ISSN 1811-5438

THE LAHORE JOURNAL OF ECONOMICS

Lahore School of Economics

Volume 24, No.2 **July-Dec, 2019**

THE LAHORE JOURNAL OF ECONOMICS

Indexing/Abstracting: Journal of Economic Literature (JEL), EBSCO, ProQuest, Library of Congress, and British Library
Editorial Staff: Tele. No: 0092 - 42 - 36560969
Telefax: 0092 - 42 - 36560905
E-mail: nina@lahoreschool.edu.pk, nina_lse@yahoo.com
Publisher: Lahore School of Economics, Lahore, Pakistan.

Correspondence relating to subscriptions and changes of address should be sent to *The Lahore Journal of Economics*, 104 -C-2, Gulberg-III, Lahore - 54660 – Pakistan.

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24 2019

THE LAHORE JOURNAL OF ECONOMICS

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The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 1–23

A Fan Chart Approach to Debt Sustainability in Pakistan*

Mehak Ejaz ** **and Kalim Hyder** ***

Abstract

Pakistan's economy has experienced relatively high growth of above 4.5 percent during FY2014-18. Meanwhile external liabilities and domestic debt have increased by almost 50 percent over the same period. This substantial increase in the external and domestic debt is a major issue for policymakers concerned about debt sustainability in Pakistan. With the objective of analyzing debt sustainability in Pakistan, this study applies a probabilistic approach to project the debt path from FY2019 to FY2025. In this approach, projections of the primary balance are derived from the estimated fiscal reaction function while the density forecast of external debt is derived from various statistical and structural models. The forecasts of the primary balance and the external debt along with the shocks of real GDP growth, real exchange rate and real interest are incorporated in the debt accumulation identity. This procedure provides a fan chart of the total debt-to-GDP ratio, which represents the appropriate uncertainty associated with the projections. The key finding of the paper is that external debt is reasonably sustained; however, the situation of the total debt is alarming. External debt may witness a declining trajectory in FY2019-20 and then remain stable within the range of 20-30 percent of GDP. However, the total debt-to-GDP ratio is rising throughout the projection period, which starts from around 100 to 175 percent of GDP in FY2020 and FY2025 and is higher than any sustainable threshold level. Therefore, policy makers need to contain fiscal deficits by domestic resource mobilization and the adoption of austerity in spending on a priority basis.

Keywords: Pakistan, public debt, external liabilities, debt sustainability, probabilistic approach.

JEL Codes: F34, F47, H63, H68.

* The views expressed in this paper are those of the authors and not of their institutes.

** Assistant Professor at Department of Economics, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST), Pakistan.

*** Senior Economist, Monetary Policy Department, State Bank of Pakistan.

1. Introduction

It is the responsibility of the government to provide public goods and services and honor both its current and future debt obligations. The solvency condition is met if the government has the ability to meet its financial obligations on time. Solvency refers to the sustainability of public debt. In other words, the present value of primary balances of the government should be equal to the existing debt. the analysis of debt sustainability is concentrated on the relationship between the primary balance and debt. Mendoza and Oviedo (2004) explain sustainability as the strategy of the government to satisfy its inter-temporal budget constraint. In addition, the debt sustainability and solvency conditions require forecasts of economic fundamentals, which are not typically accurate. Therefore, the computation of sustainability and solvency involves informed judgments since, for instance, seigniorage is not considered in the computations of the primary balance. Therefore, point forecasts without consideration and discussion of the uncertainty involved provide a number needing careful interpretation. Hence, debt sustainability analysis requires forecasts of the debt along with the uncertainty associated with it so that appropriate judgments can be made.

Debt sustainability analysis (DSA) is a medium-term framework of the debt dynamics of a country, which the International Monetary Fund (IMF) uses for sustainability analysis. A declining trend of the debt-to-GDP ratio is considered a good indicator, whereas an increasing trend raises concerns in this regard. On the basis of these, the IMF prescribes stabilization measures for debt management and the reduction of debt in the medium-term. In order to consider the uncertainty in the deterministic approach, bounds tests are used in DSA to compare the alternative debt paths by means of simulations. These simulations use a variety of assumptions of economic growth, interest rates, the exchange rate and primary balances. Further, country specific exogenous shocks to debt such as "circular debt" (such as the fiscal pressures associated with liabilities due to unpaid electricity bills in Pakistan) and others are also incorporated to simulate the debt path. Celasun et al. (2006) suggest considering the coherence or covariance structure among these shocks for better calculations. Uncertainty regarding future fiscal policy and macroeconomic conditions creates doubt for the DSA. Therefore, there is a need to consider a probabilistic approach for DSA. Our paper considers the methodology of Melou et al. (2014) and Celasun et al. (2006) for the debt sustainability analysis of Pakistan. In the literature on DSA, our value addition is the application of the probabilistic approach to analyze the debt

sustainability of Pakistan. Further, we derive the probabilistic projections of external debt whereas Melou et al. (2014) and Celasun et al. (2006) assume a constant share of external and domestic debt in total debt for the projected period. Pakistan is a foreign exchange-constrained economy and this is the reason behind relaxing the assumption of a constant share of external debt. We consider the uncertainties of economic fundamentals and fiscal policy to derive the future probabilistic path of debt for debt sustainability analysis.

This article begins with the determination of fiscal behavior by estimating the fiscal reaction function. In addition, the external debt from a variety of statistical and structural models is forecasted and finally, the probabilistic medium-term path of the debt-to-GDP ratio is presented. The fiscal reaction function represents the fiscal policy pattern in which the primary balance is explained by using the previous levels of the debt and the output gap along with other control variables. We forecast the external debt by univariate, bivariate and multivariate VAR models and represent the probabilistic forecast of the external debt with a fan chart. Finally, we use the conventional stock flow identity to derive the debt-to-GDP path for the medium term.

After the introduction, sections 2 and 3 present the literature review and stylized facts related to fiscal behavior and the external sector soundness of Pakistan relative to the rest of the world. Section 4 discusses the approaches of debt sustainability, and the theoretical and methodological framework. Data sources are given in section 5 and the results are discussed in section 6 while section 7 concludes the article.

2. Literature Review

Daniel et al. (2003), Ostry and Abiad (2005), Garcia and Rigobon (2004), Penalver and Thwaites (2004), Celasun et al. (2006), Celasun and Kang (2006), Celasun et al. (2006), and Melou et al. (2014) are important studies which conduct debt sustainability analyses. These studies consider the fiscal reaction function and perform a stochastic analysis of debt. Daniel et al. (2003) introduce the concept of over borrowing, that is, when debt is higher than the specific threshold level. The estimates of the threshold level of debt vary amongst the studies. The IMF (2002) estimates a threshold of 40 percent of GDP, Schimmelpfennig et al. (2003) estimate a threshold of 50 percent of GDP, while Reinhart et al. (2003) suggest a threshold in the range of 15-20 percent of GDP for the countries that have a history of multiple defaults. The issue of debt sustainability becomes a major concern

when the debt-to-GDP ratio exceeds the threshold level. Better estimation of the fiscal reaction function, threshold level and debt forecast for the medium-term are important for DSA. Ostry and Abiad (2005) introduce political and institutional variables in the estimation of the fiscal reaction function and explore the determinants of over-borrowing, and they find that the impact of fiscal reforms and institutional changes on debt levels. Melou et al. (2014) and Celasun et al. (2006) combine the fiscal policy reaction functions suggested by Ostry and Abiad (2005) with the stochastic analysis of debt in in Garcia and Rigobon (2004) and Penalver and Thwaites (2004). Another strand of the literature discusses debt sustainability in conjunction with Dynamic Stochastic General Equilibrium models. Fournier (2019) examines debt sustainability issue using the buffer stock model in which the public debt limit concept is incorporated. The public debt limit is a sort of threshold level beyond which governments may lose market access. The concept of the buffer stock model is similar to the cash buffer concept of Deaton (1989) and Carroll (1997). Bohn (2007) suggests lenders may impose additional bounds on debt or deficits, and a new stream of literature provides model-based debt limits (Bi, 2012; Ghosh et al., 2013; Fournier & Fall, 2017). The risk of losing market access might also arise if liquidity risks constrain solvent governments (Cole & Kehoe, 2000). Chandia and Javid (2013) estimate the fiscal reaction function in order to analyze the debt sustainability issue in the economy of Pakistan.

3. International Comparison: Debt Sustainability in Pakistan

This section presents an international comparison of public debt position, fiscal capacity, external savings and future debt paths of Pakistan's economy relative to other countries. We rely on IMF data for the comparisons presented in this section. Pakistan's economy is currently maintaining a fairly average position relative to the rest of the world regarding its debt burden, which is between 50-70 percent of GDP. However, its overall as well as its primary deficits on fiscal accounts along with a low level of foreign exchange reserves and ballooning current account deficits raises concerns regarding the sustainability of debt in the medium term. Figure 9 and 10 present the projections of the IMF regarding the debt burden of Pakistan. In the projection period, a rising trajectory of net as well as gross debt-to-GDP ratio are indicating deteriorating debt sustainability in Pakistan. Nonetheless, according to the IMF's own data in 2017, the debt position of Pakistan seems reasonable. Figure 1 indicates that Pakistan's gross debt as a percent of GDP is between 50-70 percent, which is higher than the threshold of 40-50 percent estimated by IMF (2002) and Schimmelpfennig et al. (2003), respectively. However, the threshold level

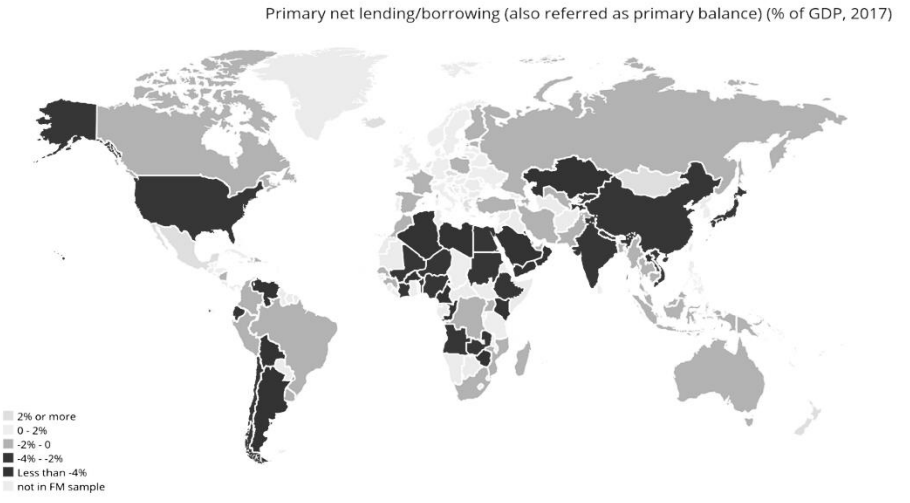
for the Pakistan's economy should be lower than the estimates for emerging economies. The reason for such a strict threshold is because of the restructuring of public debt (Asonuma, 2016).

The primary budget balance-to-GDP ratio of Pakistan is between 0 and -2 percent, and ideally should be zero or less than zero. This core indicator of debt sustainability indicates that if the debt stock accumulation is on an increasing path then fiscal dis-savings will add to the debt burden. Figure 3 reflects a similar situation, where the overall deficit exceeds 4 percent of the GDP. The gap between spending and revenues is widening over time. The primary and overall fiscal deficit indicate that the government is following a debt accumulating path, hence domestic and external borrowing are required to finance the expenditures and repayments.

Figure 1: Gross Debt Percent of GDP

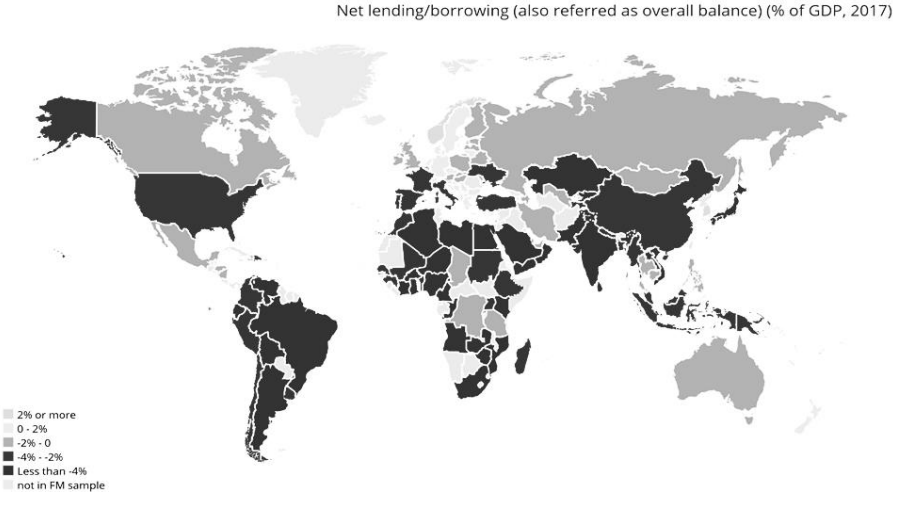
Source: Fiscal Monitor (October 2018).

