate.

5. RESULTS AND DISCUSSION

This section implements the Johansen and Juselius (1988, 1992) multivariate cointegration methodology to detect the stable long run relationships between the exchange rate and fundamental variables. The preliminary time series properties for cointegration analysis are as follows:

5.1. Order of Integration (Unit Root Test)

The presence of seasonal and non-seasonal unit roots for each quarterly series is determined via HEGY (1990) test. All variables are transformed in logarithmic form except the interest rate. The results of the HEGY test are presented in Table 1. It can be observed that the null hypothesis of a non-seasonal unit root cannot be rejected whereas the null hypothesis of seasonal unit root at both biannual and annual frequency are rejected at 5 percent critical values for all of the variables. (1-B) is an appropriate filter to make the series stationary. The results of HEGY test after applying required filter are

presented in Table 2 and we found no evidence of seasonal and non-seasonal unit roots at 5 percent level of significance. Therefore, all variables in our cointegration analysis are integrated of order one and we may suspect multiple long run cointegrating vectors.

Table 1

HEGY Test at Level of Series

HEGY Regression Model

$$\Delta_4 y_t = \alpha + \beta\ t + \sum_{i=1}^{S-1} \delta_i S_i + \pi_1 y_{1,t-1} + \pi_2 y_{2,t-1} + \pi_3 y_{3,t-1} + \pi_4 y_{3,t-2} + \sum \gamma_i \Delta_4 y_{t-i} + \varepsilon_t$$

					Null & Alternative Hypothesis			
					$\pi_1 = 0$	$\pi_2 = 0$	$\pi_3 = \pi_4 = 0$	
					$\pi_1 < 0$	$\pi_2 < 0$	$\pi_3 \neq \pi_4 \neq 0$	
	Regressors				Test Statistic			
Variable	Lags	Drift	Trend	Seasonal Dummies	π_1	π_2	π_3 , π_4	Roots (Filter)
s	0	Yes	No	No	–0.81	–5.76	55.37	1(1-B)
Y	3	Yes	No	No	–2.10	–8.81	29.61	1(1-B)
y^f	0	Yes	No	No	–3.06	–4.50	101.23	1(1-B)
P	0	Yes	Yes	Yes	–1.69	–8.66	27.92	1(1-B)
p^f	0	Yes	No	No	–2.46	–9.89	20.52	1(1-B)
i	0	No	No	No	–0.23	–4.74	22.96	1(1-B)
i^f	0	Yes	Yes	Yes	–3.14	–8.12	73.87	1(1-B)

Table 2

HEGY Test on Filtered Series

					Null & Alternative Hypothesis			
					$\pi_1 = 0$	$\pi_2 = 0$	$\pi_3 = \pi_4 = 0$	
	Regressors				$\pi_1 < 0$	$\pi_2 < 0$	$\pi_3 \neq \pi_4 \neq 0$	
					Test Statistic			
Variable	Lags	Drift	Trend	Seasonal Dummies	π_1	π_2	π_3 , π_4	Roots
(1-B) *s*	0	Yes	No	No	–4.86	–4.79	26.77	–
(1-B) *y*	2	Yes	No	No	–2.96	–8.45	36.91	–
(1-B) y^f	1	Yes	No	No	–3.69	–4.05	39.85	–
(1-B) *p*	0	Yes	No	No	–3.07	–6.77	15.54	–
(1-B) p^f	0	Yes	No	No	–4.34	–6.64	19.13	–
(1-B) *i*	0	No	No	No	–6.20	–3.72	13.27	–
(1-B) i^f	0	Yes	No	Yes	–4.94	–6.31	51.09	–

5.2. Unrestricted VAR Model Specification

The next step after implementing the unit root test is to decide the optimal lag length of the multivariate system of equations, which ensures that residuals of VAR model are white noise. We have used Johansen (1995) multivariate LM test and 3 quarters have been selected as appropriate lag structure of the model. Three central seasonal dummies and four intervention dummies D_{98}, D_{911}, D_{afgwar}, D_{fc} are also included. The residual of the VAR(3) passed the diagnostic test of no serial correlation ($\chi^2_{(49)}$= 52.31with four lags), no heterosedasticity ($\chi^2_{(1372)}$= 1355.36) at 5 percent level of significance, but fail to pass the null hypothesis of normally distributed error terms under Jarque-Bera (JB) test ($\chi^2_{(14)}$= 73.24). However, lack of normality does not affect the

results of Johansen (1988) likelihood ratio tests [Gonzalo (1994); Paruolo (1997); Cheung and Lai (1993); Eitrheim (1992) and Goldberg and Frydman (2001)].

5.3. Multivariate Cointegration Analysis

After selecting the lag length of VAR model, another fundamental issue is the suitable treatment of deterministic components such as drift and trend terms in the cointegrating and the VAR part of the VECM. Most of the series in our analysis exhibit a linear trend in the level of the series. Therefore, we introduce intercept term unrestrictedly both in long run (cointegrating part) and short run (VAR) model while performing cointegration analysis [Johansen (1995); Harris, *et al.* (2003) and Qayyum (2005)]. Table 3 presents the trace and maximum eigenvalue statistic after adjusting by factor (T-kl)/T to correct the small sample bias.

Table 3

Cointegration Test Results

Null Hypothesis	Alternative Hypothesis	Chi-Square	0.05 Critical Value
Trace Statistic			
r = 0	r > 0	155.05[a]	125.62
r ≤ 1	r > 1	104.24[a]	95.75
r ≤ 2	r > 2	71.43[a]	69.82
r ≤ 3	r > 3	40.78	47.86
r ≤ 4	r > 4	20.94	29.80
r ≤ 5	r > 5	5.77	15.49
r ≤ 6	r > 6	0.29	3.84
Maximum Eigenvalue Statistic			
r = 0	r = 1	50.81a	46.23
r = 1	r = 2	32.81	40.08
r = 2	r = 3	30.65	33.88
r = 3	r = 4	19.85	27.58
r = 4	r = 5	15.16	21.13
r = 5	r = 6	5.49	14.26
r = 6	r = 7	0.29	3.84

Note: "a" Indicates the rejection of null hypothesis at the 5 percent level.

The trace test shows that the null hypothesis of no cointegration (r=0), one cointegration (r ≤ 1) and two cointegrating vectors (r ≤ 2) can be rejected, but fails to reject the null of three cointegrating vectors at 5 percent level of significance. Therefore, variables of Keynesian exchange rate model are found to be cointegrated with three cointegrating vectors. Whereas, the maximum eigenvalue statistic with the null hypothesis r=1 is rejected, but the null hypothesis of r=2 is not rejected and refers to one long run relationship among the variables.[1] This contradiction among the tests for cointegrating vector is common. We continue our analysis on the basis of trace test, as it

[1]Before adjusting trace test reports four while maximum eigenvalue test indicates three cointegrating equations at 5 percent level of significance (results are not presented here).

is a more powerful test as compared to maximum eigenvalue statistics in case of not normally distributed error terms [Cheung and Lai (1993); Hubrich, *et al.* (2001)]. Kasa (1992) and Serletis and King (1997) also preferred trace statistics as it considers all k-r (k is no. of variables in the system and r is the cointegrating vectors) values of smallest eigenvalues.

The first three cointegrating vectors with the maximum eigenvalue have been normalised on log of nominal exchange rate to determine the sign and magnitude of the long-run elasticities in Keynesian exchange rate model Equation (4). The results of normalised vectors are presented in Equation (13);

$$s_t = 270.69 + 1.06 p_t + 20.77 p_t^f + 4.73 y_t - 26.89 y_t^f - 0.40 i_t + 0.55 i_t^f$$
$$s_t = -279.51 + 1.01 p_t - 23.67 p_t^f - 3.84 y_t + 27.39 y_t^f + 0.53 i_t - 0.73 i_t^f$$
$$s_t = -97.67 + 1.16 p_t - 1.32 p_t^f - 9.62 y_t + 14.68 y_t^f - 0.06 i_t - 0.04 i_t^f \quad \ldots \quad (13)$$

Result shows that the sign of all variables except the foreign price level are consistent with Keynesian theory in first cointegrating vector. In second cointegrating vector the signs of domestic and foreign price level, while, in the third vector the signs of domestic price level, foreign price level and domestic interest rate support the theory. The contradiction of results among the vectors arises due to arbitrary normalisation. It restricts to draw a meaningful conclusion.

As described earlier that multiple cointegrating vectors contain valuable information and must be identified properly and carefully interpreted. To obtain this information we start by imposing proportionality and symmetry restrictions on all vectors in proceeding section.

5.4. Proportionality and Symmetry Restrictions

Before the identification of cointegrating vectors, we proceed to test the proportionality and symmetry restrictions of prices, interest rates and output through likelihood ratio test on all cointegrating vectors. The acceptance of these restrictions provides the validity of strict form PPP and UIP. The likelihood ratio (LR) test statistics along with their probability values for the proportionality and symmetry restrictions are reported in Table 4.

First part of Table 4, reports the results of symmetry restrictions on prices, output and interest rates on all three cointegrating vectors in order to find whether they enter in the equilibrium relation or not. The symmetry restriction implies that prices, output and interest rates influence the exchange rate regardless of where they originate. According to LR test statistics, symmetry restrictions hold for prices and output. Under H_3, we found no evidence of interest rate symmetry. The joint symmetry restrictions implied by H_4 through H_7 are mostly rejected at 95 percent level of significance.

Further, the proportionality restriction (H_8) holds for prices but not for output and interest rate in all three cointegrating vectors. Symmetry and proportionality of prices is opposite to the finding of Khan and Qayyum (2008). The basic reason for this contradiction is the absence of other fundamental variables such as output levels and interest rate in their analysis. In our analysis we can predict the long run strong form PPP in the presence of other fundamental variables.

Table 4

Restricted Cointegrating Vectors

$$s_t = \alpha_0 + \alpha_1 p_t + \alpha_2 p_t^* + \alpha_3 y_t + \alpha_4 y_t^* + \alpha_5 i_t + \alpha_6 i_t^* + u_{1t}$$

Hypothesis	Restrictions		χ^2 (df)	P- Value
Symmetry Restrictions				
Price Symmetry	H_1:	$\alpha_1 = -\alpha_2$	9.33(3)[a]	0.03
Output Symmetry	H_2:	$\alpha_3 = -\alpha_4$	7.13(3)[aa]	0.08
Interest Rate Symmetry	H_3:	$\alpha_5 = -\alpha_6$	16.41(3)	0.00
Price and Output Symmetry	H_4:	$H_1 \cap H_2$	15.73(6)[a]	0.02
Price and Interest Rate Symmetry	H_5:	$H_1 \cap H_3$	23.24(6)	0.00
Output and Interest Rate Symmetry	H_6:	$H_2 \cap H_3$	23.00(6)	0.00
Joint Symmetry of Prices, Interest Rate and Output	H_7:	$H_1 \cap H_2 \cap H_3$	25.92(9)	0.00
Proportionality Restrictions				
	H_8:	$\alpha_1 = -\alpha_2 = 1$	14.80(6)[a]	0.02
	H_9:	$\alpha_3 = -\alpha_4 = 1$	32.85(6)	0.00
	H_{10}:	$\alpha_5 = -\alpha_6 = 1$	32.85(6)	0.00

Note: [a],[aa], and[aaa] indicate the significance at 1 percent, 5 percent and 10 percent.