Figure 2: Primary Budget Balance Percent of GDP



Source: Fiscal Monitor (October 2018).

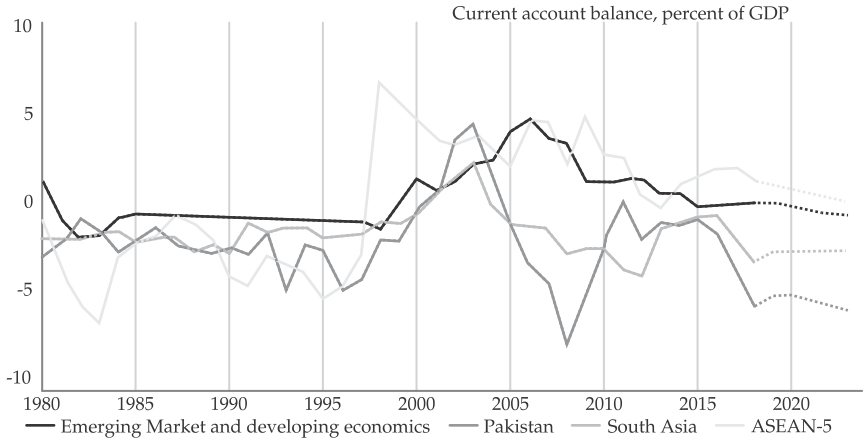
Figure 3: Overall Balance Percent of GDP



Source: Fiscal Monitor (October 2018).

On the external front, the deteriorating current account position, relative to other emerging economies, indicates that Pakistan's economy continues to rely on external resources to finance its current account deficits. This further adds to the burden of external debt. In contrast, the current account balance of ASEAN, emerging and other developing countries follows a smoother, more sustainable path as compared to Pakistan. The current account balance of the ASEAN countries has tended to be in surplus.

Figure 4: Current Account Balance percent of GDP



Source: World Economic Outlook (October 2018).

Figures 5 to 7 present Pakistan's foreign exchange reserve position. The ratio of reserves to short term debt falls in the range of 0.5-1.0. The reserves are less than three months of imports and the reserve to broad money ratio is less than 0.5. This indicates that the foreign exchange reserves of Pakistan are low according to a standard threshold. Therefore, an increase in the current account deficit requires external borrowing since the reserves do not provide any cushion to support ballooning external deficits.

Figure 5: Reserves to the Short Term Debt

Source: Assessing Reserve Adequacy - ARA

Figure 6: Reserves to Imports

Source: Assessing Reserve Adequacy - ARA

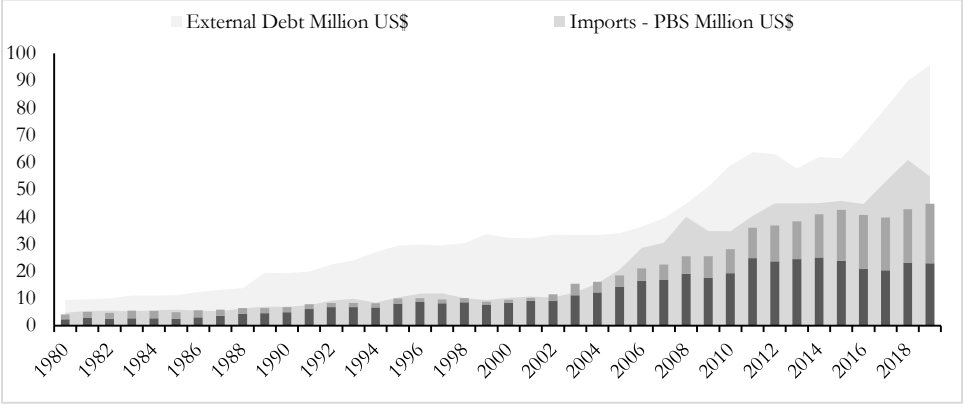
Figure 7: Reserves to Broad Money

Source: Assessing Reserve Adequacy - ARA

The inflows of foreign exchange from exports and remittances is less than the outflow of the foreign exchange through imports (Figure 8). This indicates that the stock of external debt is accumulating. The sum of exports and remittances is less than the imports by $13.14 billion and $18.02 billion in Fiscal Year 2018 and 2019, respectively. Massive depreciation of

the domestic currency can be considered as a solution but this will add capital losses to debt and increase the burden of debt servicing.

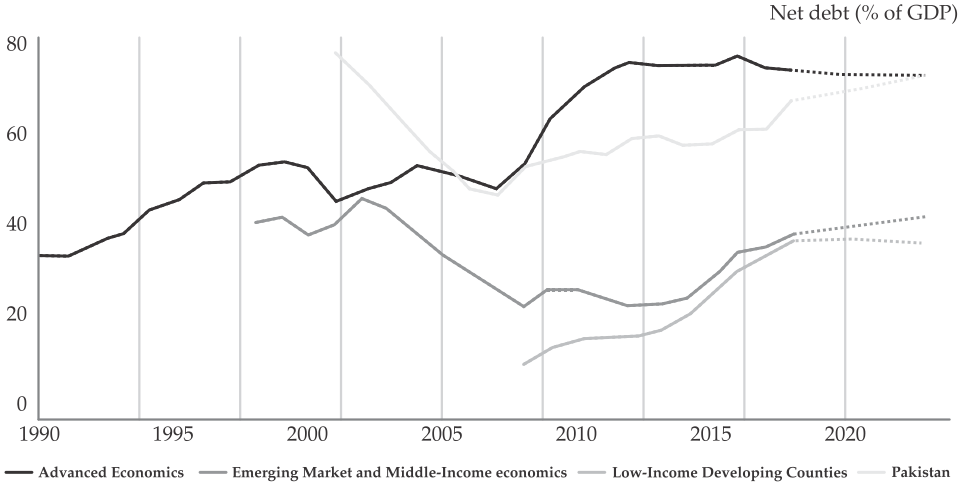
Figure 8: External Debt, Imports, Exports and Remittances Flows to Pakistan



Source: State Bank of Pakistan.

The current position of external and domestic debt raises concerns about their sustainability due to emerging deficits in the fiscal and external accounts. Figures 9 and 10 present these projections in the dotted lines. IMF projections indicate that net debt is increasing at a higher rate relative to that of emerging economies.

Figure 9: Net Debt Percent of GDP



Source: Fiscal Monitor (October 2018).

Figure 10: Gross Debt Percent of GDP

Source: Fiscal Monitor (October 2018).

Stylized facts indicate that expansionary demand management policies leading to higher fiscal and current account deficits may cause debt sustainability. Therefore, there is a need to analyze the situation further. We require a medium-term projection of the debt-to-GDP ratio for this purpose. In addition, in order to improve decision making, the uncertainty around the debt path is also to be estimated.

4. Theoretical and Methodological Framework

The main question that arises in this context is why should we project the probabilistic path or why do we forecast a debt path? The reason is that there prevails uncertainty as regards to the future condition of the economy. Celasun et al. (2006) and Melou et al. (2014) conclude that these uncertainties may arise due to increasing deficits, declining growth patterns, oil price shocks and global recessions. The point forecast of the debt-to-GDP ratio does not consider such changes. Therefore, the main objective of this study is to provide a forecast of the debt (external and total) and incorporate the projected uncertainties into it. The uncertainties can be considered in one of two ways: "deterministic" and "probabilistic". Generally, the IMF considers the deterministic approach in debt sustainability analysis (IMF, 2018). The deterministic approach is based on scenarios, and the projection of debt-to-GDP ratio is based on the fiscal policy directions and macroeconomic fundamentals. It has been observed that a declining trend of debt-to-GDP ratio is a good indicator. However, an increasing trend raises concerns (Daniel et al., 2003).

The Deterministic Approach: In this approach, the trajectory of the debt-to-GDP ratio is simulated by assuming different scenarios of economic growth. For instance, the trajectory of the debt-to-GDP ratio is conditional on economic growth of 5 percent and 2 percent. Debt Sustainability Analysis (DSA) by Daniel et al. (2003) is a deterministic approach in which the debt path is projected based on assumptions with regard to economic fundamentals (variables such as growth, interest rates, exchange rate and others). Alternative paths are projected by varying the assumptions regarding fiscal and macroeconomic variables such as low growth, high interest rates, lower primary balances and exogenous shocks to debt increase coming from depreciation of the currency or off-budget obligations. The IMF provides the bands-of-debt path by considering different scenarios and checks these by bounds testing. The main criticism of this approach is the lack of consideration of uncertainties in a stochastic way.

The Stochastic Approach: The stochastic or probabilistic approach provides the measure of uncertainty around the debt forecasts by considering shocks to the explanatory variables. It provides the probability of change in the debt path due to uncertainties in the economic variables. For instance, growth fluctuates around its average owing to its variance. How does this distribution of growth change the debt projection and what is the probability of change in debt projection? The stochastic approach is also utilized by the IMF as introduced by Celasun et al. (2006). This approach comprises three steps: estimation of the fiscal behavior, estimation of shocks in macroeconomic variables and finally incorporating the two in a debt identity. This gives a forecast of the debt path and uncertainties associated with the forecast by considering the shocks in the economic variables and fiscal behavior.

The probabilistic approach of debt sustainability considers the inherent uncertainties of the economic fundamentals, whereas the deterministic approach is based on the exogenous path of these fundamentals. For instance, the scenarios of the debt path in the deterministic approach are derived from the assumed trajectory of economic growth, interest rates and the twin deficits. However, being a small open economy, Pakistan's economy is vulnerable to external and domestic shocks. Therefore, the probabilistic approach is preferable as it considers stochastic movements in the economic fundamentals. Further, seigniorage is not considered in the computations of the primary balance. Hence, point forecasts without consideration and discussion of uncertainty give a number that requires careful interpretation. Hence, debt sustainability analysis requires a forecast of the debt along with the uncertainty associated with it

so that judgments can be made in an appropriate way. The stochastic approach suggested by Celasun et al. (2006) and Melou et al. (2014) assume a fixed share of domestic and foreign debt in the projections of total debt. However, the share of domestic and external debt may vary in the forecasted period due to the varying impact of external and domestic factors. We introduce varying projected shares of external and domestic debt in the projection of public debt for the medium term.

Primarily, debt sustainability analysis has been developed by the IMF and most of the work related to DSA is undertaken by the IMF (Daniel et al., 2003; Celasun et al., 2006; Ostry & Abiad, 2005; Melou et al., 2014). Therefore, the methodology of our study is based on the IMF framework. This section presents the methodology of forecasting external and total debt by using the probabilistic approach. We start with the specification of the fiscal reaction function that explains the behavior of the primary surplus by using debt, output gap and other control variables. After the estimation of the fiscal reaction function, we specify various models for the determination and forecasting of external debt. These models are based on a statistical technique and structural relationships. In order to identify the shocks in the economic fundamentals, the VARX of endogenous variables of real GDP growth, real exchange rates, and real interest rates and primary fiscal deficits and exogenous variables of world GDP growth and foreign real interest rates are included. The fiscal reaction function, probabilistic forecast of external debt along with the shock generated from the VARX will be incorporated into the debt motion equation. This provides the density forecast of the debt-to-GDP ratio in the fan chart. Daniel et al. (2003) Celasun et al. (2006), Ostry and Abiad (2005), and Melou et al. (2014) assume a constant share of external and domestic debt in the overall public debt, which indicates that the countries are not constrained in foreign exchange. However, we consider that the external debt accumulation depends on the its determinants such as the current account deficit and other external inflows and fiscal discipline.

Following Celasun et al. (2006) Melou et al. (2014), we specify the fiscal reaction function as follows:

$$pb_t = \alpha + \beta_1 \ d_{t-1} + \beta_2 \ Gap_t + \Gamma_t \ X_t + \epsilon_t \quad (1)$$

Where pb_t is the primary surplus-to-GDP ratio, d_{t-1} is the lag of total debt, Gap_t is output gap and X_t is a vector of control variables. The fiscal reaction function is estimated by using simple OLS. However, there is a possibility that the output gap can cause endogeneity. Therefore, we consider

estimating the fiscal reaction function with 2SLS and GMM. GMM yields more efficient and consistent estimates as compared to the estimates of 2SLS. The choice of a better instrument in the case of such a technique is an important issue. We include international oil prices, US interest rates and lagged values of the output gap in the list of instrumental variables. LIML estimations are also considered for robustness in the case of weak instruments. Further, dummy variables for political regimes and IMF programs are included as control variables.

The second step of the methodology is to find out the density forecast of external debt. Unconditional mean, random walk with drift, random walk with drift and trend, autoregressive, moving average, autoregressive and moving average models are estimated in the category of univariate statistical models. Bivariate vector autoregressive models are estimated by considering the current account deficit, gross foreign borrowing and real exchange rate as determinants of external debt. Multivariate vector autoregressive models consider the real exchange rate, real exports, real imports, trade balance, current account balance, fiscal deficit, primary deficit, economic growth, foreign exchange reserves, international oil prices, interest payments, amortization and gross foreign borrowing to determine the external debt. These exogenous and endogenous variables are used to construct various VAR models to forecast external debt. In addition, international oil prices, world inflation and world growth are used as exogenous variables in the estimations of VAR models. The details of the models are presented in Table 1. These models provide the forecast of external debt for the medium term. The probability of the forecast of each model is used to derive the fan chart of the external debt.

Table 1: Statistical and Structural Models of External Debt

Models	Specification	Exogenous Variables
Univariate Models	Unconditional Mean	$\Delta Ln(D_t^f) = \alpha + \mu_t$
	Random Walk with Drift	$\Delta Ln(D_t^f) = \alpha + +\beta \Delta Ln(D_{t-1}^f) + \mu_t$
	Random Walk with Drift and trend	$\Delta Ln(D_t^f) = \alpha + +\beta \Delta Ln(D_{t-1}^f) + \gamma * t_t + \mu_t$
	AR	$\Delta Ln(D_t^f) = \alpha + \sum \beta_i AR_{(t-i)}$
	MA	$\Delta Ln(D_t^f) = \alpha + \sum \beta_i MA_{(t-i)}$
	ARIMA	$\Delta Ln(D_t^f) = \alpha + \sum \beta_i AR_{(t-i)} + \sum \gamma_i MA_{(t-i)}$
Bivariate VAR Models	CA and External debt Trade balance and External debt Gross foreign borrowing and External debt Real exchange rate and External debt Real exchange rate, current account deficit and External debt Real exports and External debt Real Imports and External debt Foreign exchange reserves and External debt	$\begin{bmatrix} \Delta Ln(D_t^f) \\ \Delta Ln(X_t) \end{bmatrix} = \Gamma \begin{bmatrix} \Delta Ln(D_{t-i}^f) \\ \Delta Ln(X_{t-i}) \end{bmatrix}$
Multivariate VAR Models	CA, real exchange rate and External debt Trade deficit, real exchange rate and External debt Real exports, real imports, real exchange rate and External debt Real exports, real imports, real exchange rate and External debt Real exports, real imports, real exchange rate, inflation in consumer prices and External debt	$\begin{bmatrix} \Delta Ln(D_t^f) \\ \Delta Ln(Y_t) \\ \Delta Ln(X_t) \end{bmatrix} = \Gamma \begin{bmatrix} \Delta Ln(D_{t-i}^f) \\ \Delta Ln(Y_{t-i}) \\ \Delta Ln(X_{t-i}) \end{bmatrix}$

International oil prices, US real interest rates, gross foreign borrowing, remittances, US inflation in consumer prices and US real GDP along with the dummy variables for IMF programs, rescheduling and democracy are considered as exogenous variables.

Source: Authors.

In the third step, the VARX is estimated using the real GDP growth ($\Delta(real\ GDP)_t$), real interest rate on domestic debt ($\Delta\left(real\ r^d\right)_t$), real interest rate on foreign debt ($\Delta\left(real\ r^f\right)_t$) and real exchange rate ($\Delta(real\ e)_t$) as endogenous variables whereas global GDP growth (ΔY_t^f), real global interest rate ($\Delta\left(real\ r^{f*}\right)_t$) and global oil prices ($\Delta(Oil_t)$) are used as exogenous variables.

$$Y_t = \Gamma Y_{t-i} + \phi_1 X_{t-i} + E_t\ , \tag{2}$$

$$Y_t = \begin{bmatrix} \Delta(real\ GDP)_t \\ \Delta\left(real\ r^d\right)_t \\ \Delta\left(real\ r^f\right)_t \\ \Delta(real\ e)_t \end{bmatrix}, \mathrm{X_t} = \begin{bmatrix} \Delta Y_t^f \\ \Delta\left(real\ r^{f*}\right)_t \\ \Delta(Oil_t) \end{bmatrix}$$

Finally, the shocks in the endogenous variables of the VARX along with the shocks to the primary balance from the fiscal reaction function and density forecast of external debt, are used in the debt accumulation identity to construct probabilistic projections of the public debt-to-GDP ratio.

Melou et al. (2014) presents the specification of the debt accumulation identity as follows:

$$D_t = D_{t-1} + \left(i_t^d \frac{D_{t-1}^d}{D_{t-1}} + i_t^f \frac{D_{t-1}^f}{D_{t-1}}\right) D_{t-1} + \Delta e_t \left(1 + i_t^f\right) D_{t-1}^f - PB_t + S_t \tag{3}$$

D_t, $D_t^d$and D_t^f are the total public debt, domestic debt and external debt, respectively. i_t^d and $i_t^f$are the nominal interest rate on domestic debt and external debt, respectively. Δe_t is the rate of depreciation of the nominal exchange rate, PB_t is the primary balance, and S_t is the adjustment of flows. Following Melou et al. (2014), we divide both sides of the equation by nominal GDP, which after rearranging gives:

$$d_t = \frac{1}{1+g_t}(d_{t-1} + \left(i_t^d \frac{d_{t-1}^d}{d_{t-1}} + i_t^f \frac{d_{t-1}^f}{d_{t-1}}\right) d_{t-1} + \Delta e_t \left(1 + i_t^f\right) d_{t-1}^f - pb_t + s_t \tag{4}$$

where d_t, d_t^d, d_t^f, pb_t and s_t are total public debt, domestic debt, external debt, primary balance and adjustment of flows as fraction of nominal GDP, respectively.

5. Data Sources

We collect data from 1973 to 2018 from various issues of the Pakistan Economic Survey (2018) and Annual Reports of the State Bank of Pakistan (2018). In the case of international variables, we use the online data base of Haver Analytics (2005) and the International Financial Statistics of the IMF (2018).

Table 2: Variable Description

Variables	Symbols	Source
Domestic Debt	D_t^d	State Bank of Pakistan
External debt & liabilities	D_t^f	State Bank of Pakistan
Output Gap	Gap_t	Constructed by HP filter
Dummy for IMF programs	IMF_t	IMF
Dummy for democracy	DEM_t	Constructed
Dummy for Rescheduling	$RESC_t$	IMF
Primary balance	PB_t	Economic Survey of Pakistan
Fiscal Balance	FB_t	Economic Survey of Pakistan
Real GDP	Y_t	Economic Survey of Pakistan
Foreign Exchange Reserves	$FOREX_t$	State Bank of Pakistan
Gross total debt	GD_t	State Bank of Pakistan
Net total debt	ND_t	State Bank of Pakistan
current account balance	CA_t	State Bank of Pakistan
short term debt	D_t^S	State Bank of Pakistan
real Imports	IMP_t	Economic Survey of Pakistan
remittances	REM_t	Economic Survey of Pakistan
Real exports	EXP_T	Economic Survey of Pakistan
broad money	$M2_t$	State Bank of Pakistan
Real exchange rate	ER_t	State Bank of Pakistan
real interest rate	R_t	State Bank of Pakistan
CPI	CPI_t	Economic Survey of Pakistan
US interest rates	R_t^{US}	Haver
trade balance	TB_T	State Bank of Pakistan
Global oil prices	Oil_t	Haver
Domestic debt servicing	DS_t^d	State Bank of Pakistan
External debt servicing	DS_t^f	State Bank of Pakistan
gross foreign borrowing	GFB_t	State Bank of Pakistan
world inflation	π_t^f	Haver
world growth	g_t^f	Haver

Source: Authors.

6. Results

This section starts with the discussion of the estimates of the fiscal reaction function. The forecast of the primary balance is derived from the GMM estimates of the fiscal reaction function. Further, the stochastic

forecast of the external debt is computed from the univariate, bivariate and multivariate models. These forecasts of external debt yield the fan charts for the external debt. Then, VARX is estimated to find out the shocks of real economic growth, real exchange rate, and real interest rate. Finally, the forecast of the primary balance, external debt and shocks to the economic fundamentals are incorporated in the debt accumulation identity to derive the probabilistic projected path of the public debt-to-GDP ratio.

The fiscal reaction function specified in Equation 1 is estimated using OLS, 2SLS and GMM. Instrumental variable techniques are used to tackle the issue of endogeneity due to the output gap. LIML is preferable to GMM estimates in the case of weak instruments; therefore, the results of the LIML are also reported in Table 1. The estimates of the fiscal reaction function are consistent with the same reported by Celasun et al. (2006). The estimation results are robust across 2SLS, GMM and LIML techniques. GMM yields more efficient and consistent estimates than 2SLS. As it turns out, the parameter estimates of LIML are consistent with GMM estimates, thereby confirming that there is no issue of weak identification in the estimations. Based on the within-sample root mean square error (RMSE), we consider GMM results to forecast the primary balance-to-GDP ratio. In the instrumental variable specifications, the Sargan J statistics - with null hypothesis that the over-identifying restrictions are valid, fail to reject the null hypothesis, thus confirming that the over-identifying restrictions are maintained.

Table 3: Estimates of Fiscal Reaction Function

Variables	OLS	2SLS	GMM	LIML
Constant	-0.090	-0.100	-0.100	-0.110
d_{t-1}	0.080	0.090	0.100	0.094
Gap_t	0.210	0.341	0.372	0.383
IMF	0.010	0.010	0.010	0.012
Dem	-0.002	-0.002	-0.002	-0.002
Resc	0.014	0.013	0.011	0.008
DW	1.910	1.880	1.800	1.840
J-Stat	-	4.060	4.210	-
Prob	-	(0.14)	(0.12)	-

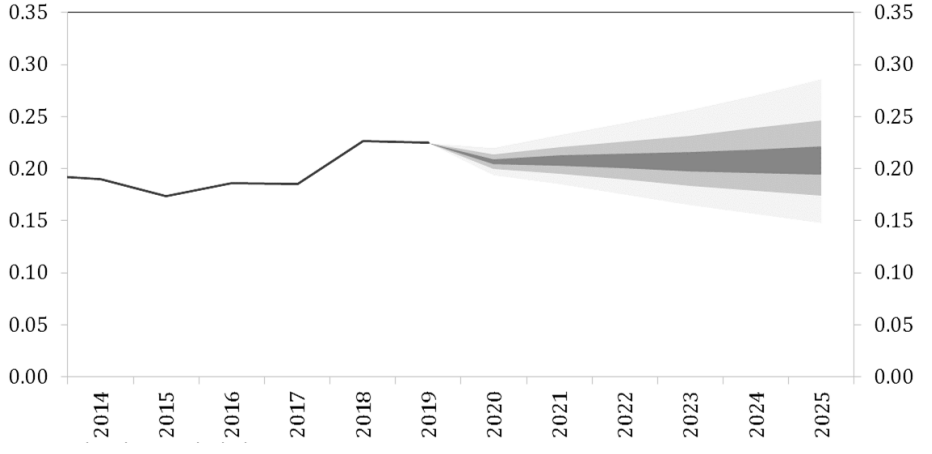
Source: Authors' calculations.

Notes: Dependent variable is the primary balance-to-GDP ratio. All variables are significant at 5% level.

After estimation of the fiscal reaction function and the forecasting of primary balance-to-GDP ratio, the external debt is forecasted from a variety of statistical and structural models. Univariate, bivariate and multivariate models are used to formulate the density forecast of the external debt-to-

GDP ratio. Figure 11 presents the fan chart of external debt projections from FY2019 to FY2025. It indicates that the external debt relative to GDP witnesses a declining trajectory during FY2019 and FY2020 and then becomes stable around 20 percent. A 95 percent confidence interval indicates that the external debt-to-GDP ratio will be in the range of 18 to 28 percent in FY2025. This stability in the trajectory of the external debt-to-GDP ratio is due to the recent implementation of stabilization efforts of the government and the IMF program.