5.5. Identification of Cointegrating Vectors

In Table 5, we proceed by imposing the theoretical restrictions on PPP, UIP and their combinations. First part of Table 5 reports individual parity conditions. Under H_{11}, strict version of PPP is tested in all cointegrating vectors. The LR test statistics for this hypothesis yields to accept the strong form of PPP with other fundamental variables at 10 percent level of significance. Similarly strong PPP form with unrestricted output coefficients (H_{24}) and with unrestricted interest rate coefficients (H_{22}) are also accepted at 5 percent level of significance.

H_{12} analysed the strict form of PPP in the first cointegrating vector. This was done by executing unity restriction on exchange rate and prices and zero restriction on output and exchange rates coefficients in the first cointegrating vector. This hypothesis is rejected by LR test. This result suggests that strong form of PPP does not hold on its own.

Weak form of PPP is investigated under H_{13} and H_{14}, both of these hypothesis are rejected by LR test.

The rejection of both strict and weak forms of PPP on its own (in the absence of other fundamental variables) is consistent with Khan and Qayyum (2008), Helg and Serati (1996), Dibooglu and Enders (1995) and Macdonald (1993). Last two authors argued that this is due to the different ways of finding national indices, which result into the non proportionality of price adjustments. According to Helg and Serati (1996), standard PPP does not hold on its own during the period of flexible exchange rate. Khan and Qayyum (2008) argue that rejection of strong form of PPP is due to the significance of transportation and transaction cost.

Table 5

Identification of Cointegrating Vectors

Some Theoretical Restrictions				
Hypothesis		*Restricted CI vectors* $s\ p\ p^f\ y\ y^f\ i\ i^f$	χ^2 (df)	P- Value
Individual Parity Conditions				
PPP in all Three Vectors	H_{11}:	1 -1 1 * * * *	14.80(6)[a]	0.02
(Strict PPP with other		1 -1 1 * * * *		
Fundamental Variables)		1 -1 1 * * * *		
PPP in One Vector	H_{12}:	1 -1 1 0 0 0 0	15.98(4)	0.003
(Strict PPP on its Own)		* * * * * * *		
		* * * * * * *		
Weak PPP in all Three Vectors	H_{13}:	1 ** 0 0 0 0	52.83(12)	0.00
		1 ** 0 0 0 0		
		1 ** 0 0 0 0		
Weak PPP in One Vector	H_{14}:	1 ** 0 0 0 0	16.44(2)	0.00
(PPP on its Own)		* * * * * * *		
		* * * * * * *		
UIP in all Three Vectors	H_{15}:	1 * * * * 1 -1	32.85(6)	0.00
(Strict UIP with other		1 * * * * 1 -1		
Fundamental Variables)		1 * * * * 1 -1		
UIP in One Vector	H_{16}:	1 0 0 0 0 1 -1	2.06(4)[aaa]	0.73
(Strict UIP on its Own)		* * * * * * *		
		* * * * * * *		
Weak UIP in all Three Vectors	H_{17}:	1 0 0 0 0 * *	70.84(12)	0.00
		1 0 0 0 0 * *		
		1 0 0 0 0 * *		
Weak UIP in One Vector	H_{18}:	1 0 0 0 0 * *	0.58(2)[aaa]	0.75
(UIP on its Own)		* * * * * * *		
		* * * * * * *		
Combined Parity Conditions				
PPP and UIP	H_{19}:	1 -1 1 0 0 1 -1	1.48(4)[aaa]	0.83
(Strict PPP and Strict UIP)		* * * * * * *		
		* * * * * * *		
PPP and UIP	H_{20}:	1 * * 0 0 1 -1	60.95(12)	0.00
(Weak PPP and Strict UIP)		1 * * 0 0 1 -1		
		1 * * 0 0 1 -1		
PPP and UIP	H_{21}:	1 * * 0 0 1 -1	0.73(2)[aaa]	0.69
(Weak PPP and Strict UIP)		* * * * * * *		
		* * * * * * *		
PPP, i, i*	H_{22}:	1 -1 1 0 0 * *	0.42(2)[aaa]	0.82
(Strict PPP and Weak UIP)		* * * * * * *		
		* * * * * * *		
Weak PPP and Weak UIP	H_{23}:	1 * * 0 0 * *	26.35(6)	0.00
		1 * * 0 0 * *		
		1 * * 0 0 * *		
Other Restrictions				
PPP, y, y*	H_{24}:	1 -1 1 * * 0 0	1.72(2)[aaa]	0.22
		* * * * * * *		
		* * * * * * *		
Relationship between s,y,y*	H_{26}:	1 0 0 * * 0 0	4.30(2)[aaa]	0.12
		* * * * * * *		
		* * * * * * *		
PPP,UIP and Output Symmetry	H_{27}:	1 -1 1 -1 1 1 -1	0.38(4)[aaa]	0.85
		* * * * * * *		
		* * * * * * *		

Note: * In column three represents no restriction.

[a], [aa], and [aaa] in column four indicate the significance at 1 percent, 5 percent and 10 percent.

After investigating the different versions of PPP restrictions, we now analyse the UIP condition. First we examine whether strong form of UIP restriction enters in all three cointegrating vectors or not, by formulating H_{15}. This hypothesis is strongly rejected by LR test. However, under H_{16}, we set out that UIP relationship is stationary by itself by imposing unity restriction on interest rate coefficients and zero restriction on prices and output coefficients in first cointegration vector. The LR test result supports that one of the cointegrating vectors contains a stationary relationship between the interest rate variables. This result is consistent with Johanson and Juselius (1992).

Further, the weak form of UIP is tested in all cointegrating vectors by H_{17} and in first cointegrating vectors through H_{18} with zero restriction on the coefficient of prices and output. H_{17} is rejected by the LR test, whereas, the later hypothesis is not rejected by LR test. From the results of various forms of UIP conditions, we can conclude that UIP holds without the fundamental variables in one cointegrating vector only.

Following this, we combined PPP and UIP restrictions by H_{19} through H_{23}. On the basis of LR statistic the strong form of PPP along with strong form of UIP (H_{19}), weak form of PPP with strong form of UIP (H_{21}) and strong form of PPP with weak UIP (H_{22}) enter in the cointegrating vector.

Finally the joint hypothesis of PPP, UIP and output symmetry in one cointegrating vector is not rejected under H_{27}.

The general hypothesis tested through H_1 to $H_{27,}$ are informative to formulate unique vectors in the multiple cointegration space. These results suggest that strong form of PPP with output relationship (H_{24}) is considerable in one vector while the weak form of UIP relationship (H_{18}) is in the second vector and the strict form of PPP and unrestricted interest rate is in the third vector. All cointegrating vectors are normalised on nominal exchange rate. Thus, it would seem plausible to specify the long run cointegrating vector β' matrix as:

$$\beta' = \begin{bmatrix} 1 & -1 & 1 & * & * & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & * & * \\ 1 & -1 & 1 & 0 & 0 & * & * \end{bmatrix}$$

The LR test statistics for these restrictions are $\chi^2_{df=6} = 11.88$ which do not reject this hypothesis. The results of long-run cointegrating vectors are presented as:

$$s_t = p_t - p_t^* + 6.37 y_t - 8.66 y_t^* + 55.06 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (14)$$

$$s_t = 0.65 i_t - 0.76 i_t^* + 2.06 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (15)$$

$$s_t = p_t - p_t^* + 0.19 i_t - 0.24 i_t^* + 3.47 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (16)$$

The results of restricted vectors suggest that exchange rate is determined by both current account balance and net capital inflows. The estimated signs of all variables except the domestic and foreign interest rates are consistent with Keynesian theory. On the basis of cointegrating vectors following results can be made:

Strong form of PPP does not hold on its own but holds with other fundamental variables. This result supports the arguments by Helg and Sarati (1996) and Khan and Qayyum (2008) i.e., the rejection of strong form of PPP on its own is due to the significance of transportation and transaction cost. However, increase in domestic (foreign) price level will lead to depreciation (appreciation) of the domestic currency.

Positive (negative) coefficient of domestic (foreign) output reveals that increase in domestic (foreign) output level results in depreciation (appreciation) of domestic currency via higher demand of imported (exported) commodities. Hence, stronger economic growth of Pakistan tends to cause depreciation in the exchange rate. This is because the growth is led by higher consumer spending, this will cause a rise in imports which could lower the exchange rate.

Positive impact of domestic interest rate on exchange rate suggests that increase in domestic interest rate leads to depreciation of the domestic currency against US dollar. Whereas, increase in foreign interest rate results in the appreciation of domestic currency. The estimated coefficients of both interest rates are not according to the theory, the opposite signs of interest rates were also observed in Bhatti (2001).

5.6. The Short-Run Function for Keynesian Exchange Rate: Dynamic Error Correction Model

This section presents the short-run dynamic error correction model (ECM) of the Keynesian exchange rate model. The residuals of the long run cointegration functions (from Equations 14 to 16) are used as an important determinant of ECM. These residuals are also known as disequilibrium estimates or error correction terms. They measure the divergence from long run equilibrium in period t–1 and provide the speed of adjustment information toward equilibrium.

The ECM is estimated by ordinary least squares (OLS) method. The estimation process considers the Hendray 'general-to-specific' strategy (1992). General model is started by having drift term, three seasonal dummies, intervention dummies (D_{98}, D_{911}, $D_{afgwar,}$ D_{fc}), lag of error correction terms and lag length of eight for each first difference variables (exchange rate, prices, outputs, interest rates). The specific model is achieved by dropping the insignificant lags. The parsimonious ECM model with t-ratios in parentheses is as follows:

$$\begin{array}{lccccccc} \Delta s_t = & -0.22\Delta s_{t-7} & +2.19\Delta p_t^f & +1.19\Delta p_{t-1}^f & +1.61\Delta p_{t-2}^f & -1.16\Delta y_t^f & +0.22\Delta y_{t-1} & -0.42\Delta y_{t-4} \\ & (-2.77) & (4.98) & (2.79) & (3.98) & (-2.89) & (1.67) & (-3.18)^{**} \\ & +0.23\Delta y_{t-7} & -0.01\Delta i_t^f & -0.01\Delta i_{t-7} & -0.03D_{afgwar} & +0.03EC1_{t-1} & +0.07EC2_{t-1} & -0.27EC3_{t-1} \\ & (1.77) & (-2.48) & (-2.50) & (-5.04) & (3.47) & (4.64) & (-5.01) \end{array} \quad (17)$$

$$Adj\ R^2 = 0.40\ \ F_{(13,92)} = 9.93 \text{ prob } (0.000)$$

The residual of parsimonious ECM satisfied the diagnostic tests of Breusch and Godfrey (1981) LM test of no serial correlation ($\chi^2_{(4)} = 4.28$), Engle's (1982) no autocorrelation conditional heteroskedasticity (ARCH) LM test ($\chi^2_{(1)} = 1.40$ and $\chi^2_{(4)} = 3.56$ and Jarque-Bera normality test ($\chi^2_{(2)} = 5.47$) at 5 percent level of significance.

The estimated coefficients of ECM in Equation (17), show that in short run exchange rate immediately responds to change in foreign price level, domestic and foreign real output and domestic and foreign interest rates. The presence of lag of dependent variable makes the short run dynamic ECM as an autoregressive model. Its estimated coefficient indicates that a one percent depreciation in preceding seventh quarter (approximately two years back) results in the appreciation of current exchange rate by 0.22 percent.

In short-run change in foreign price level has dominant effect on the nominal exchange rate among the other variables, due to its higher coefficient. The positive sign of change in foreign price level indicates that increase in foreign price level immediately depreciates the domestic currency in the short run rather than appreciating it as suggested by the theory. It confirms the finding of Alam and Ahmed (2010) that Pakistan is a growth driven economy and increase in relative price of imports may not reduce the import demand. Pakistan's major imports consist of petroleum products, essential capital goods and machinery goods. These goods contributed more than 50 percent share of total imports and among these goods Petroleum Group only constituted the largest share in our import bill that is 32 percent in 2010 (State Bank of Pakistan). An increase in oil prices disturbs balance of payment and puts downward pressure on exchange rate which makes imports more expensive [Malik (2008); Kiani (2010)].

A change in domestic output level in preceding quarter depreciates the domestic currency by 0.22 percent, but a change in four quarter previous output level results in the appreciation of currency by 0.42 percent. This result is consistent with Ahmed and Ali (1999) study, in which they suggest that a shock in output initially depreciates the domestic currency but after four periods it appreciates the domestic currency.

The estimated coefficients of lagged change in domestic and foreign interest rate are significant and negative. According to estimates, nominal exchange rate immediately appreciates due to change in domestic and foreign interest rates.

Among the intervention dummy variables only D_{afgwar} is found to be significant in short run dynamic model. Its negative coefficient signifies the appreciation of rupee. During the period of US war against terror in Afghanistan the total US foreign assistance received by Pakistan since fiscal year 2002 is $ 20 billion. This is more than the aid Pakistan received from the US between 1947 and 2000, which is $12 billion [Epstein and Kronstadt (2012)].

The absence of financial crisis dummy variable does not imply that nominal exchange rate of Pakistan is independent of financial crisis. But the reason is the ignorance of financial sector in the Keynesian model. Therefore, the effect of financial crisis will be clearly measured in those models that incorporate the financial sector such as monetary and portfolio models of exchange rate.

Theoretically, sign of error correction term should be negative and significant. The negative sign confirms adjustment towards equilibrium state. In our analysis, coefficient of first error correction term is positive and statistically significant, while the coefficients of second and third error correction terms obey theoretical definition that is negative and significant.

The result of $EC1_{t-1}$ and $EC2_{t-1}$ indicates that exchange rate overshoots from long run equilibrium path by 10 percent. The third error correction term demonstrates that

long run deviation of nominal exchange rate from its equilibrium path is being corrected by 27 percent every quarter. Therefore, the net convergence of exchange rate towards its equilibrium state is 17 percent per quarter. The time required to remove 50 percent of disequilibrium from its exchange rate equilibrium path is three quarters (nine months).[2]

Finally, the stability of ECM's parameters are examined by utilising Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Residuals (CUSUMSQ) test. The plots, provided in Figure 1 and Figure 2, show that CUSUM and CUSUMSQ remain within the 5 percent critical bound, suggesting that there is no significant structural instability and residual variance is stable during the analysis period.

Fig. 1. Cumulative Sum of Recursive Residuals

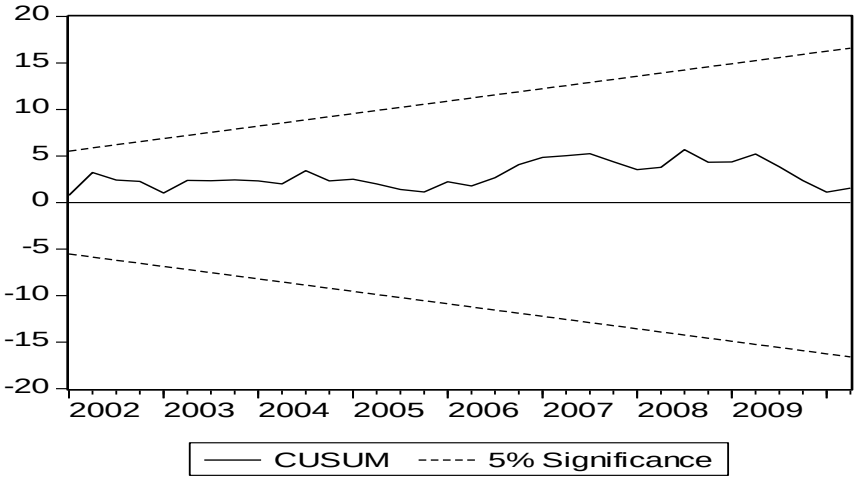
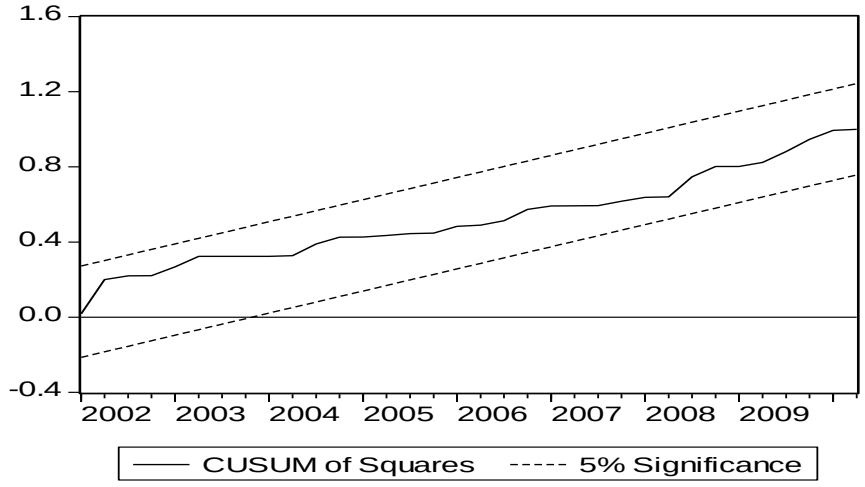


Fig. 2. Cumulative Sum of Squares of Recursive Residuals



[2]The time required to remove the x percent of disequilibrium from its equilibrium path is determined as $(1 - EC)^{41} = (1 - x)$, where t is required number of periods to dissipate x percent of disequilibrium.

6. OUT OF SAMPLE FORECASTS

Mark (1995) and Cushman (2007) methodology[3] of recursive regression has been adopted to generate multi-step-ahead forecast from Keynesian and random walk models. The methodology starts by dividing the data set, containing t=1, 2,……, T number of observations that is from 1982:1 to 2010:2, into thirty seven subsamples $t_1, t_2, \ldots\ldots, t_{37}$. The first subsample contains T-37 (smallest subsample) number of observations. We denote it by t_1 (ends at period 2001:1). The next subsample t_2 is extended by one observation; it contains T-36 number of observations (ends at period 2001:2), and so on the largest and last sample ends with T-1 number of observations, we denote it by t_{37} with ending period 2010:1.

The parsimonious error correction model Equation (17) is estimated for each subsample. This recursive procedure updates the estimated parameters in each subsample due to the inclusion of new data point. Each subsample estimated error correction model has been used to construct a one quarter ahead forecast to sixteen quarter ahead forecast. This results in 37 one quarter ahead forecast, 36 two quarter ahead forecast and so on till 22 sixteen quarter ahead forecast. Forecasted values are also obtained from random walk models for each subsample.

The forecasting performance of each forecast horizon under Keynesian exchange rate and random walk models are evaluated by using standard root mean squared error (RMSE) and Theil's U statistics. Theil's U statistics computes the ratio of the RMSE of the Keynesian model to the RMSE of random walk models. If this ratio is less than one then structural model on average provides better forecast than benchmark. Finally, statistical significance of each forecasting horizon is judged with the Diebold and Mariano (DM) (1995) test statistics.

Table 6 gives the result for RMSE of different models at 1, 4, 8, 12 and 16 forecasting horizons. It can be noted that RMSE of Keynesian model is smaller than the RMSE of benchmark random walk models, with and without drift, at all out of sample forecast horizons. Therefore, it is easy to conclude that Keynesian model yields better forecast for exchange rate than random walk models. Theil's U coefficient at each forecasting horizon is reported in Table 7. This coefficient again supports the dominance of structural model over the random walk models at every horizon.

RMSE and Theil's U factor do not provide any idea of the significance of the difference in the forecasting performance. Therefore, final conclusion will draw on DM test statistics. Table 8 lists the DM statistics and its associated probability values at various horizons, to significantly test whether the mean square error of one forecast is better than another.

First part of Table 8 takes random walk model without drift as benchmark model in loss differential function. The DM test statistics confirm that the predictive accuracy of Keynesian model is significantly more accurate than the random walk model at long forecast horizon i.e. k=12, and 16. The success of structural models at long horizons is consistent with Mark (1995) and Chinn and Meese (1992). Second part of Table 8

[3]Only the difference is in the construction of subsamples, Mark (1995) has considered forty subsamples and Cushman (2007) has followed Hansen and Juselius (1995) methodology and constructed thirty seven subsamples. This study has considered the later approach to elude the problem of smaller sample size at long horizon forecast and make the DM test statistics more reliable.