Figure 11: Fan Chart of External Debt (as percent of GDP)



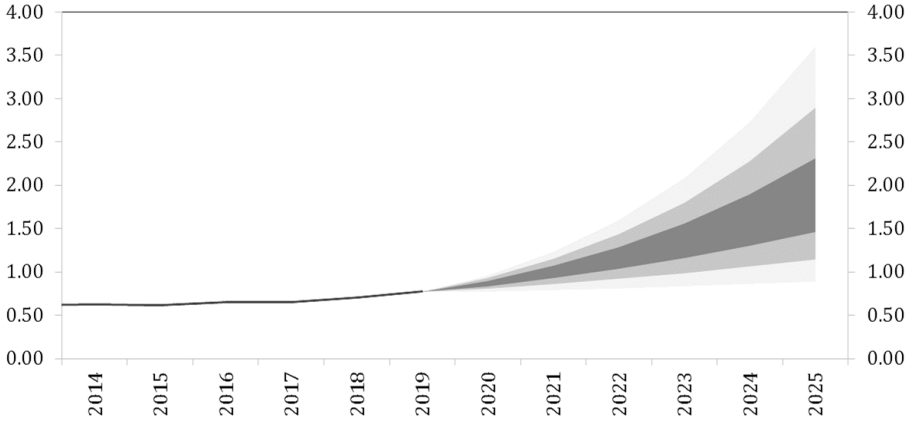
Source: Authors' calculations.

The projections of the primary balance-to-GDP ratio and the external debt-to-GDP ratio along with the shocks to economic growth, real interest rate and real exchange rate derived from VARX, are incorporated in the debt accumulation identity to produce the probabilistic projections of the overall debt-to-GDP ratio. The fan chart in Figure 12 of the probabilistic projections of the total debt-to-GDP ratio is raising concerns about debt sustainability in Pakistan. In the medium term, FY2019 to FY2025, total debt relative to GDP follows a rising trajectory. It starts to rise from almost 100 percent in FY2019 to 200 percent in FY2025. Not only is the projected level of debt-to-GDP increasing, but the amount of uncertainty associated with these projections is also widening over time. This indicates an alarming situation and requires urgent policy actions to avoid crisis.

The results suggest that the external debt is reasonably sustained but the situation of total debt is alarming. It is in contradiction with the basic Keynesian proposition in macroeconomics, the twin deficits

hypothesis, that there is a strong causal link between a nation's government budget balance and its current account balance. On the contrary, Ricardian equivalence proposes that the twin deficits are not related. Further, validity of the twin deficits hypothesis depends mainly on the exchange rate regime of the country. In the case of a flexible exchange rate, the link between the fiscal deficit and current account deficit becomes weaker. Anoruo and Ramchander (1998), Kim and Roubini (2008) and Grubisic et al. (2018) confirm that the fiscal deficit has no impact on the current account deficit, but that the current account deficit has an impact on the fiscal balances. In the case of Pakistan, Aqeel and Nishat (2000), Saeed and Khan (2012) and Yasmin (2015) present mixed results about the validity of the twin deficit phenomenon.

Figure 12: Fan Chart of Overall Debt (as percent of GDP)



Source: Authors' calculations.

7. Conclusion

This paper aims at providing the framework for the debt sustainability analysis by presenting the probabilistic projections of external and total debt-to-GDP ratio of Pakistan. The IMF developed the debt sustainability framework to provide the policy advice to the countries that approach the IMF. Initially, the IMF introduced the deterministic framework for the analysis of debt sustainability. But in order to capture uncertainty regarding the macroeconomic fundamentals and policy actions, simulations are performed on the basis of different paths of economic growth, real interest rates and the real exchange rate. Later, the stochastic or probabilistic approach is developed to better incorporate the uncertainty. Our contribution in this regard is the application of the

probabilistic approach to project the debt-to-GDP ratio for Pakistan. In addition, Pakistan's economy faces foreign exchange constraints. Hence, we relax the assumption of a fixed share of domestic and external debt-to-GDP ratio in the debt accumulation identity. For this purpose, we require a probabilistic forecast of the external debt-to-GDP ratio, and so for this purpose we develop a reasonable number of forecasting models of the external debt-to-GDP ratio. Finally, the forecast of the primary balance-to-GDP ratio and projections of the external debt-to-GDP ratio are incorporated in the debt accumulation identity that yields the fan chart of a debt-to-GDP ratio. In order to introduce appropriate uncertainty into these projections of total debt, we derive the shocks in economic growth, real exchange rate and real interest rates on domestic and external debt.

This study presents the projections of total debt-to-GDP ratio in the medium term (FY2019-FY2025). Along with the future trajectory of the debt-to-GDP ratio, it also presents the uncertainty associated with these projections by computing the probabilistic forecasts. The key finding of this study suggests that the external debt is reasonably sustained; however, the situation of total debt is alarming. External debt may follow a declining trajectory in FY2019-20 and then remain stable within the range of 20-30 percent of GDP. But the total debt-to-GDP ratio is currently following a rising trajectory throughout the projection period, and is above sustainable threshold levels. Therefore, there is a need for policy actions to contain the fiscal deficits by domestic resource mobilization and the adoption of fiscal austerity on a priority basis.

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The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 25–48

Productivity Dispersion across Districts in Punjab

Maryiam Haroon*

Abstract

Industrial clusters and special economic zones are key areas of focus for industrial policy makers who are aiming to expand the industrial base and increase competitiveness. Thus, the role of development of industrial clusters in the productivity improvement of manufacturing firms merits attention. We use the firm-level Census of Manufacturing Industries (CMI) and Directory of Industries (DOI) datasets to empirically investigate the relationship between agglomeration and firm level total factor productivity for different sectors in Punjab, Pakistan. Our findings suggest that there is a correlation between localization, urbanization and total factor productivity of firms in the Punjab. However, the relationship varies by sectors, necessarily pointing industrial policy towards sector-specific recommendations.

Keywords: Total factor productivity, industrial concentration, economic geography, Pakistan.

JEL classification: D24, L19.

1. Introduction

The concentration of industrial activity has long been a widely studied phenomenon. Agglomeration — defined as the presence of a number of distinct economic units within the same geographical location— occurs widely across economies of all types (see Krugman, 1995; Duranton and Puga, 2004). One of the seminal contributions of the new economic geography is to explicitly model "the self-reinforcing character of spatial concentration" (Fujita, Krugman & Venables, 1999; Krugman, 1991; Venables, 1996). Enquiries into the reasons for variation in growth levels and economic activity between geographical locations has long ascribed a role to agglomeration externalities. The basic underlying insight is that, without some form of agglomeration externalities, it is difficult to explain the existence of many cities. Since wages and land rents are typically higher in cities, employers would not locate there unless they were deriving some

* Assistant Professor, Department of Economics, and Research Fellow, Centre for Research in Economics and Business. Lahore School of Economics, Pakistan.

benefit from their urban location.

Industrial clusters have been a source of growth in both developed and developing economies as location impacts firms' individual productivity directly through agglomeration externalities. This allocation of factors shapes aggregate productivity (Hsieh and Klenow, 2009). Localization externalities, which are defined as the presence of activity from the same industry in a geographic area, raises productivity though externalities coming from input markets, labor markets or knowledge externalities (Marshall, 1920). Similarly, urbanization or inter-industry agglomeration, defined as the presence of activity from other industries in an area, can also be a source of positive externalities as industries borrow ideas and technology. Industrial diversity also generates pecuniary externalities in the form of output and input linkages (Rosenthal et. al; 2001; Combes et al. 2011) and inter-industry agglomeration economies (Jacobs 1984; Glaeser et al. 1992; Cainelli and Iacobucci, 2012).

Within industrial clusters there is a range of diversification, with some that may be specialized in a very small number of industries as are many medium-size American cities (Henderson, 1997), and others that house differentiated industries such as large metropolises including New York and Tokyo. These cities are highly diversified in that they nest many industries that are not related through direct linkages (Chinitz 1961; Fujita and Tabuchi 1997). Industrial districts involving firms with strong technological or informational linkages, or both (e.g., the Silicon Valley or Italian districts engaged in more traditional activities) as well as factory towns (e.g., Toyota City or IBM in Armonk, New York) manifest various types of local specialization. Therefore, it appears that highly varied size and activity arrangements exist at the regional and urban levels. There are many well-known examples in Pakistan such as the surgical goods and sports goods industries in Sialkot, Pakistan (Atkin et al., 2017; Nadvi, 1999; Nadvi, 2003).

This paper aims to identify the role of agglomeration externalities in the productivity improvement of firms. Based upon our findings we aim to rank sectors to maximize the benefits from industrial clustering. Our research provides recommendations for the development of industrial districts and special economic zones for different sectors in Punjab. Our analysis is based on two firm-level data sets, which are the Census of Manufacturing Industries (CMI) and Directory of Industries (DOI) for 2011 and 2006. Our findings also suggest that there is a correlation between

localization, urbanization and total factor productivity (TFP) of firms in the province. However, the relationship varies across sectors. Thus, our results suggest that polices focusing on development of special economic zones and industrial parks should be sector-specific rather than general in nature.

2. Data

We have used the CMI 2005-06 and 2010-11 for Punjab, Pakistan. The CMI is a firm level data set, which includes information on various firm level characteristics including sales, products, employment, raw materials, energy usage, and other information. We make use of this extensive dataset for two time periods and match the firms using their names, addresses, phone numbers and registration numbers to create a panel of manufacturing firms. We were able to match approximately 1300 firms in both years. We make use of this panel to calculate the productivity of each firm using semi-parametric approaches.

In addition to the CMI, we also make use of the DOI dataset for Punjab, Pakistan in two time periods i.e., 2010-11 and 2005-06[1]. The DOI contains information on all firms in the province with basic information on employment, district, industry and year of establishment. We make use of this dataset to calculate our agglomeration measures. In each year the dataset has information on more than 18,000 firms belonging to different industries. This is a rich dataset that lists all firms in Punjab. Since our access to a data set is limited to Punjab, our main focus is on presenting firm level TFP for Punjab, which is one of the largest and most economically active provinces of the country.

Punjab accounts for almost 60 percent of total annual production of goods and services of the country. The province's Gross Provincial Product grew at an average of 5.5 percent, this being higher than the 4 percent growth rate of the entire country. Manufacturing industries in Punjab contribute almost 58 percent to the overall industrial production of Pakistan and accounts for about 60 percent of value added in the country's manufacturing sector. So, the country's economic health is directly related to the province's growth rate.

The overall industrial structure in the province is dominated by small and medium enterprise (SME) clusters in Punjab. The province provides a very interesting case for analyzing industrial clusters primarily

[1] For graphs and tables we also use DOI 2014.

because it comprises both specialized and diversified districts. Some of the most concentrated industries are textiles, surgical instruments, auto parts, leather, and sports. Prominent concentrated districts include Lahore, Faisalabad, Sialkot, Gujranwala and Sheikhupura. Out of these districts, some are specialized ones such as Faisalabad which is considered as the main hub of textiles while Lahore is diversified in different industries such as food, auto parts, equipment and furniture.

3. Empirical Strategy

We aim to empirically estimate the correlation between TFP and agglomeration. We estimate the following equation:

$$\alpha_{iyrt} = \gamma loc_{yrt} + \delta urb_{rt} + \varphi X_{iyrt} + \varepsilon_{iyrt} \quad (1a)$$

In Equation (1a) total factor productivity (α_{iyrt}) of firm i in industry y region r and time t is a function of localization (loc_{yrt}) of industry y region r and time t, urbanization (urb_{rt}) in region r and time t, firm level controls (X_{iyrt}) and an error term ε_{iyrt}.

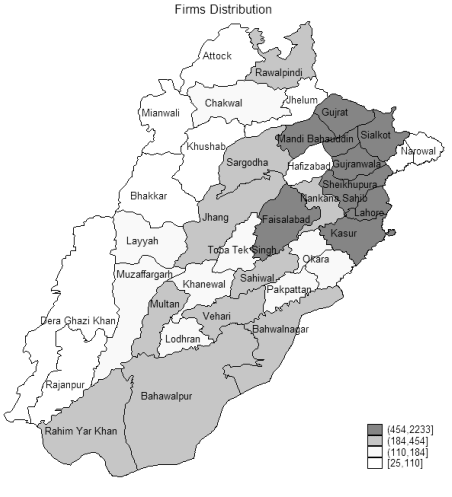
Our dependent variable (α_{iyrt}) is the TFP of firms calculated using the semi-parametric approach which includes Olley and Pakes (1996) and Levinsohn and Petrin (2003). We incorporated agglomeration using two components, which are localization (loc_{yrt}) and urbanization (urb_{rt}). Localization is referred to as the presence of similar activity (or presence of the same industry) in a region whereas urbanization refers to the presence of diversified activity (or presence of multiple industries). Localization in this study is taken as a relative measure which is defined as total employment in a sector y and district r as a ratio of total employment of a sector in Punjab. Urbanization is defined as total employment in a district r as a ratio of total employment in Punjab (irrespective of sector). We used the relative measures as compared to absolute measures since districts are not of equal size. Thus, relative measures are superior to absolute measures since relative measures account for region size. Our estimations will control for ownership status (private enterprise, public enterprises or foreign collaboration) and regions of Punjab (north, south, central or west), physical capital and labor.