Table 6

Out-of- Sample Forecast Evaluation: RMSE

	Forecast Horizon				
RMSE	1	4	8	12	16
RW Model	0.048	0.103	0.162	0.201	0.247
RW with Drift Model	0.030	0.089	0.152	0.177	0.199
Keynesian Model	0.024	0.019	0.021	0.018	0.021

Table 7

Out-of- Sample Forecast Evaluation: Theil's U

	Forecast Horizon				
Model	1	4	8	12	16
		Benchmark: RW Model			
Keynesian	0.793	0.216	0.135	0.104	0.107
		Benchmark: RW with Drift Model			
Keynesian	0.507	0.187	0.127	0.091	0.086

Table 8

Out-of- Sample Forecast Evaluation: DM Test Statistic

	Forecast Horizon				
	1	4	8	12	16
		Benchmark Loss Function: RW Model			
Keynesian	0.573[a]	1.458[a]	1.869[a]	2.201	2.268
	(0.570)	(0.154)	(0.072)	(0.037)	(0.034)
		Benchmark Loss Function: RW with Drift Model			
Keynesian	1.133[a]	3.011	4.146	3.583	2.902
	(0.265)	(0.005)	(0.000)	(0.001)	(0.009)

**Note:* '[a]' Represents the acceptance of null hypothesis of equal forecast.
A probability value of DM statistics is in brackets.

compares the difference in the forecasting performance of the structural models to the benchmark random walk with drift model. DM test statistics clearly states that parsimonious cointegrated Keynesian model easily beat the random walk model with drift at every horizon except the first. This finding confirms the remarks of Faust, *et al.* (2003) that it is easy to beat the random walk model with drift than the random walk model without drift.

7. CONCLUSION

This paper has empirically analysed the Keynesian exchange rate model by employing Johansen and Juselius (1988, 1992) cointegration method. Trace test has found three long run relationships among exchange rate, prices, interest rates and output levels. The symmetry restrictions on price coefficients and output coefficients and proportionality restriction on price coefficients are only satisfied by maximum likelihood

ratio test. This study has tested the various forms of PPP, UIP and their combinations to identify the cointegrating vectors. The results support the validity of PPP with the presence of other fundamental variables such as unrestricted output level and interest rates. However, UIP condition holds on its own. Based on these restrictions, further, the first cointegration vector has defined the current account, the second vector has explained the UIP and the last vector has described the Keynesian approach to exchange rate determination. The entire coefficients (except the interest rates) estimated in the system are significant and according to theory. The error correction terms suggest that the net convergence of exchange rate towards its equilibrium state is 17 percent per quarter and three quarters are required to remove 50 percent of exchange rate misalignment from equilibrium path.

The out of sample forecasting results suggests that in case of Pakistan Keynesian exchange rate model outperforms the random walk model, with and without drift, to accurately predict the nominal exchange rate. This finding is attributable to the parsimonious error correction model, which includes lag of dependent variable and fundamental variables to exchange rate determination, error correction terms and financial crisis dummy variable. Therefore, it captures the interruptions in the economy and explains the significant part of instability and outliers in exchange rate series.

The main policy implications drawn from this study are:

- The maintenance of PPP ensures that obtaining unlimited benefits from arbitrage in traded goods is not possible. Therefore, Pakistan is unlikely to improve its external competitiveness against U.S.
- Validity of PPP and UIP allows the use of inflation differentials and interest rate differentials to forecast long-run movements in exchange rates.
- The exchange rate of rupee against US dollar is significantly determined by output levels, prices and interest rates. Therefore, interaction between good and capital assets market is required to study exchange rate dynamics in Pakistan.

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Job Mismatches in Pakistan: Is there Some Wage Penalty to Graduates?

SHUJAAT FAROOQ

In this study, an attempt has been made to estimate the incidence of job mismatch and its impacts on graduate's earnings in Pakistan. The study has divided the job mismatch into three categories; qualification-job mismatch, skill mismatch and field of study and job mismatch. The primary dataset has been used in which the formal sector employed graduates have been studied. This study has measured the qualification-job mismatch by three approaches and found that about one-third of the graduates are facing qualification-job mismatch. Similarly, more than one-fourth of the graduates are mismatched in skill, about half of them are over-skilled and the half are under-skilled. The analysis also shows that 11.3 percent of the graduates have irrelevant and 13.8 percent have slightly relevant jobs to their studied field of disciplines. Our analysis shows that over-qualified graduates face wage penalty under different approaches. After controlling skill heterogeneity, there is less penalty to *apparently* over-qualified and more penalty to *genuinely* over-qualified. The over-skilled graduates face wage penalties and the under-skilled get wage premiums as compared to the matched workers. A good field of study and job matches also improve the wages of graduates.

JEL Classification: I23, I24, J21, J24, J31
Keywords: Education and Inequality, Higher Education, Human Capital, Labour Market, Wages

1. INTRODUCTION

The role of human capital has long been acknowledged by researchers and policy makers not only for sustained economic growth but also for social cohesion. Being so important, the policy-makers all around the globe have stressed allocating more resources to raise education level, which in turn, affects worker's earning and national productivity. In 1960s and 70s, many developed countries including U.S and U.K started to invest heavily in higher education, and Freeman (1976) was the first who raised his concern while analysing the accuracy of the match between graduates' attained education and education demanded by the labour market. The initial studies perceived it as a temporary phenomenon [Freeman (1976)]; however, it was not empirically supported as the incidence of 'over-education', mainly focused on literature, ranges from 10 percent to 40 percent, an average of 25 percent in developed countries [Groot and Maassen (2000); Leuven and Oosterbeek (2011)]. These

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estimates raised serious questions over the validity of conventional views of the labour market; consequently a good debate has started with the emergence of some new theories i.e. the job competition theory and the job assignment theory in which the institutional rigidities, allocation problems and skill heterogeneities were dealt.

Both the economists and sociologists have consigned the job mismatch phenomenon as a serious efficiency concern with its pertinent socio-economic costs at individual, firm and national level. At individual level, it would decrease the individual's marginal product as the existing studies show that over-qualified workers earn less than the matched workers, though the estimated wage differentials differ across the countries.[1] The lower returns to education may also incur some non-transitory costs i.e. lower level of job satisfaction, frustration and higher turnover rate. At the firm level, job mismatch is associated with lower productivity and lower level of job involvement; and in case of high turnover rates, firms may have to incur extra costs on screening, recruiting and training [Tsang (1987); Sloane, *et al.* (1999)]. At the macro level, the national welfare would be lowered by under-utilisation of skills [McGuinnes (2006)]. It is also possible that previously well-matched graduates in the economy will be 'bumped down' in the labour market as over-qualified workers move into lower occupations thus raising the educational requirements within these occupations [Battu, *et al.* (2000)].

The phenomenon can be perceived from some studies, which have highlighted educated unemployment and under-employment [Ghayur (1989); Pakistan (2013)], skill heterogeneity due to educational expansion [Haque, *et al.* (2007)] and decline in rate of return to education [Hausman, *et al.* (2005); Qayyum, *et al.* (2007)]. Recently some studies have emphasised this phenomenon in the context of role of education in career development [Zahid (2014)]. The ongoing demographic transition in Pakistan may also cause the job mismatch phenomenon as the labour force grows faster than the employment rate. As a result, the quality of jobs and access to modest earning opportunities has been emerging as a key issue as reflected by the various labour indicators e.g. educated unemployment, decline in worker's productivity, rising share of informal labour, rising job search periods and high risk of vulnerability especially for youths and females [Pakistan (2008, 2011, 2013)].[2]

Becker's (1964) monogram 'Human Capital' provides the basic foundations to explain earning distribution in developed countries and Mincer's model (1974) on earning provides a cornerstone empirical framework to predict the human capital theory. Both Becker (1964) and Mincer (1974) asserted that education and training are the most important components of human capital accumulation, which in turn, directly and indirectly affect the individuals' life time earnings. Following Becker's Human Capital Theory (1964), a number of studies in Pakistan have measured the return to education by assuming that labour market is competitive and workers are paid according to their marginal product.[3] But no study has anticipated the impact of job mismatch on earnings. In view of the importance of job mismatch and existing

[1] For U.K, 12 percent by Dolton and Vignoles (2000), 18 percent by Dolton and Silles (2003), 23.2 percent by Chevalier and Lindley (2006). For U.S, 13 percent by Verdugo and Verdugo (1989), 11 percent by Cohn and Khan (1995). For Holland, 26 percent by Groot (1996), 8 percent in Kiker, *et al.* (1997) for Portugal and 27 percent in Budría and Edigo (2007) for Spain.

[2] 61.2 percent were considered vulnerable, meaning "at risk of lacking decent work" in 2012-13 [Pakistan (2013)].

[3] Shabbir (1993), Nasir (2002, 2005), Akbari, *et al*. (2000), Nazli (2004), Aslam (2005), Chaudhary, *et al.* (2010), Afzal (2011) and many others.

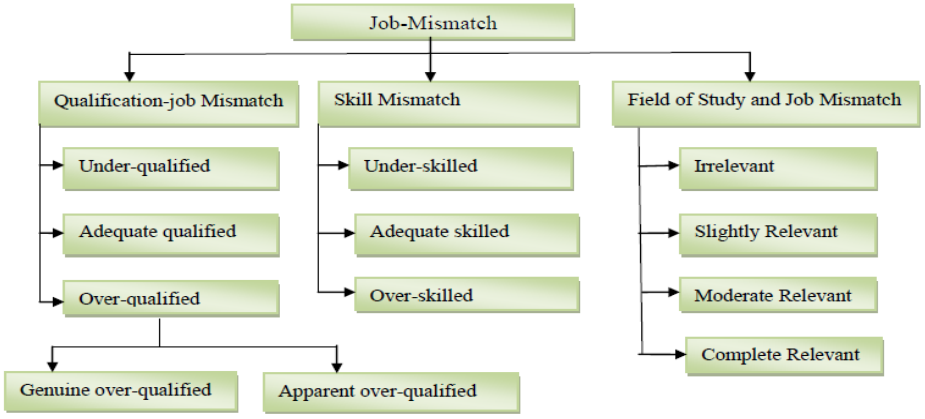
literature gap in Pakistan, the study aims to measure the potential impact of various types of job mismatchs on graduates' earning in Pakistan. Since terms 'education and job mismatch' are linked with educated workers, therefore the analysis in this study is carried out on employed graduates working in the formal sector who hold at least fourteen years formal education, named as the 'graduate workers'.