4. Findings and Analysis

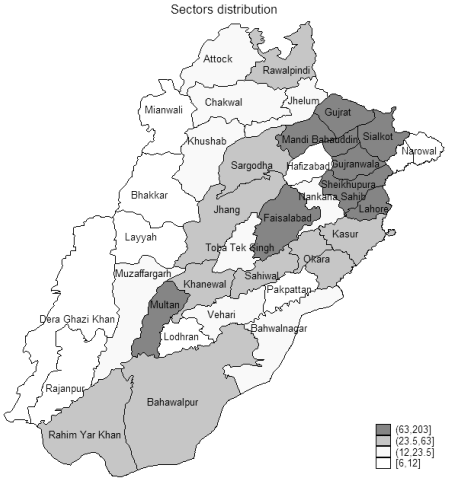
Our data presents some interesting facts about spatial patterns or layout of firms and sectors in Punjab. Figure 1 plots employment of firms and sectors across districts. Analyzing the spatial distribution of firms and sectors, we find that firms and sectors are mainly concentrated in a few districts and there is unequal distribution of activity, with greater concentrations in the central region of Punjab. Much of the activity is concentrated in the central part of Punjab, with highest levels of activity being located in the Lahore, Gujrat, Sialkot, Gujranwala, Faisalabad and Kasur districts. Following this, a moderate level of industrial activity can be witnessed in the districts of the southern Punjab including Bahawalpur, Rahim Yar Khan and Multan. Whereas west and north Punjab have the least activity present in terms of both firms and sectors. This clearly gives us the picture that firms, employment and sectors are not uniformly distributed across Punjab with central Punjab considered as the main hub of economic activity in Punjab.

Figure 1: Distribution of Firms and Sectors Across Districts of Punjab, Pakistan

Distribution of Firms Across Punjab, Pakistan



Distribution of Sectors Across Punjab, Pakistan



Source: Authors' calculations based on Directory of Industries 2014 for Punjab, Pakistan.
Note: Graphs used 5-digit industrial classification to define sectors.

Similarly, when we plot firms from various sectors across districts in Punjab as shown in Figure 2, we find some interesting results. Some

sectors are highly concentrated while others are dispersed. We find that 90% of firms in the sports and surgical industries are concentrated in the Sialkot district alone. Forty percent of firms in the textile sector are concentrated in Faisalabad and the rest of the textile firms are dispersed across other districts. We see leather and food sector is mostly dispersed across districts, while the electrical equipment industry is mostly concentrated in Lahore and in Gujranwala. Thus, this raises the question that do firms from sectors which are concentrated in a few districts derive significant productivity benefits?

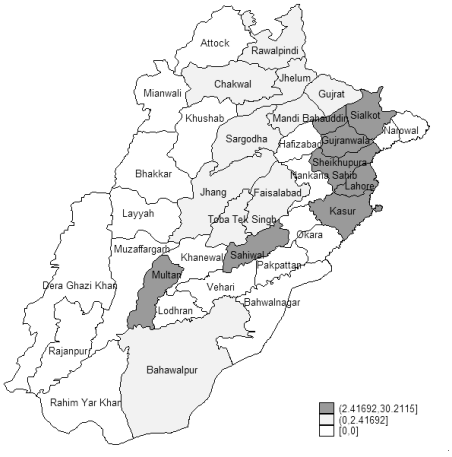
Figure 2: Distribution of Firms from Major Industries Across District in Punjab, Pakistan

Distribution of Firms from Sports Industry

Distribution of Firms from Surgical Industry

Distribution of Firms from Textile Industry

Distribution of Firms from Leather Industry



Distribution of Firms from Electrical Equipment Industry

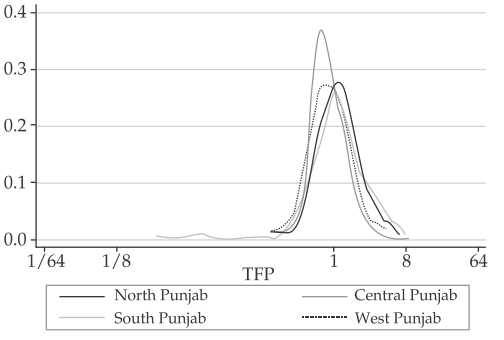
Distribution of Firms from Food Industry

Source: Authors' calculations based on Directory of Industries 2014 for Punjab, Pakistan.
Note: Two-digit industrial classification has been used to define Textile, Leather, Food and Electrical equipment industry and four-digit industrial classification has been used for Sports and Surgical instrument industry. The data used in the graphs is presented in Table 2A in appendix section.

In Figure 3, the distributions of TFP by region demonstrate that central Punjab has the least dispersed productivity with the highest mode. In comparison, north, south and west Punjab on average have the same (lower) level of average productivity and a more dispersed distribution. We then plot the log of total factor productivity for six individual districts of

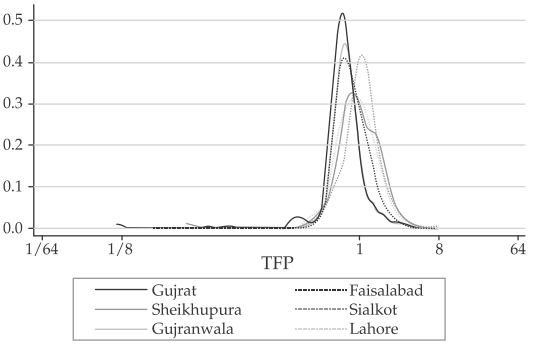
central Punjab (in Figure 4), which contains much of Punjab's industrial activity. We find that Sialkot has higher productivity firms as compared to other districts, which is as expected since Sialkot comprises the sectors which are heavily export-oriented. Sheikhupura and Lahore follow a similar trend with greater-than-average productive firms, while the distribution is more dispersed than Sialkot. Gujrat and Gujranwala have less productive firms. However, the distribution is narrow or less dispersed depicting that a large share of the extant firms are less productive.

Figure 3: Productivity distribution across regions of Punjab



Source: Authors' calculations based on CMI Punjab, 2011 and 2006.
Note: These graphs used TFP derived from regression using Olley and Pakes (1996) estimation method.

Figure 4: Productivity distribution across districts in Central Punjab

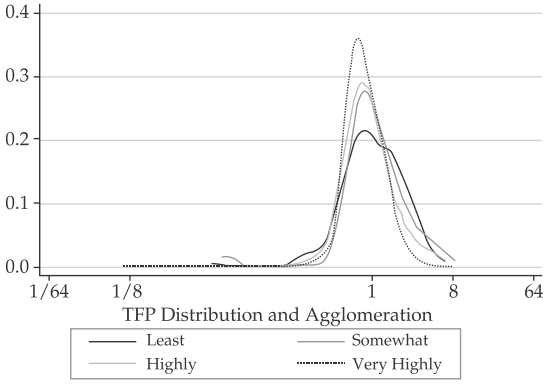


Source: Authors' calculations based on CMI Punjab, 2011 and 2006.
Note: These graphs used TFP derived from regression using Olley and Pakes estimation method.

We then plot the productivity of firms with respect to agglomeration (shown in Figure 5). We divided districts into four categories based upon their level of agglomeration. Categorization of agglomeration was done using the

employment share in a district as a ratio of total employment in Punjab using the Directory of Industries dataset. The four categories are least agglomerated, somewhat agglomerated, highly agglomerated and very highly agglomerated regions. The graph depicts that very highly agglomerated regions have the least dispersion. It also shows that the least agglomerated regions have the greatest dispersion. As the level of agglomeration declines from very highly agglomeration to least agglomerated, the distribution becomes wider. This motivates us to examine that whether agglomeration and firm productivity are correlated.

Figure 5: Productivity distribution according to level of agglomeration Punjab



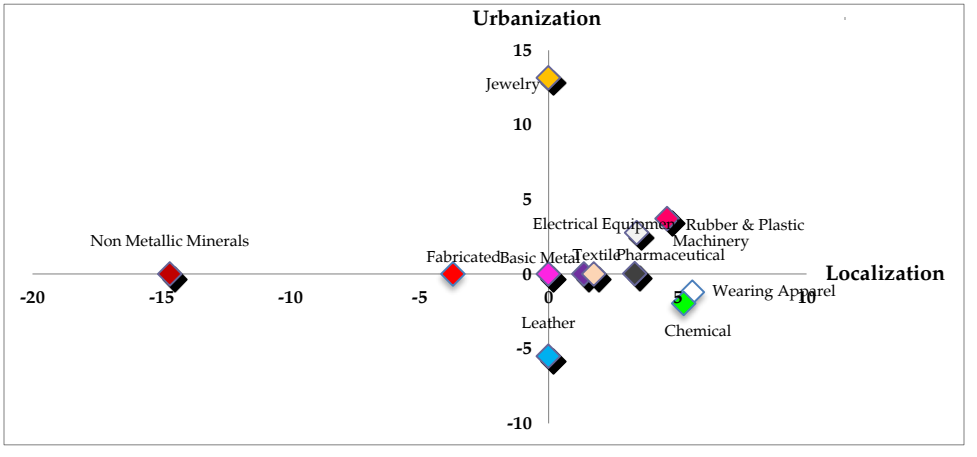
Source: Authors' calculations based on CMI Punjab, 2011 and 2006.
Note: These graphs used TFP derived from regression using Olley and Pakes (1996) estimation method. Agglomeration categorized based upon employment in a district as a share of total employment in Punjab using Directory of Industries (2006).

In order to find whether agglomeration is correlated with the productivity of firms, we estimated two-digit sector-level regressions to find the correlation between agglomeration and TFP. The correlation estimates of agglomeration economies (localization and urbanization) and total factor productivity for different industries at 2-digit industrial classification are presented in Table 1 and graphically represented in Figure 6. Based upon our findings, we identify whether a sector benefits from localization and/or urbanization economies. If an industry is likely to benefit from localization economies, then we may be able to recommend the development of specialized industrial clusters. But if an industry benefits from urbanization economies, then we may be able to recommend the development of special economic zones which are not specialized industrial clusters. After we identify the source of benefit for each industry we present our suggestions in Table 2. In Figure 7, for each industry we

recommend the location choice for the development of industrial clusters or special economic zones based upon our previous findings.

Table 1 and Figure 6 presents findings from sector-level regressions and reveal that localization and urbanization economies matter in the case of Punjab. However, they are beneficial for some sectors only.

Figure 6: Ranking sectors in terms of benefits from industrial concentration in Punjab



Source: Authors' calculations based on CMI (2011 and 2006) and DOI (2011 and 2006) for Punjab.
Note: Regression estimates from agglomeration and productivity estimation for different sectors, where sectors have been defined using two-digit industrial classification.

Our findings suggest that localization but not urbanization economies are beneficial for the textile and pharmaceuticals sectors (Table 1, Column 1& 5). The two industries will benefit if there is a specialized policy designed to make it more concentrated. The policy focus for both sectors should be on promoting the development of industrial clusters.

In addition to this, there are sectors where not only localization economies are beneficial but the urbanization economies are beneficial as well. These sectors include rubber and plastic (Table 1, Col 6), electrical equipment (Table 1, Col 10) and machinery equipment (Table 1, Col 11). These sectors not only require spatial proximity to their own industry, but require spatial proximity to other similar or different industries as well which can possibly be their suppliers, buyers or input providers. The policy focus for such sectors could be to promote proximity both to their own industry but bring other industries closer to them as well.

We also find that spatial proximity to similar activity in an area has a positive relation, while the greater activity from other sectors has a negative relation on average with the total factor productivity of firms for wearing apparel (Table 1, Col 2) and chemical industries (Table 1, Col 4). The two industries are quite different in nature; nonetheless, a similar policy focus can be fruitful for the sectors. However, urbanization is not on average beneficial for these firms' TFP and this might be because these firms do not require specialized inputs and labor. This creates competition for resources and reduces the firm's productivity. The policy should focus on promoting proximity to its own industry and the development of industrial clusters but not to other sectors.

Industrial concentration is not beneficial for some of the sectors which include non-metallic minerals (Table 1, Col 7) and fabricated metals (Table 1, Col 9). These are the sectors for which the policy focus should not be that of creating nor establishing industrial clusters and special economic zones. The presence of similar firms has a negative correlation with the firm's TFP which thus suggests that the presence of similar firms is harmful for firms.

For the leather industry (Table 1, Column 3), localization economies do not matter and urbanization economies are harmful for the firm's productivity. Industrial policy should not focus on creating economic zones nor promoting concentration for such industries. The policy focus of such industries should not be to promote spatial proximity.

When we compare our coefficient of localization across sectors, we find that the industries that benefit the most from localization economies are wearing apparel, chemical, rubber and plastic followed by electrical and machinery equipment, and finally textiles and pharmaceuticals. Similarly, our analysis shows that the urbanization economies are most beneficial for the jewelry sector followed by rubber and plastic, electrical equipment and machinery equipment.

Table 1: Agglomeration and productivity of firms for different sectors in The Punjab

	Textile	Wearing apparel	Leather	Chemical	Pharmaceutical	Rubber and plastic	Other Non-metallic mineral	Basic metal	Fabricated metal	Electrical Equipment	Machinery equipment	Jewelry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Localization	1.370*	5.574***	2.487	5.236*	1.752**	4.601*	-14.67***	-0.573	-3.696***	3.414***	3.341***	2.310
	(0.787)	(1.920)	(4.810)	(2.907)	(0.818)	(2.671)	(3.597)	(0.824)	(0.839)	(1.093)	(0.980)	(1.412)
Urbanization	0.00422	-1.233**	-5.524*	-1.972**	0.245	3.711**	0.00263	0.00441	-0.747	2.772**	0.0161***	13.16*
	(0.00537)	(0.498)	(3.026)	(0.846)	(1.111)	(1.662)	(0.00453)	(0.00731)	(0.921)	(1.072)	(0.00511)	(6.689)

Source: Authors' calculations based on CMI (2011 and 2006) and DOI (2011 and 2006) for Punjab.
Note: Regression estimations used Total factor productivity found using Levinsohn and Petrin's (2003) approach derived using value added as outcome variables. Regressions have controlled for physical capital, labor, ownership (private enterprise, public enterprise or foreign collaboration) and Punjab further disaggregation in the form of north, south, central and west.
Standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Two-digit industrial classification has been used to define the sectors.

In Table 2, we sort the sectors according to their appropriate policy options. Based upon our regression estimates, we suggest the policy choices for rubber and plastic, electrical equipment and machinery industries should be a combination of industrial clusters and special economic zones. On the other hand, we suggest that for the textile, pharmaceuticals, wearing apparel and chemical industries the policy focus should be the development of industrial clusters. While for the jewelry industry, the policy focus should be the development of special economic zones. Lastly, for industries such as the non-metallic industry, fabricated metal, leather, food, beverage, wood and its products, paper and paper products and motor vehicle industry, we do not recommend promoting greater proximity to other firms, either because it is ineffective or because it would have negative effects on the productivity of the average firm.

Table 2: Ranking Sectors Based Upon Policy Choices

Industrial Cluster and Special Economic Zones	**Industrial Cluster only**
Rubber and plastic Industry	Textile Industry
Electrical Equipment Industry	Pharmaceuticals Industry
Machinery Equipment	Wearing Apparel Industry
	Chemical Industry
Special Economic Zones only	**None**
Jewelry Industry	Other Non-Metallic Industry
	Fabricated Metal Industry
	Leather Industry
	Basic Metal Industry
	Food Industry
	Beverage Industry
	Wood and its products Industry
	Paper and paper product Industry
	Motor vehicles, trailers, and semi-trailers Industry

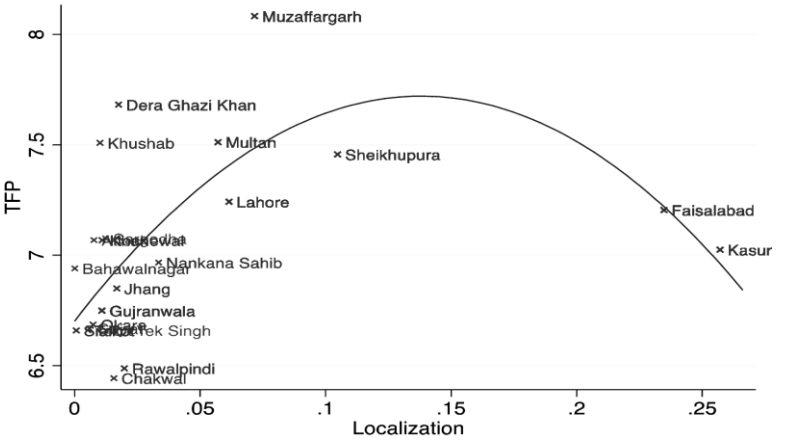
Note: Based upon the author's results.

Finally, we also compute fitted values of TFP and plot these with our localization variable. The fitted values were calculated from a regression of TFP on all variables included in the previous regression and in addition to a quadratic term. Similar estimations were repeated for urbanization (and its quadratic) as well. This was done to find out whether the policy choices suggested above should focus on making existing clusters stronger (because productivity is rising with localization) or the development of new clusters (if productivity is falling with localization), and find the possible districts for the development of industrial clusters and special economic zones, when those districts are above the trendline

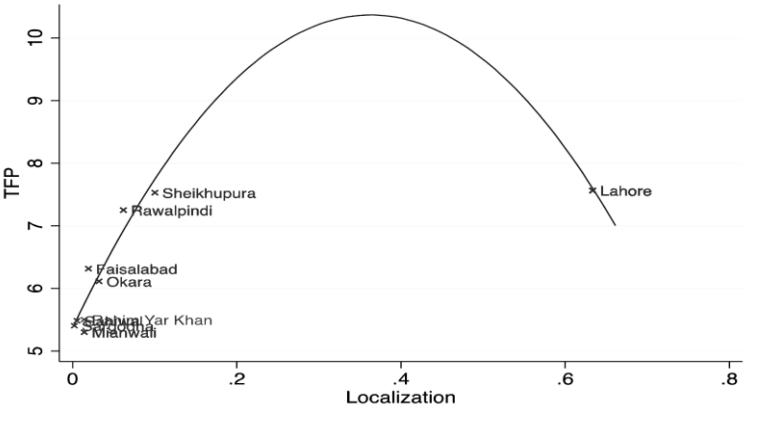
for the agglomeration-productivity relationship. The results of this are shown in Figure 7.

Figure 7: Identifying location choices for Special Economic Zones and Industrial Clusters

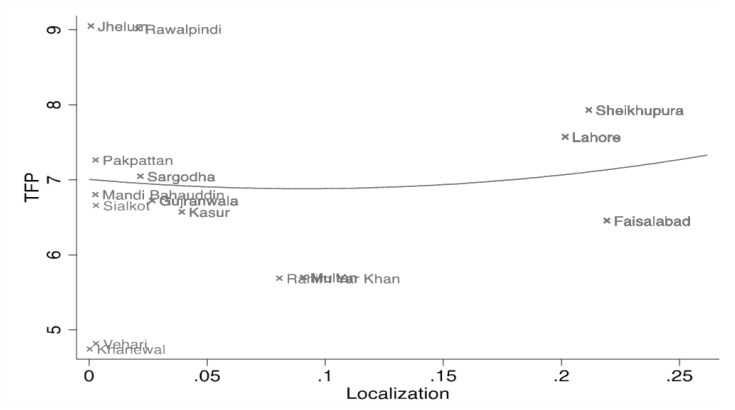
Textile Industry



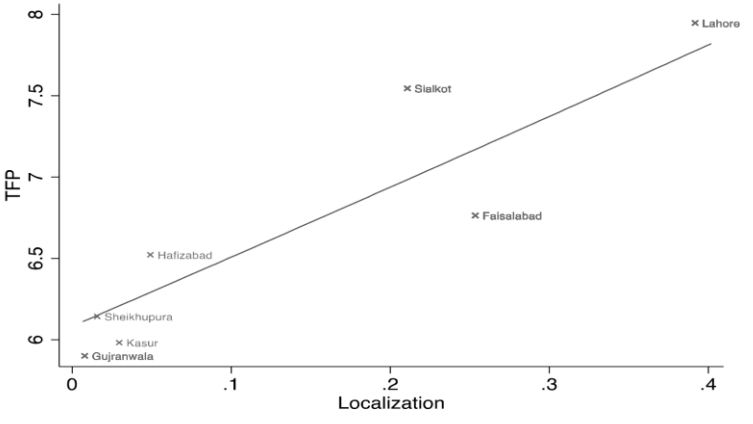
Pharmaceuticals Industry



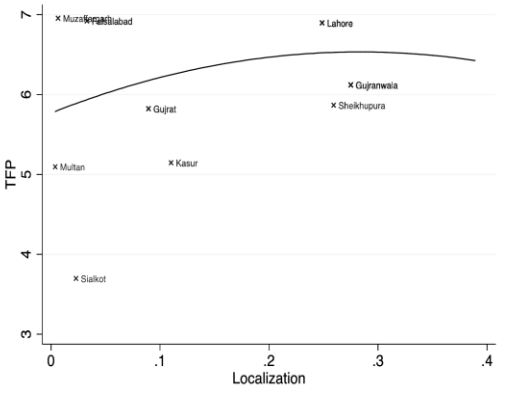
Chemical Industry

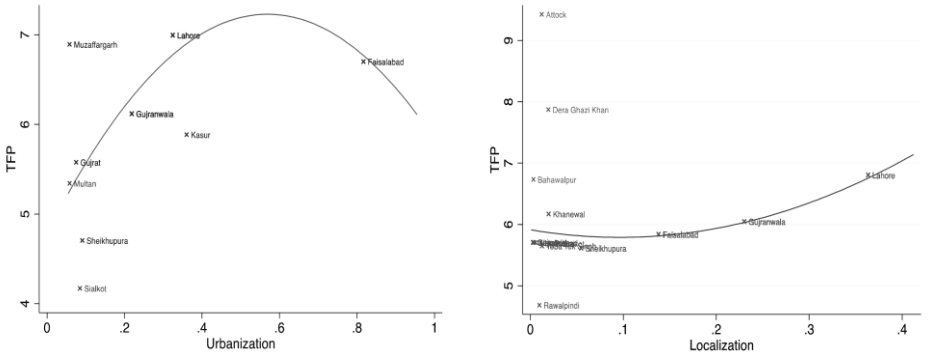


Wearing Apparel Industry

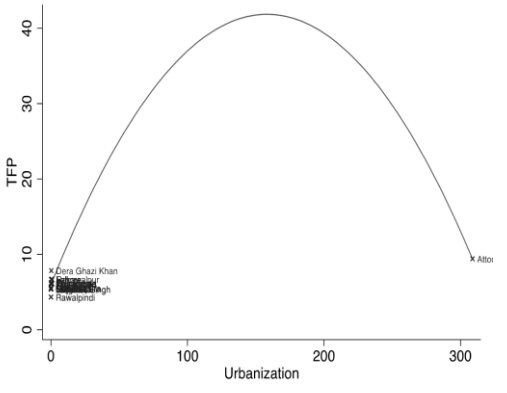


Rubber and Plastic Industry

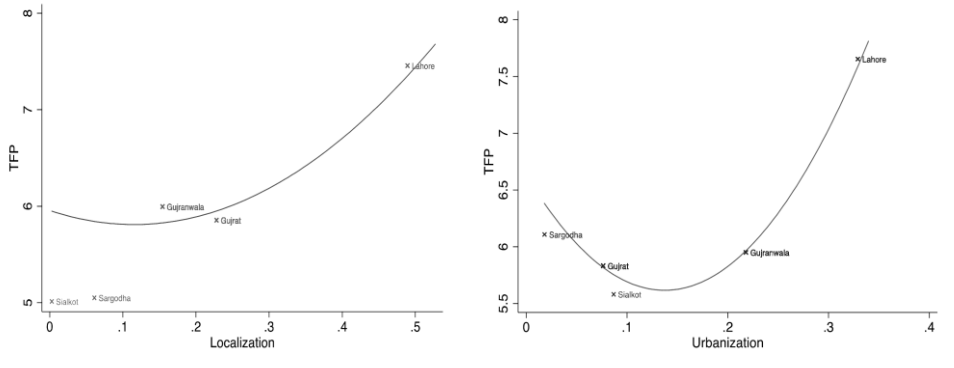




Machinery Equipment Industry



Electrical Equipment Industry



Source: Authors' calculations based on CMI (2011 and 2006) and DOI (2011 and 2006) for Punjab.