The rest of the study is organised as follows. Section 2 presents the theoretical framework of job mismatch discussing both: the types of job mismatch and theoretic aspects of job mismatch. Discussion on data sources and methodology is given in Section 3. The penultimate section has discussed the results over the incidence of job mismatch and its impact on graduate's earning. Conclusions and policy considerations are given in the final section.

2. JOB MISMATCH AND WORKER'S EARNING: A THEORETICAL FRAMEWORK

Job mismatch has three dimensions; qualification-job mismatch, skill mismatch and field of study and job mismatch [Farooq (2011)]. qualification-job mismatch compares the acquired qualification (in years) with the required qualification (in years) of a worker in his/her current job, while the skill mismatch compares overall acquired competences with the required competences. The field of study and job mismatch evaluates that how much studied field of discipline is relevant to the nature of job. An extensive literature exists on the first type of job mismatch; whereas, only few subjective studies recently have been made on skill mismatch and field of study and job mismatch. All these studies have been carried out primarily in the developed economies. The existing studies are mixed over the use of titles for three types of job mismatches as some studies have used the term 'qualification mismatch' by Green and McIntosh (2002), and 'education mismatch' by Verdugo and Verdugo, (1989), Battu, *et al.* (2000), Lourdes, *et al.* (2005) etc. for the first type of job mismatch (qualification mismatch). Similarly, different titles have been used for the second type of job mismatch (skill mismatch) i.e. competence mismatch by Lourdes, *et al.* (2005) and skill mismatch by Green and McIntosh (2002), Jim and Egbert (2005) and Lourdes and Luis (2013).The rest of this study will follow the titles as given in Figure 1; qualification-job mismatch, skill mismatch and field of study and job mismatch. The sub-classification of graduates under each type of job mismatch is also given in Figure 1.

Fig. 1. Conceptual Framework for the Three Types of Job Mismatch



Though there is no unified accepted theory on job mismatch and earnings; however, the following three theories have explained the job mismatch phenomenon with earnings. According to *Human Capital Theory (HCT),* labour market is competitive where every worker is paid the value of his/her marginal product [Schultz (1962); Becker (1964)]. Wages and productivity are fixed in relation to prospective jobs; therefore, over-qualified workers have same productivity and thus receive the same wages as compared to the matched workers. In a pure human capital framework, the concept of job mismatch may be meaningless. The job mismatch phenomenon may not necessarily reject the HCT in case of short run existence; however, if it appears to be a long run phenomenon, then no one can save the HCT [McGuiness (2006)]. The opponents of HCT argue that it fails to explain the underutilisation of skills, institutional rigidities and non-competitive labour market. Tsang (1987) suggested that the relationship between education and productivity is more multifaceted than the direct and positive relationship as suggested by HCT. Some studies have pointed out that return to education may not increase with the level of education [World Bank in "Knowledge for Development" (1999); Psacharopoulos and Patrinos (2002)].

In contrast to HCT, the *Job Competition Theory* highlights the institutional rigidities where earnings are associated with job characteristics [Thurow (1975)]. The allocation on job is based on available supplies of both workers and jobs, workers may possess more education and skills than their jobs necessitate. If there is an over-supply of educated job seekers, some educated workers will look for jobs at lower level with wage penalties. In the extreme case, education simply serves to obtain the job, and there is a zero return to human capital beyond that required to do the job. Therefore, Mincer model (1974) and the Thurow's model (1975)are two extreme cases, the first being purely supply side driven and the second being purely demand side driven.

A third strand between the former two extreme cases is found in the *Job Assignment Theory,* which asserts that there is an allocation problem in assigning the heterogeneous workers to jobs which differ in their complexity [Sattinger (1993)]. Hartog (2000) viewed that the labour market is consisting of a bundle of capabilities and suggested that up to 40 percent of the income variance can be attributed to capability variables. In practice, the frequency distributions are unlikely to match and education mismatch may be a persistent problem if the job structure is relatively unresponsive to changes in relative supplies of educated labour. Earnings are then a function of both individual and job characteristics where over-qualified workers earn some rate of return on over-education but less than the return to required education.

Duncan and Hoffman (1981) found that over-qualified workers receive a lower return on surplus schooling. In Europe, similar findings have been reported by Dolton and Vignoles (2000), Groot and Maasen (2000), Battu, *et al.* (1999) and many others. A dominant paradigm of literature concludes that over-qualified workers face wage penalties, while under-qualified workers enjoy wage premiums while comparing them with the matched workers with the same level of formal education. Initially, these finding were reported by Verdugo and Verdugo (1989), Gill and Solberg (1992). Later these results were endorsed by Cohn and Khan (1995), Dolton and Vignoles (2000), Bauer (2002) and Frenette (2004). The second finding is that the job mismatch explains the wage differentials among workers who hold the same type of jobs. Thus, the workers

earn a positive rate of return on years of over-education, which is lower than the required education (in years). Similarly, under-qualified workers have a negative rate of return. These results were initially estimated by Duncan and Hoffman (1981) and later confirmed by Alba (1993), Sloane, *et al.* (1999), Groot and Maasen (2000), Ng (2001), Groeneveld and Hartog (2004).Overall, the literature supports the assignment theory that the over-qualified workers are working below their potential but gaining some benefit from surplus schooling [Alba (1993); Groot (1996); Sloane, *et al*. (1999); Hartog (2000); Dolton and Silles (2003); Lourdes, *et al.* (2005); Chevalier and Lindley (2006); Martin, *et al.* (2008)].

3. DATA SOURCE AND METHODOLOGY

3.1. Data Description

Due to non-availability of key information in national secondary data sources including e.g. required education for a specific job, attained and required level of skills, relevance of field of study to current job and job satisfaction, the present study has used the primary dataset by targeting the employed graduates working in the formal sector who have fourteen and above years of education (Graduates, Master, MS/MPhil, PhD), named as 'graduate workers'. A primary survey, the Survey of Employed Graduates (SEG) has been conducted in 2010 in two major cities of Pakistan, Islamabad and Rawalpindi to study the job mismatch phenomenon in depth. At broad level, the targeted universe in the SEG dataset has been divided into the three major groups; graduates in federal government, graduates in autonomous/semi-autonomous bodies under federal government and graduates in the private sector. The Thirteenth Census Report of Federal Government Civil Servants (2003-04)[4] and Annual Statistical Bulletin of Federal Government and Semi-government (2007-08)[5] were used to estimate the graduate employees in the federal government and semi-government. For private sector, the relevant information was gathered from a few private departments i.e. banks, hotels, telecom companies, international donor offices, media (newspaper and broadcasting). For the remaining private sector like hospitals, educational institutions, NGOs, manufacturing and Industry etc., the internet and the other sources were used to get the total numbers of units located in Islamabad/Rawalpindi and then through rapid sample survey, the information was obtained to estimate the employed graduates.

To avoid the sampling bias and errors, the proportional stratified random sampling technique was adopted where the published BPS grades for the government and semi-government sectors have been considered as 'strata' while the 3-digit occupational codes were used as 'strata' for the private sector. For further detail on population universe and sampling, see Farooq (2011). A sample of 514 graduates across the three major groups was collected according to their relative employment share. All the questionnaires have been conducted by face-to-face interviews.

[4]Government of Pakistan (2003-04) "Thirteenth Census of Federal Government Civil Servants". Pakistan Public Administration Research Centre, Management Services Wing, Establishment Division, Islamabad.

[5]Government of Pakistan (2007-08) "Annual Statistical Bulletin of Federal Government". Pakistan Public Administration Research Centre, Management Services Wing, Establishment Division, Islamabad.

3.1. The Measurement of Three Types of Job Mismatch

Regarding qualification-job mismatch, the empirical work so far has relied on the three methods to measure required qualification. First, the Job Analysts (JA) Method (*Objective Approach*), in which the professional job analysts grade the jobs and recommend the minimum educational requirements for a certain job [Battu, *et al.* (2000)]. Second method refers to Self Assessment (*Subjective approach*), where workers are asked directly to give information on the minimum educational requirements for their current job or whether they are mismatched or not [Alba (1993)]. The third method 'Realised match (RM)' measures the degree of qualification-job mismatch by two variables; years of schooling and occupation. The distribution of education is calculated for each occupation; employees who depart from the mean by some *ad-hoc* value (generally one) standard deviation are classified as mismatched workers [Verdugo and Verdugo (1989) and Ng (2001)].

This study has measured qualification-job mismatch by all the three methods, which are job analyst (JA), worker self assessment (WSA), and realised match (RM) on the basis of SEG 2010 dataset. The attained education (number of completed years) has been used as a measure of qualification; while the required qualification (education) has also been measured in years. For the JA method, the required level of qualification in years has been measured by questioning the sampled graduates "*In your opinion, what level of formal education (years) and experience (years) is demanded by your employer/organisation to get the job like yours?*" For the WSA approach, graduates were asked *"In your opinion, how much formal education (years) and experience (years) is required to perform your current job well?"* By comparing the attained qualification and required qualification, the graduates have been classified into three categories; over-qualified, under-qualified and matched graduates.

For the third RM measure, the required qualification has been measured on the basis of two variables; completed years of schooling and occupations. The mean years of schooling at two-digit occupational classification has been used as a measure of required qualification by assuming that the graduates working in similar occupation require the same level of qualification. The qualification-job mismatch has been estimated by comparing the attained and required qualification with (+/–) one standard deviation of the mean.[6] Graduates with attained qualification greater and less than one standard deviation were defined as over-qualified and under-qualified graduates, respectively. The middle range; within +/– of one standard deviation comprised of the matched workers.

Following Chevalier (2003), a measure of qualification-job mismatch and occupation-satisfaction has also been adopted to capture the idiosyncratic characteristics by segregating the over-qualified graduates into two categories; those over-qualified who are satisfied over their mismatch are defined as *apparently* over-qualified, whereas those who are dissatisfied are *genuinely* over-qualified.[7]

[6]+/– One standard deviation was used as the actual mean deviation of the difference of the attained education and the required education was 0.989, close to one.

[7]Job satisfaction has been measured at five point Likert scale range from very dissatisfied to very satisfied. For *apparently* over-qualified workers, range 1 (very dissatisfied) and range 2 (dissatisfied) were used while for *genuinely* over-qualified workers range 3 to 5 have been used.