Note: Graphs have been created using fitted values of TFP from regressions including a non-linear (quadratic) term.

Industrial policy should carefully design the development of industrial clusters and special economic zones since, for some sectors, agglomeration in particular districts has reached the point where congestion has occurred and further benefits cannot be extracted from growing existing clusters. In other districts, sector-level productivity is above average or those districts are in the range of an upward sloping agglomeration-productivity relationship. So we provide suggestions for some potential areas where firms could be further agglomerated to benefit from positive location-specific externalities. For instance, for the textile sector, the possible location choices for the development of new industrial clusters could be Multan, Attock, Sargodha, Khushab, Dera Ghazi Khan, Muzaffargarh, Lahore, and Bahawalnagar. In contrast, agglomeration economies in the textile sector have been exhausted in Kasur and Faisalabad. The possible location choices for the development of new industrial clusters for pharmaceuticals could be Rawalpindi, Faisalabad, Sheikhupura, and Okara. For the chemical sectors, possible location choices for industrial clusters include Lahore, Sheikhupura, Jhelum, Rawalpindi, Pakpattan, and Sargodha. Lastly, the wearing apparel industrial clusters could be further developed in Sialkot, Faisalabad, Lahore, or Hafizabad.

For the machinery equipment sector, the development of industrial clusters could be in Faisalabad, Lahore, Gujranwala while the development of special economic zones should be in Dera Ghazi Khan, Rawalpindi, Bahawalpur, or Toba Tek Singh. For the electrical equipment sector, the development of industrial clusters could be in districts such as Lahore, Gujranwala, or Gujrat, while the development of special economic zones should be in Lahore or Gujranwala. The rubber and plastic industry could focus on the development of industrial clusters in districts such as Muzaffargarh, Faisalabad, Gujrat, or Lahore while the industry locations considered for special economic zones should be Gujrat, Multan, Gujranwala, Lahore, Muzaffargarh, or Kasur.

5. Conclusion

The literature has gained considerable attention regarding industrial concentration dating back to Marshall (1920). Agglomeration externalities have been used to justify cluster policies by national and local governments in developed and developing countries. In Pakistan, industrial clusters and special economic zones are key areas of focus for industrial policy makers in order to promote the industrial base and increase competitiveness. Thus, the role of the development of industrial clusters in the productivity improvement of manufacturing firms merits attention.

Using a firm level data set, we empirically investigate the relationship between agglomeration and firm-level productivity for different sectors in Punjab, Pakistan. Our aim is to rank sectors to maximize the benefits from industrial clustering and to highlight the sectors where the development of industrial clusters and special economic zones are considered to be useful. Our analysis is based on two provincial firm level data sets, the Census of Manufacturing Industries (CMI) and the Directory of Industries for 2011 and 2006. In order to find out whether agglomeration is correlated with the productivity of firms we estimated two-digit sector level regressions to find the correlation between agglomeration measured as localization and urbanization and TFP.

Our findings from sectoral level regressions reveal that localization and urbanization economies matter in the case of Pakistan. However, they are beneficial for a limited number of sectors. Localization economies are beneficial for the textile and pharmaceuticals sectors. The sectors that benefit from both localization and urbanization economies include rubber and plastic, electrical equipment and machinery equipment. We also find that spatial proximity to similar activity has a positive effect, while the more intensive activity from outside sectors has a negative relation on the total factor productivity of firms in the wearing apparel and chemical industries. Thus, our results suggest that policies focusing on the development of special economic zones and industrial parks should be sector-specific and not general in nature.

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Appendix

Table 1A: Distribution of firms and sectors across districts of Punjab

Total number of firms and sectors in each district		
Districts	**Firms**	**Sectors**
Attock	22	53
Bahawalnagar	18	214
Bahawalpur	30	357
Bhakkar	11	29
Chakwal	13	139
Dera Ghazi Khan	12	103
Faisalabad	93	1890
Gujranwala	137	1218
Gujrat	66	650
Hafizabad	12	68
Jhang	41	229
Jhelum	16	93
Kasur	58	718
Khanewal	25	175
Khushab	19	110
Lahore	203	2233
Layyah	7	132
Lodhran	9	131
Mianwali	11	77
Multan	65	454
Muzaffargarh	18	133
Nankana Sahib	18	201
Narowal	8	25
Okara	37	127
Pakpattan	12	179
Rahimyar Khan	26	221
Rajan Pur	6	78
Rawalpindi	63	324
Sahiwal	35	225
Sargodha	40	362
Sheikhupura	88	856
Sialkot	78	878
Toba Tek Singh	18	137
Vehari	13	189

Source: Author's calculations based on Directory of Industries 2014 for Punjab, Pakistan.
Note: Graphs used 5-digit industrial classification to define sectors.

Table 2A: Distribution of firms from different sectors across districts of Punjab

Districts	Percentage of firms in each district						
	Sports	Surgical	Textile	Leather	Food	Electrical Equipment	Chemical
Attock	0.00	0.00	0.28	0.00	0.76	0.21	0.37
Bahawalnagar	0.00	0.00	0.14	0.00	4.23	0.00	0.19
Bahawalpur	0.00	0.00	0.35	0.30	7.04	0.00	0.37
Bhakkar	0.00	0.00	0.07	0.00	0.79	0.00	0.00
Chakwal	0.00	0.00	0.32	0.30	0.18	0.00	0.19
Dera Ghazi Khan	0.00	0.00	0.28	0.00	2.13	0.00	0.19
Faisalabad	0.00	0.00	40.85	0.60	4.52	0.00	12.27
Gujranwala	1.07	1.48	8.98	3.63	4.55	18.43	4.46
Gujrat	0.00	0.37	0.60	2.42	1.73	1.45	0.93
Hafizabad	0.00	0.00	0.11	0.00	0.51	0.00	0.00
Jhang	0.00	0.00	1.17	0.30	2.78	0.41	0.93
Jhelum	0.00	0.00	0.04	0.30	0.40	0.00	0.56
Kasur	0.00	1.85	8.90	30.21	3.58	0.62	2.42
Khanewal	0.00	0.00	0.49	0.00	4.15	0.00	0.19
Khushab	0.00	0.00	0.39	0.00	0.94	0.00	0.19
Lahore	0.53	3.32	12.26	23.56	6.65	54.66	39.22
Layyah	0.00	0.00	0.00	0.00	1.08	0.00	0.00
Lodhran	0.00	0.00	0.07	0.00	3.25	0.00	0.00
Mianwali	0.00	0.00	0.00	0.00	0.47	0.00	2.04
Multan	0.00	0.00	2.30	2.72	6.25	0.62	3.90
Muzaffargarh	0.00	0.00	0.64	0.00	2.82	0.00	0.37
Nankana Sahib	0.00	0.00	1.59	0.00	1.48	0.00	0.19
Narowal	0.00	0.00	0.00	0.00	0.72	0.21	0.00
Okara	0.00	0.37	0.35	0.00	2.85	0.00	0.00
Pakpattan	0.00	0.00	0.04	0.00	1.59	0.62	0.19
Rahimyar Khan	0.00	0.00	0.67	0.00	5.64	0.21	0.93
Rajan Pur	0.00	0.00	0.00	0.00	1.55	0.00	0.00
Rawalpindi	0.00	0.00	0.53	1.81	2.46	0.62	5.76
Sahiwal	0.00	0.00	0.35	3.02	4.12	0.00	0.56
Sargodha	0.00	0.00	0.32	1.21	2.35	0.00	1.86
Sheikhupura	0.00	0.37	5.34	11.18	0.29	0.00	14.50
Sialkot	97.33	90.04	0.74	11.18	0.76	1.86	1.49
Toba Tek Singh	0.00	0.00	1.80	1.21	2.35	0.00	0.19
Vehari	0.00	0.00	0.11	0.00	5.17	0.00	0.19

Source: Author's calculations based on Directory of Industries 2014 for Punjab, Pakistan.
Note: Two-digit industrial classification has been used for Textile, Leather, Food and Electrical equipment industry and four-digit industrial classification has been used for Sports and Surgical instrument industry.

Table 3A: Average Productivity across districts of Punjab

District	Average productivity
Attock	8.172
Bahawalnagar	8.451
Bahawalpur	7.864
Bhakkar	8.002
Chakwal	8.690
Chiniot	8.817
Dera Ghazi Khan	8.349
Faisalabad	7.032
Gujranwala	6.392
Gujrat	5.959
Hafizabad	7.244
Jhang	7.240
Jhelum	7.483
Kasur	7.247
Khanewal	6.925
Khushab	8.771
Lahore	7.321
Layyah	7.330
Lodhran	8.018
Mandi Bahauddin	6.756
Mianwali	7.084
Multan	7.215
Muzaffargarh	8.012
Nankana Sahib	6.307
Narowal	5.792
Okara	6.802
Pakpattan	7.541
Rahim Yar Khan	7.653
Rajanpur	7.251
Rawalpindi	7.952
Sargodha	5.487
Sheikhupura	6.185
Sialkot	7.608
Toba Tek Singh	7.367
Vehari	6.939
Sahiwal	7.912

Source: Author's calculations based on Census of Manufacturing Industries 2011 for Punjab, Pakistan.

Table 4A: Average Productivity across industries in Punjab

Industries	Average productivity
Manufacture of food products	7.339
Manufacture of beverages	9.044
Manufacture of textiles	7.284
Manufacture of wearing apparel	7.191
Manufacture of leather and related products	6.622
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	6.405
Manufacture of paper and paper products	6.677
Manufacture of coke and refined petroleum products	7.788
Manufacture of chemicals and chemical products	7.241
Manufacture of basic pharmaceutical products and pharmaceutical preparations	7.549
Manufacture of rubber and plastics products	6.874
Manufacture of other non-metallic mineral products	6.612
Manufacture of basic metals	7.170
Manufacture of fabricated metal products, except machinery and equipment	6.360
Manufacture of computer, electronic and optical products	7.320
Manufacture of electrical equipment	6.122
Manufacture of machinery and equipment n.e.c.	6.545
Manufacture of motor vehicles, trailers and semi-trailers	7.394
Manufacture of other transport equipment	6.363
Manufacture of furniture	5.803
Other manufacturing	7.895

Source: Author's calculations based on Census of Manufacturing Industries 2011 for Punjab, Pakistan.
Note: Two-digit industrial classification has been used to define sectors.

Definitions of important terms

Localization economies- the benefits firms accrue due to spatial proximity to the same sector of a firm. These benefits are generally categorized as knowledge spill overs, labor pooling and input sharing.

Urbanization economies- the benefits firms accrue due to spatial proximity to the diversified and more sectors. These benefits generally come due to greater and diversified presence of inputs, possibility to vertical and horizontal cooperation, more specialized suppliers.

Special economic zones- A special economic zone is an area in which the business and trade laws are different from the rest of the country. SEZs are located within a country's national borders. These zones are not specialized for one particular industry.

Industrial clusters- Industry clusters are groups of similar and related firms in a defined geographic area that share common markets, technologies, worker skill needs, and which are often linked by buyer-seller relationships.

The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 49–72

Does Uncovered Interest Rate Parity Hold After All?*

Muhammad Omer[**], **Jakob de Haan**[***] **and Bert Scholtens**[****]

Abstract

This paper tests Uncovered Interest Rate Parity (UIP) using LIBOR rates for six major international currencies for the period January 2001 to December 2008. We find that UIP generally holds over a short-term (above 5-months) horizon for individual as well as groups of currencies. Our results suggest that it is important to consider the cross-correlation between currencies. We also find that "state dependence" plays an important role for currencies with a negative interest rate differential vis-à-vis the US dollar. This state dependence could also be instrumental in explaining exchange rate overshooting.

Keywords: UIP, LIBOR, system SUR, system DGLS, system DOLS.

JEL Classification: G12, G15, F31.

1. Introduction

Uncovered interest rate parity (UIP) suggests that any arbitrage opportunity between interest-earning assets of different economies but with similar characteristics, will disappear due to exchange rate movements. A positive shock to the domestic interest rate *vis-à-vis* the foreign interest rate will lead to the depreciation of the home currency and vice versa. UIP plays a critical role in most exchange rate determination theories, such as the monetary exchange rate model, Dornbusch's (1976) overshooting model and Krugman's (1991) target zone model. Also, central banks frequently count on this relationship in order to anchor exchange rate expectations in the economy (Kalyvitis & Skotida, 2010).

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* The views expressed in the paper are solely of authors and have nothing to do with the State Bank of Pakistan or De Nederlandsche Bank. Moreover, authors are solely responsible for any unintentional error or omission, if they remain in this paper.