Skill is a broad signal of human capital because it assimilates the other constituents of human capital (skills, experience) and also the formal qualification/education. The attained skills possessed by the workers, may be lower or higher than the required skills in their prospective jobs, known as mismatch in skill. Majority of the studies have used formal education as the proxy of skill;[8] however, the later studies have criticised it as it is difficult to quantify the extent of this skill [Jim and Egbert (2005); Lourdes, *et al.* (2005)]. The two measurement approaches of skill mismatch have emerged from the literature; majority of the studies have used the *subjective approach*, based on worker's perception [Green and McIntosh (2002); Lourdes, *et al.* (2005)], while some studies have used the *specific approach* by measuring the various specific attained skills possessed by the workers and the required skills in their current jobs [Jim and Egbert (2005); and Chevalier and Lindley (2006)].

The ongoing study has followed the specific approach to measure skill mismatch where initially, the level of nine specific attained and required skills have been estimated in SEG survey on five-point scale, ranging from 1 'not at all' to 5 'a lot'. These nine skills are; supervisory skills, English writing skills, English speaking skills, numeracy skills, teamwork skills, management skills, computer skills, research skills and time management skills. Through Principal Component Analysis (PCA) method, the weights has been estimated on attained skills and required skills on the basis of mean required level of nine skills by assuming that the workers in same occupations at two-digit occupational coding require the similar types of skills in their jobs. The skill mismatch has been estimated by comparing the attained skill index and required skill index with (+/–) 0.08 standard deviation (SD) of the mean (0.075 SD for SEG weights).[9] The graduates with attained skills more or less than required skills by 0.08 standard deviation were defined as over-skilled and under-skilled, respectively. The middle range comprises the skill matched graduates. For detail methodology along with questions on attained and required skills, see Farooq (2011).

The field of study and job mismatch analyses the level of match between the individual's field of study and his/her features of the job. The existing three studies have adopted both subjective and education-occupation combination to measure the field of study and job mismatch [Jim and Robert (2004); Robst (2007) and Martin, *et al.*(2008)]. The ongoing study has estimated the field of study and job mismatch by subjective approach with the question: *'how much is your current job relevant to your areas of education?'* The four possible options were; irrelevant field of study, slightly relevant, moderately relevant and completely relevant field of study.

3.3. Impact of Job Mismatch on Earnings: Methodology

The specification to estimate the impact of job mismatch on earnings revolves around the standard Mincer earning equation [Mincer (1974)], which itself was originated to measure Becker's human capital theory (1964). The standard Mincer earnings equation is generally written as:

$$Ln\, y_i = \delta_0 + \delta_1 \text{ Year\_School }_i + \delta' X_{ki} + \mu_i \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

[8]As Battu, *et al.* (1999), Frenette (2004), Groot (1996) and Ng (2001) did.

[9]Standard deviation has been calculated after comparing the both attained and required skill index.

Where, Lny_i is natural log of monthly wages, year of schooling measure the impact of attained qualification on earning while X_i represents the vector of all independent control variables related to personal characteristics and human capital characteristics. In contrast to the HCT, one can measure the Job Competition Theory [Thurow (1975)] by replacing the required qualification with attained qualification in Equation 1.The job assignment theory provides the framework to analyse the impact of job mismatch on earning by adding over-qualification and under-qualification. Two types of model specifications have been applied so far in the literature to measure the impact of qualification-job mismatch on earnings as given in the following two equations:

$$Ln\, y_i = \alpha_0 + \alpha_1 Q^r{}_i + \alpha_2 Q^o{}_i + \alpha_3 Q^u{}_i + \alpha' X_i + \varepsilon_i \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

$$Ln\, y_i = \beta_0 + \beta_1 \text{Year\_school}_i + \beta_2 D^{oq}{}_i + \beta_3 D^{uq}{}_i + \beta' X_i + \varepsilon_i \quad \ldots \quad \ldots \quad (3)$$

In Equation 2, the years of required qualification (Q^r), years of over-qualification (Q^o) and years of under-qualification (Q^u) have been used as explanatory variables to analyse the impact on earnings. In Equation 3, the former methodology has been modified by taking dummy variables of over-qualification (D^{oq}) and under-qualification (D^{uq}). The core difference between the two approaches is when one measures the qualification-job mismatch in terms of years, then the coefficients of over-qualification and under-qualification should be compared with those workers who are matched but on the same jobs; whereas, in dummy specification, the over-qualified and under-qualified graduates have been compared with those who have same qualification but on matched jobs. As this study has targeted the graduate employees, therefore, being limited variation in years of over-qualification and years of under-qualification variables, the second approach has been adopted. Another advantage of using the second approach is that it has the capability to split over-qualification ($D^{oq}{}_i$) variable into *genuinely* over-qualified(D^{ogq}) and *apparently* over-qualified (D^{oaq}) category to capture the heterogeneity among the skills of graduates, thus resulting in the following equation;

$$Ln\, y_i = \beta_0 + \beta_1 \text{Year\_school}_i + \beta_2 D^{ogq}{}_i + \beta_3 D^{oaq}{}_i + \beta_4 D^{uq}{}_i + \beta' X_{ki} + \mu_i \quad \ldots \quad (4)$$

In the light of Mincerian earning equation, the following equation has been used to measure the impact of skill mismatch on graduates' earnings where os_i and us_i are dummy variables for over-skill and under-skill for graduate i;

$$Lnyi = \beta_0 + \beta_1 \text{Year\_school}_i + \beta_2 os_i + \beta_3 us_i + \beta' X_i + \varepsilon_i \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

The following equation has been used to measure the impact of field of study and job mismatch on graduates' earnings where sr_i, mr_i and cr_i represent the three dummies for weakly relevant, moderately relevant and completely relevant field of study to the current job:

$$Lnyi = \beta_0 + \beta_1 \text{Year\_school}_i + \beta_2 sr_i + \beta_3 mr_i + \beta_4 cr_i + \beta' X_i + \varepsilon_i \quad \ldots \quad \ldots \quad (6)$$

4. RESULTS

4.1. Incidences of Job Mismatch

The estimates in Table 1 show that the incidence of qualification-job mismatch varies by the three measures, which are worker's self assessment (WSA), job analysis (JA) and

realised match (RM) method. Both the WSA and JA show that the level of over-qualification and under-qualification are close to each other as compared to the RM measure. The close estimates of over-qualification by WSA and JA approach suggest that graduates have not overstated or understated the qualification requirements. These estimates are consistent with the earlier findings that RM method reports a lower incidence of over-qualification as compared to the WSA and JA methods [Meta-analysis of Groot and Maassen (2000) and McGuinnes (2006)].High statistical relation was found between WSA and JA while poor relationship was found with RM of both JA and WSA.[10]

Table 1

The Level of Qualification-Job Mismatch by Various Measures (%)

Measures	Matched	Under-qualified	Over-qualified
WSA Method	65.4	9.9	24.7
JA Method	69.5	4.5	26.1
RM Method	63.4	21.6	15.0

To get a realistic picture, the assumption of 'homogeneity in skills of workers who hold the same qualification level', has been relaxed by segregating the over-qualified workers into '*apparently over-qualified'* and '*genuinely over-qualified'* on the basis of occupation-satisfaction approach. Table 2 shows that under WSA and JA approaches, about 57 to 63 percent of the over-qualified respondents in non-graduate jobs are not too dissatisfied with their mismatch, therefore, they are defined as *apparently* over-qualified graduates and the rest (37 percent to 43 percent)who are dissatisfied, are defined as *genuinely* over-qualified graduates. The issue of heterogeneity of jobs is now clear as the *genuinely* and *apparently* over-qualified graduates are not similar in skill possession. These results are consistent with the earlier studies, which have captured the issue of heterogeneity [Chevalier (2003); Chevalier and Lindley (2006)].

Table 2

The Level of Genuine and Apparent Over-qualification (%)

Education-Job Mismatch	WSA Approach	JA Approach	RM Approach
Matched	65.4	69.5	63.4
Under-qualified	9.9	4.5	21.6
Genuinely Over-qualified	10.7	9.7	4.7
Apparently Over-qualified	14.0	16.3	10.3

The results over skill mismatch have been reported in Table 3, which shows that more than one-fourth of the graduates are mismatched in skill either in terms of being over-skilled or in terms of being under-skilled. The phenomenon of 'matched graduates' is considerably higher among males (73 percent—74 percent) than among females (67 percent). A lesser proportion of female graduates are under-skilled, while, there are more over-skilled female graduates. It reflects the scenario of relatively more under-utilisation of females' skills in their jobs in Pakistan.

[10]Parametric t-test and spearman rank correlation tests were applied.

Table 3

The Distribution of Respondents by the Level of Skill Mismatch (%)

	Matched Graduates	Under-skilled	Over-skilled
Female	66.7	11.1	22.2
Male	72.8	13.9	13.4
Both Sexes	71.8	13.4	14.8

The results for the field of study and job mismatch have been reported in Table 4, which shows that 11 percent of the graduates consider that their current jobs are totally irrelevant to their studied field of discipline, while another 14 percent reported their jobs are slightly relevant, followed by the moderately relevant with 38 percent and completely relevant with 37 percent. An important information is that the female graduates are facing more field of study and job mismatch than the male graduates as one-third of the female graduates are mismatched falling in either irrelevant or weakly relevant category; however, less than one-fourth of the male graduates are falling in these first two categories (Table 3). See Farooq (2011) whether the formal education is good proxy of skill or not?

Table 4

% Distribution of the Respondents by Field of Study and Job Mismatch

Level of Mismatch	Female	Male	Total
Irrelevant	14.8	10.6	11.3
Slightly Relevant	18.5	12.9	13.8
Moderately Relevant	33.3	39.3	38.3
Completely Relevant	33.3	37.2	36.6

4.2. Impact of Job Mismatch on Graduates' Earnings

In the light of Equations 3 and 4, Table 5 reports the estimated results of qualification-job mismatch where model 1 and model 2 estimate the impact of qualification-job mismatch on graduates' earning by WSA and JA approach. In model 3 and model 4, the over-qualified graduates have further been split into *genuinely* over-qualified and *apparently* over-qualified. The exponential criteria has been adopted to calculate the percentage impact of indicator variables. The residuals of all the 4 models have been reported in Appendix Figures 1 to Figure 4, which are normally distributed, sugesting that the t-stat values are reliable. The coefficients of over-qualification in model 1 and model 2 show that over-qualified graduates face 30 percent to 37 percent of wage penalty under different approaches (WSA and JA). The results are in line with existing studies of qualification-job mismatch, which support the job assignment model [Sattinger (1993)] that both individual and job characteristics determine the level of earnings. These results are also in the line with previous studies that both WSA and JA yield consistent results, with the overestimation by WSA approach [McGoldrick and Robst (1996); Battu, *et al.* (2000); Groot and Maasen (2000)]. After controlling the heterogeneity in model 3 and model 4 by splitting the over-qualified graduates into

'genuine' and 'apparent' category, the penalty for over-qualification is still statistically significant with less penalty to apparently over-qualified (20 percent to 26 percent) and more to the genuinely over-qualified graduates (49 percent to 53 percent) under WSA and JA approaches. The coefficient of under-qualification is not significant in all the models. These results are consistent with the earlier studies that the *genuinely* over-qualified face more wage penalties as compared to *apparently* over-qualified [Chevalier (2003); Chevalier and Lindley (2006)].

Regarding the other control variables, all the models show that the male graduates are likely to earn 10 percent to 12 percent more than the female graduates, consistent with earlier studies conducted in Pakistan [Sabot (1992); Nazli (2004); Nasir (2002, 2005) and many others)]. The significant coefficients for education and experience show the importance of human capital accumulation as the graduates with more education and experience have a positive rate of return on it. Regarding the quality of institution from where the graduates have obtained their highest degree, the graduates who got their education from distance learning institutes earn about 32 percent less than those who got their education from the university. The foreign degree/diploma holders graduates earn about 20 to 23 percent more than the locally educated. These differences reflect the heterogeneity of education, which in turn is generating the wage differences among the graduates.

Regarding the labour market characteristics, a wage differential exists between government and private organisations where graduates in the government sector earn less than the private sector. Tenure with the current job also has a strong influence on graduates' earnings, as the graduates who have been in the current job between two to four years earn about 20 percent to 22 percent more and the graduates with more than four years in the current job earn 30 percent to 32 percent more than those who have tenure up to one year (Table 5).

Table 5

The Impact of three Types of Job Mismatch on Graduates' Earnings—SEG, 2010

	Model 1 WSA-I		Model 2 JA-I		Model 3 WSA-II		Model 4 JA-II	
Regressor	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Err.
Over-qualification	–0.367*	0.060	–0.295*	0.061	–	–	–	–
Under-qualification	–0.051	0.079	–0.051	0.111	–0.044	0.078	–0.044	0.110
Over-qualification genuine	–	–	–	–	–0.532*	0.081	–0.487*	0.085
Over-qualification apparent	–	–	–	–	–0.265*	0.068	–0.203*	0.067
Education	0.136*	0.024	0.138*	0.025	0.139*	0.024	0.142*	0.025
Experience	0.025*	0.009	0.027*	0.01	0.024*	0.009	0.025*	0.009
Experience square	–0.017*	0.008	–0.016*	0.009	–0.017*	0.008	–0.016*	0.009
Sex (male=1)	0.113**	0.063	0.118**	0.063	0.114**	0.062	0.121**	0.063
Marital status (married=1)	0.118*	0.06	0.117**	0.061	0.118*	0.06	0.120*	0.061
Foreign diploma (yes=1)	0.226*	0.087	0.209*	0.088	0.207*	0.086	0.203*	0.087
Type of institution (university as ref.)								
College	–0.050	0.068	–0.07	0.069	–0.055	0.067	–0.067	0.068
Distance learning	–0.282*	0.084	–0.279*	0.086	–0.292*	0.084	–0.287*	0.085
Organisation of job (govt.=1)	–0.049**	0.03	–0.050**	0.03	–0.045**	0.027	–0.048**	0.030
Tenure (up to 1 year as ref.)								
1 to 2 year	0.019	0.082	–0.01	0.083	0.007	0.081	–0.017	0.082
2 to 4 year	0.212*	0.077	0.195*	0.078	0.205*	0.076	0.181*	0.078
More than 4 year	0.322*	0.090	0.305*	0.091	0.306*	0.089	0.291*	0.091
Constant	7.430*	0.408	7.395*	0.415	7.409*	0.404	7.366*	0.411
F-Stat	17.99		17.17		18.06		17.30	
R-square	0.5759		0.5644		0.5840		0.5735	
N	514							

* Denotes significant at 5 percent, ** denotes significant at 10 percent.

Following Equations 5 and 6, the results are given in Table 6 where model 5 measures the impact of skill mismatch on earnings, while model 6measures the impact of field of study and job mismatch. The residuals of both models have been reported in Appendix Figure 5 to Figure 6. The results about the impact of skill mismatch on graduates' earnings in model 5 show that over-skilled graduates face 20 percent wage penalties and under-skilled get 16 percent wage premium as compared to those who have the same level of education and on matched jobs. Regarding the under-skilled, the findings of this study are different from the studies of Lourdes, *et al.* (2005) in which the under-skilled workers face wage penalties; however, the estimates of this study are in the right direction that under-skilled graduates get wage premium when compared with the matched workers. These results are consistent with the earlier studies, which indicate that skill mismatch leads to wage differential among the workers [Green and McIntosh (2002); Lourdes, *et al*. (2005); Di-Pietro and Urwin (2006)].

In the last model, the estimates show that the moderate field of study and job matched and complete field of study and job matched graduates earn significantly more by 23 percent and 20 percent respectively compared to those who have irrelevant field of study in their current jobs. These results are in line with existing studies showing that a good match between the field of study and the current job improves the level of earnings [Robst (2007); Martin, *et al.* (2008); Domadenik, *et al.* (2013)].

Regarding gender, the estimates support the initial results as mentioned in Table 5 that male graduates, on average, earn 11 percent more than the female graduates. Similarly, education and experience have a significant impact on graduates' earnings with 10 percent and 3 percent per year, respectively. The graduates with foreign diploma earn more than the locally educated graduates (Table 6).

Table 6

The Impact of three Types of Job Mismatch on Graduates' Earnings—SEG, 2010

	Model 5 Skill Mismatch		Model 6 Field of study Mismatch	
Regressor	Coeff.	St. Err.	Coeff.	St. Err.
Over-skill	–0.195*	0.066	–	–
Under-skill	0.155*	0.069	–	–
Weak relevance/irrelevant	–	–	0.115	0.09
Moderate relevance/irrelevant	–	–	0.228*	0.083
Complete relevance/irrelevant	–	–	0.203*	0.09
Education	0.102*	0.023	0.102*	0.024
Experience	0.026*	0.01	0.029*	0.01
Experience square	–0.017*	0.008	–0.016*	0.009
Sex (male=1)	0.102**	0.063	0.099**	0.062
Marital status (married=1)	0.103**	0.062	0.118**	0.062
Foreign diploma (yes=1)	0.194*	0.089	0.218*	0.09
Type of institution (university as ref.)				
College	–0.073	0.069	–0.043	0.07
Distance learning	–0.276*	0.086	–0.260*	0.088
Organisation of job (govt.=1)	–0.056**	0.03	–0.053**	0.031
Tenure (up to 1 year as ref.)				
1 to 2 year	–0.018	0.084	0.000	0.084
2 to 4 year	0.197*	0.079	0.216*	0.079
More than 4 year	0.292*	0.092	0.298*	0.093
Constant	7.866*	0.393	7.735*	0.409
F-Stat	16.67		15.75	
R-square	0.5572		0.55	
N	514			

* Denotes significant at 5 percent, ** Denotes significant at 10 percent.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The main focus of this study is to estimate the three types of job mismatches and analysing the pecuniary consequences of job mismatch. The present study has found that the choice of measurement method has a significant effect on the incidences of qualification-job mismatch. Overall 31–37 percent of the graduates are facing the qualification-job mismatch either falling in over-qualification or under-qualification category. Similarly, more than one-fourth of the graduates are mismatched in skill either in terms of being over-skilled or in terms of being under-skilled. The phenomenon of 'matched graduates' is considerably higher among males than among females. An important information is that the female graduates are facing more field of study and job mismatch than the male graduates as one-third of the female graduates are mismatched falling in either irrelevant or weakly relevant category; however, less than one-fourth of the male graduates are falling in these two categories.

This study has examined the impact of all the three types of job mismatches on graduates' earnings and found that the over-qualified graduates face 30 to 37 percent wage penalty under different approaches. After controlling skill heterogeneity, the penalty for over-education is still significant with fewer penalties to *apparently* over-qualified and more penalties to *genuinely* over-qualified. The over-skilled graduates face wage penalties and the under-skilled get wage premium as compared to the matched workers. A good field of study and job match also improve the wages of graduates. Overall these results do not support the Human Capital Theory. However, this study cannot necessarily reject the Human Capital Theory on the basis of cross-sectional dataset as the mismatch phenomenon might be temporary. The results of this study support the Job Assignment Theory [Sattinger (1993)] as both the individual and job characteristics are determining the levels of job mismatch and wages.

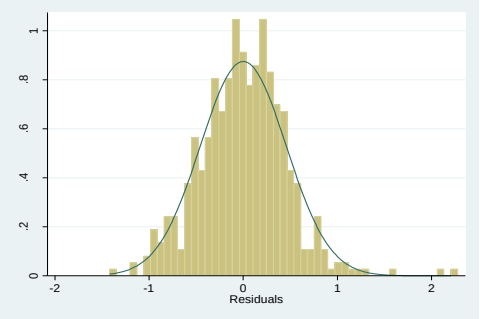
Our findings lead to the following policy implications and recommendations primarily in two areas; reforms in human resource development and labour market institutions:

- The incidences of various types of job mismatches especially the skill mismatch suggest the need for better quality of education and skills by ensuring the equality of skills and rightly demanded skills across the institutes and regions. The phenomenon of field of study and job mismatch suggests the close coordination among the various demand and supply side stakeholders of the labour market for better understanding of issues in order to formulate the right policies.
- The rapid enrolment at higher education level with limited labour demand suggests to implement entrepreneurial reforms both in educational institutes and in the labour market to absorb this educated influx. Females should receive a special focus in such policies, which would not only raise their participation but also provide them the entrepreneurial opportunities.
- Some tracer type studies or panel studies are required for a better understanding of employment patterns and skills demanded by the various sectors and occupations. It would not only guide the planners and enrolled youths about the

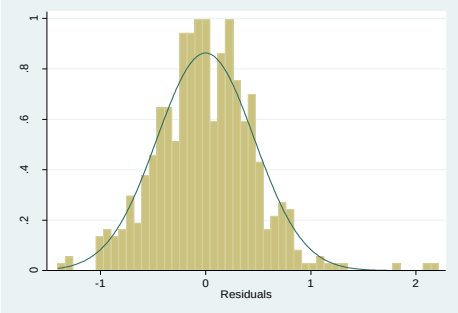
labour market opportunities and type of skills needed, but also would help to project future educational needs.

- There is a need to improve the Labour Force Survey (LFS) questionnaire for skill assessment and job mismatches. A module about the history of employment may also be made part of the LFS. Additional research is of course needed to estimate the timing and depth of job mismatch, productivity losses and direct and indirect hiring and firing costs to firms due to job mismatch.

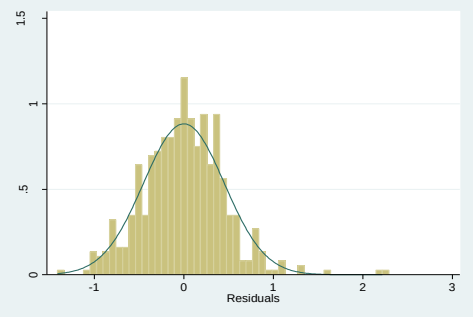
Appendix Fig. 1: Residuals of Model 1



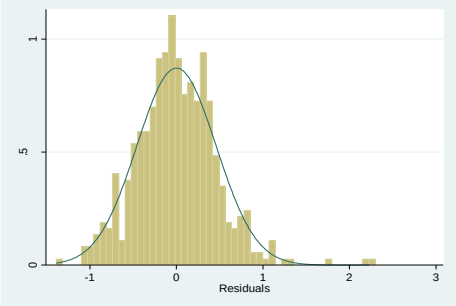
Appendix Fig. 2: Residuals of Model 2



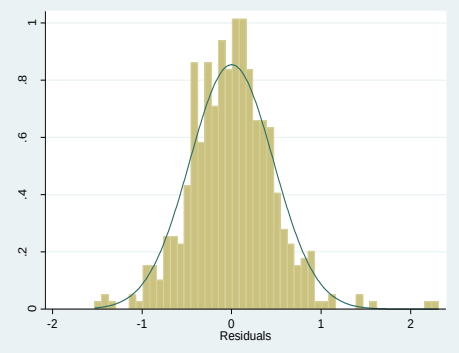
Appendix Fig. 3 Residuals of Model 3



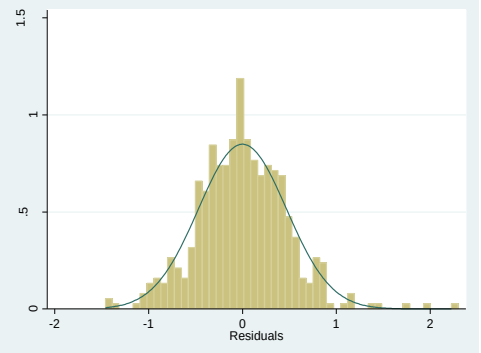
Appendix Fig. 4 Residuals of Model 4



Appendix Fig. 5: Residuals, Skill Mismatch



App. Fig. 6: Residuals, Field of Study Mismatch



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Book Review

Harold Demsetz. *From Economic Man to Economic System: Essays on Human Behaviour and Institutions of Capitalism*. New York, USA. 2011. 198 pages. U.S. $ 39.99.

Harold Demsetz, Emeritus Professor of Business Economics at the University of California, Los Angeles, has done an excellent job of putting together research in the area of human behaviour and the influence of institutions thereon. Demsetz is one of the leading figures of the New Institutional Economics School. In this book, his focus is on the institution of capitalism, which is by far the most influential system prevalent now. It presents and reviews historical developments in the area and cites influential works, which makes the book a very interesting read. The book is not technical and is meant for a broad readership.

The book is divided into two broad themes, namely self-interest and capitalism and its institutions. First four chapters deal with the theme of self-interest and the remaining seven discuss the issue of capitalism and its institutions. The first chapter pitches the argument of situational understanding for human behaviour in a crispy manner. The author asserts in the Book that markets are unable to allocate resources automatically until self-interest, as proposed by the conventionalists, is brought into the interplay of market forces. Markets do not care for the type of commodities to be exchanged; rather the focus is on the wants only. After all, markets are not replacements of churches. Once the argument of morality is presented in the first chapter, the second chapter discusses how outcomes can be turned into morally acceptable ones. This chapter starts with Thorstein Veblen's theory of mismatch between acquisition and true needs, which was later extended by John Kenneth Galbraith's work on affluent societies. They claim that humans instinctively want more wealth and rank. Hence, the society without regulation or restriction would produce commodities in excess for the affluent class. But unlike Frank's (*Luxury Fever, 1999)* attack on wealthy segments of the society, Demsetz provides good examples where restriction might also be wrong.

In the third chapter, he spells out the context of selfish-gene theory [proposed by Richard Dawkins (1976)] and the ways to avoid getting into its trap. He first elaborates the natural selection process and points out that the consciousness and freedom of action are favoured by the gene survival needs and efficiency requirements. In chapter four, from the very beginning, the basic ideology of Adam Smith, namely the pursuit of selfish interest leading to an efficient outcome for society, is challenged with examples like prisoner's dilemma. Malthusian trap, namely the phenomenon of population growth ultimately leading to increased poverty in the long run, is also challenged based on the fact that it did not happen.

Starting from the fifth chapter, Demsetz elaborates the capitalism and its influence on society. Capitalism is a relatively new economic system, which started to operate in the nineteenth century. Earlier, human activity was managed by small hierarchical groups and preconditions for capitalism gradually made their way into the economic systems. Under the hunter-gatherer or agrarian systems, where land becomes infertile after some time, food was produced and gathered only as per requirements. As excess productions began to emerge, legal systems had to be innovated for exchange with others' excess production and private ownerships. Therefore, in stepwise transformation, capitalistic institutions started to grow in sixteenth and seventeenth century and finally matured in the nineteenth century. Now private ownership (decentralised mechanism of specialisation) and open markets were considered to help nations provide for the collective goals. The basis of capitalism was accumulation of capital in the hands of few (Karl Mark's prediction) or many with access to market.

The sixth chapter builds on the discussion of the previous chapter on the private ownership and exchange. Markets and prices are central to the idea of capitalism but precondition (what we teach in classes as assumptions) of private ownership of resources by all, is often not highlighted. Private ownership is established when society accepts it and exchanges are voluntary. Ownership and legal systems to protect these develop overtime and are still developing. Giving the example of Coase's theory (based on doctor-confectioner court case), the author argues that once ownership is decentralised the most efficient allocation takes place and it does not matter who owns the rights, although certain assumptions need to be invoked. Chapter seven furthers the issue of externalities, transaction costs and the allocation of resources. Who is assigned the rights does matter because it redistributes the wealth and the prices do not reflect the true value for the users due to transaction costs. Therefore, markets are not to blame, in Coase's example it is the court.

The next chapter dwells on the role of firms and households in the context of resource allocation. In explaining the firm's decisions for business, which are based on expected profit and loss, Demsetz refers to the classic works, such as *Risk, Uncertainty and Profit* (1921) by F. H. Knight and *The Modern Corporation and Private Property* (1932) by Adolf A. Berle and Gardiner Means. Knight, in his book, explained that it was the uncertainty and not the risk (where some probability can be assigned), which made the firms profitable. Berle and Means, on the other hand, talked about the internal organisation of the firms. Firms make their decisions on the basis of prices, technology and profit seeking behaviours.

In the ninth chapter, the author compares the political system with those of the firms and market, with the simple logic that firms provide private goods and governments provide public goods. The firms are relatively quick to adapt to changes whereas political parties, due to their internal inconsistencies, are reluctant to adapt and maintain a consistent position. The penultimate chapter of the book describes the case of public corporations, which are ironically referred to by Demsetz as Socialist entities within the capitalistic structure. He further elaborates how it has been proven empirically that the decisions are not made by all but are rather concentrated in a few hands only, which gets the management into agency problems.

In the final chapter of the book, Demsetz introduces the interdisciplinary debate on human species, now commonly referred to as the Homo Economicus. He argues that all the influential writers of the time had taken lessons from the previous influential works of others and the contemporary interdisciplinary pieces of works. He further states that lack of commonality is the barrier for a successful interaction, though each discipline has its own concerns/puzzles based on which specific tools are developed. Unlike a natural selection process of animals, competition is seldom present in markets; hence, this situation requires strong antitrust laws, such as the Sherman Antitrust Act of USA. Further, there are no norms for the animal kingdom and therefore, there is no reference of chaos, orderly distribution of goods, etc. but the man has to consider the normative aspects for society as well.

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Shorter Notice

Ofwona Adera, *et al.* (eds.) *ICT Pathways to Poverty Reduction: Empirical Evidence from East and Southern Africa.* Rugby, U.K.: Practical Action Publishing, IDRC. 2014. 271 pages. Paperback. U.K. £ 17.96.

This book discusses the innovative usage of mobile phones and internet in resource-limited situations in eastern and southern Africa. It addresses questions such as how does information communication technologies (ICTs) usage help in eradicating poverty in eastern and southern Africa and what are the challenges still faced by the countries in formalising the process of ICT so that it helps in eradication of poverty by using innovative techniques. The book is a collection of studies done on various countries in eastern and southern Africa, including Kenya, Tanzania, Rwanda, South Africa, and Namibia. The book also includes an introductory chapter, which gives an overall situation of ICTs and poverty in Africa as well as a summary of the analysis done in the entire book. Recommendations and conclusions are presented in the last chapter. The book calls ICTs a developmental process, which could be used as a powerful tool for empowerment and income generation in developing countries as well as for increasing access to education and other social services. One of the interesting aspects of the book is that it comprehensively reviews the important topic of political economy of the ICTs, which is the subject of second chapter. The qualitative analysis shows the advantages and disadvantages of ICTs usage, such as saving in travel time, costs reduction, information about the latest news, socialisation, jobs, running individual businesses, and security in emergencies. The chapter on the ICTs usage in Kenya shows that people are reluctant to use modern ICTs tools, such as internet and mobile phones; instead, they rely on old ICTs, such as TV and radio. ICTs improves the livelihood of the people of Kenya by enhancing human capital in terms of gain in valuable knowledge and skills, increase in income, reduction in vulnerability, and having a voice in how they are governed. On the other hand, in Tanzania, increase in usage of internet and mobile phone has resulted in decline in income poverty. The South African case shows that the impact of use of ICTs, especially the use of computers, enhances quality of life. More importantly, there is not a single case that shows that quality of life declines after using ICT tools. Nevertheless, the author believes that intensity of ICT intervention is necessary to eradicate the extent of poverty. In Namibia, the gap between internet accessibility has narrowed due to availability of internet on mobile phones. However, it is not clear if it increases the quality of life. The analysis is done by taking age and gender into consideration but it cannot be said unambiguously that ICTs are strongly associated with poverty reduction. Although, the book does not come up with conclusive evidence whether the ICTs affect poverty or not, one conclusion is straight forward that ICTs build capabilities to reduce poverty rather than reducing poverty directly. *(M. Ali Kemal)*