** University of Groningen, Faculty of Economics and Business, PO Box 800, 9700 AV Groningen, The Netherlands.

*** University of Groningen, Faculty of Economics and Business, PO Box 800, 9700 AV Groningen, The Netherlands. De Nederlandsche Bank, PO Box 98, 1000 AB Amsterdam, The Netherlands. CESifo, Munich, Germany

**** University of Groningen, Faculty of Economics and Business, PO Box 800, 9700 AV Groningen, The Netherlands.

It is surprising that theorists continue to rely on UIP despite ambiguous (at best) empirical support. Several studies (Bekaert & Hodrick, 1993; Engel, 1996; Froot & Thaler, 1990; Mark & Wu, 1998; Weber, 2011; Tang, 2011), to mention just a few, reject UIP. Only a few studies report some support for UIP, including Flood & Rose (1996), Bekaert and Hodrick (2001), Baillie and Bollerslev (2000), Chaboud and Wright (2005) and Beyaert et al. (2007).

Given the crucial role played by UIP in exchange rate theory and exchange rate stabilization policy, this relationship warrants more detailed investigation. Evidence supporting UIP will not only increase confidence in the existing exchange rate models but may also enhance the quality of monetary policy decision-making. This paper is an effort in this direction.

This paper extends the existing UIP literature by focusing on important issues affecting this relationship. First, we use a multi-currency setup to make use of cross currency correlation. Some previous studies using Seemingly Unrelated Regression (SUR), such as Flood & Rose (1996) and Mark & Wu (1998), have exploited cross currency correlations. However, most studies investigate UIP mainly bilaterally. In our view, bilateral studies implicitly impose restrictions on the third-country effect, which may play an important role in determining exchange rates. This is equally true for studies using a panel data setup that ignores cross sectional dependence. In a globalized world, any shock to the US debt market say, will not only affect the Japanese debt market but also the euro debt market. Therefore, an interest rate shock in the US will not only affect the US dollar and the Japanese yen exchange rate or the US dollar and the euro exchange rate, but also the euro-yen exchange rate. Studies on UIP have mostly ignored this cross currency correlation.

Second, we use data for industrial economies as the literature suggest that, for these countries, the problem of a forward premium puzzle is more prominent (see Alper et al., 2009; Bansal, 1997; Bansal & Dahlquist, 2000). For developing and emerging market economies, the empirical evidence provides more support for UIP (see, for example, Frankel & Poonawala, 2010; Ferreira & Leon-Ledesma, 2007; Flood & Rose, 2001; Bansal & Dahlquist, 2000).

Third, rather than using domestic interest rates, we use the London Interbank Offered Rates (LIBOR). LIBOR is an indicative interbank rate for specific currencies based on the non-binding quotes in the London

interbank market.[1] LIBOR rates are widely used as benchmarks in global financial transactions and provide a framework where several known frictions, such as imperfect capital mobility and differences in transaction costs explaining the failure of UIP, are absent.[2]

The statistical evaluation supports LIBOR as a substitute for domestic interest rates. Factor analysis shows that the LIBOR rates are defined by only one factor, i.e. domestic interest rates, suggesting that our results are not driven by the use of LIBOR.[3] Still, using LIBOR has several advantages. For instance, the currency specific LIBOR rates have similar transaction costs for the assets denominated in various currencies, while capital is perfectly mobile. Juselius and MacDonald (2004), Harvey (2004) and Ichiue and Koyama (2011) have used LIBOR as a proxy for Japanese domestic rates, arguing that the thin and heavily regulated Japanese money market in the 1980s and 1990s was less reflective of Japan's economic fundamentals.

Finally, following a suggestion of Moon and Perron (2005), we take as our null hypothesis that UIP holds; that is, the slope coefficient is unity. Often the null hypothesis tested is that the slope coefficient is not different from zero, which on rejection provides support for the alternative hypothesis that the slope coefficient is in fact different from zero. According to Moon and Perron (2005), such a test design has a strong bias towards the null hypothesis, which is rejected only when there is strong support against it. Moreover, when the null of a zero slope coefficient cannot be rejected, it is difficult to conclude whether the theory is rejected or the power of the test is low.

Our estimates using weekly data for the period January 2001 to December 2008 support UIP over the short-term (above 5-months) horizon for currencies from advanced countries. Further, our currency specific estimates show that the null hypothesis of a unit coefficient can generally not be rejected at the 5 percent level of significance. However, for the Japanese yen and the Swiss franc, the slope coefficients are negative. This finding is consistent with the argument put forward by Bansal and

[1] For details see Michaud and Upper (2008).

[2] Forbes Investopedia estimates that $360 trillion worth of international financial products are benchmarked with LIBOR. Additionally, one trillion dollars of sub-prime mortgages have rates adjustable to LIBOR.

[3] Factor analysis is a widely used technique for summarizing usually a large number of variables with a small number of factors. For the sake of brevity, we do not report the results of the factor analysis but they are available on request.

Dahlquist (2000) and Ballie and Kalic (2006) that deviations from UIP appear when the US interest rate exceeds the foreign interest rate, called "state dependence". Once we incorporate the negative interest rate differential, UIP cannot be rejected for the Japanese yen and the Swiss franc. Our results show that cross currency effects play an important role in determining the exchange rate between currencies. Finally, we also find some support for Dornbusch's (1976) overshooting hypothesis for exchange rates, specifically for the Japanese yen and the Swiss franc against the US dollar, suggesting that state dependence could also be instrumental in explaining exchange rate overshooting.

The rest of the paper is structured in the following way. Section 2 reviews the literature. Section 3 delves into data and methodology issues, while section 4 presents results. Finally, section 5 offers conclusions of the paper.

2. Literature Review

According to the Covered Interest Rate Parity (CIP) hypothesis, under risk free arbitrage the ratio of the forward to the spot exchange rate will be equal to the ratio of the returns on two similar assets, measured in the local currencies. Expressing the forward and spot rates in logarithms, CIP can be written as:

$$\left(f_{t,t+i} - S_t\right) = (r_{i,t} - r^*_{i,t}) \tag{1}$$

where $f_{t,t+i}$ is the forward rate for maturity i, s_t is the spot exchange rate, $r_{i,t}$ and $r^*_{i,t}$ are the nominal return at any time t for maturity i on a domestic and foreign asset, respectively. However, if forward rates deviate from the expected future spot rate, a risk premium is required such that:

$$\left[E(S_{t,t+i}) - S_t\right] = \alpha + \left(r_{i,t} - r^*_{i,t}\right) \tag{2}$$

where α is the risk premium and $E(S_{t,t+i})$ is the expected future exchange rate at time $t + i$. Under UIP, the risk premium is zero and the coefficient of the interest differential is one. Since the future spot exchange rates cannot be observed directly, UIP is generally tested jointly with the assumption of *rational* expectations in the exchange rate market (Chinn, 2007):

$$[RE(S_{t+i}) - S_t] = \alpha + \beta\left(r_{i,t} - r^*_{i,t}\right) + \varepsilon_{t+i} \tag{3}$$

Following studies such as Tang (2011), Bekaert et al. (2007), Chinn and Meredith (2004), and Carvalho et al. (2004), we assume that agents have perfect foresight so that exchange rate movements can be estimated using equation (4):

$$[S_{t+i} - S_t] = \alpha + \beta\left(r_{i,t} - r^*_{i,t}\right) + \varepsilon_{t+i} \quad (4)$$

Most studies on UIP report a negative point estimate for the beta coefficient, β, over the short-term horizon (see Froot & Thaler, 1990; MacDonald & Taylor, 1992; McCallum, 1994; Engel, 1996; Chin & Meredith, 2004; Isard, 2006; Chinn & Quayyum, 2012). A notable exception is Flood and Rose (1996), who report a slope coefficient close to one during the period with exchange rate alignments within Europe's Exchange Rate Mechanism (ERM). Other studies, such as Bruggemann and Lutkepohl (2005), Huisman et al. (1998), and Krishna Kumar and Neto (2008) provide indirect support for UIP. More precisely, Huisman et al. (1998) have shown that the large forward premium provides an unbiased estimate of the future change in the spot rate while a small forward premium fails to predict the same correctly. Bruggemann and Lutkepohl (2005), and Krishna Kumar and Neto (2008) have tested UIP jointly with the expectation hypothesis of the term structure (EHT) using interest rates of the respective economies. By assuming that exchange rates are generated by a stationary process they provided evidence in support of UIP using the stationarity of the interest rate differential.

Bansal (1997) reports that the failure of UIP is more severe for industrial economies compared to developing economies. In addition, Bansal and Dahlquist (2000) and Baillie and Kilic (2006) point to state dependence in the UIP relationship, i.e. the exchange rate denominated in the US Dollar responds differently to the positive or negative interest rate differentials. More specifically, deviations from UIP appear only when the US interest rate exceeds the foreign interest rate. When the foreign interest rate exceeds the US interest rate, the expected depreciation and the increase in interest rate differentials are positively related.

Several studies have tested UIP bilaterally, thereby implicitly imposing restrictions on the third economy's effect. Moreover, this restriction might have fostered non-linearities in the UIP relationship, a subject investigated by a different strand of literature.[4] Studies using

[4] Studies discussing non-linearities in UIP include Baldwin (1990), Dumas (1992), Sercu and Wu (2000), Lyons (2001), Kilian and Taylor (2003), and Carlson and Osler (1999).

panel data techniques and ignoring the cross currency effect suffer from similar problems.

Chinn and Meredith (2004) note that UIP models by construction have cross-equation correlation of the error terms and therefore techniques incorporating cross currency correlations such as SUR are appropriate. Two studies, Flood and Rose (1996) and Mark and Wu (1998), have employed SUR to control for cross currency correlations. However, the outcomes of both studies are very different. While Flood and Rose (1996) report a slope coefficient close to one during the period with exchange rate alignments within Europe's ERM, Mark and Wu (1998) do not find strong support for UIP.

To control for the cross-equation correlation, both studies employ SUR based on OLS, but using the contemporaneous covariance matrix. A contemporaneous covariance matrix uses current information only, ignoring long-run relationships which may be misleading if there exists such a long-run relationship.

Importantly, when regressors are integrated, indicating a long-run relationship between them, Moon and Perron (2005) have shown that the limiting distributions of OLS estimators are not normal. To solve this problem, they propose augmenting the regressors with their leads and lags to capture the long-run correlation. In addition, they argue for using the long-run covariance matrix instead of the contemporaneous covariance matrix, which enhances the efficiency gain of the long-run estimators. This paper therefore uses SUR with integrated regressors as proposed by Moon and Perron (2005).

More recently, Omer et al. (2014), and Ismailov and Rossi (2018) tested UIP over a short horizon for advanced economies. Precisely, Omer et al. (2014) has tested uncovered interest rate parity (UIP) using LIBOR interest rates by controlling the cross currency correlation similar to this study. They have reported that UIP holds for several short-term maturities for advanced economies. Their estimates, as discussed by these authors, were aggregate in the sense that the bilateral relationships between the currencies could not be explored due to procedural limitations. This study, is therefore an extension of Omer et al. (2014), and estimates beta coefficients for the individual currencies in a correlated currency environment by adopting a more suitable procedure proposed by Moon and Perron (2005).

Similar to Omer et al. (2014), Ismailov and Rossi (2018) have investigated UIP for currencies except for the Australian dollar, and using 3-month Euribor (Euro Interbank Offered Rate) only. Euribor is an average interest rate at which a large panel of European banks borrow funds from one another in the European interbank market. Besides the familiar currency and interest rate setup, they have constructed an exchange rate uncertainty index to measure any uncertainty in support of their empirical evidence. Their findings suggest that uncovered interest rate parity does hold in five industrialized countries *vis-à-vis* the US dollar at times when uncertainty is not exceptionally high. However, this relationship breaks down during high periods of uncertainty.

3. Data and Methodology

3.1. Data

Our sample period is January 2001 - December 2008.[5] We use the following currencies: the Euro, the Japanese yen, the British pound, the Australian dollar, the Canadian dollar, and the Swiss franc against the US dollar. We have acquired daily data on the exchange rates from the International Monetary Fund (IMF).[6] For the interest rates, we use daily LIBOR rates for the above currencies with short maturities. The LIBOR interest rates data can be accessed from the British Bankers Association (BBA) website.[7] Exchange rate differentials are calculated assuming that economic agents have perfect foresight. So the -month exchange rate differential series, for example, is calculated by subtracting the current spot rate from the spot rate after six months. Similarly, to generate interest rate differentials we subtract the currency- and maturity-specific LIBOR from the US dollar LIBOR with similar maturity. In view of the outcomes of unit root tests (to be discussed below), we use maturities ranging from 6 to 12 months.

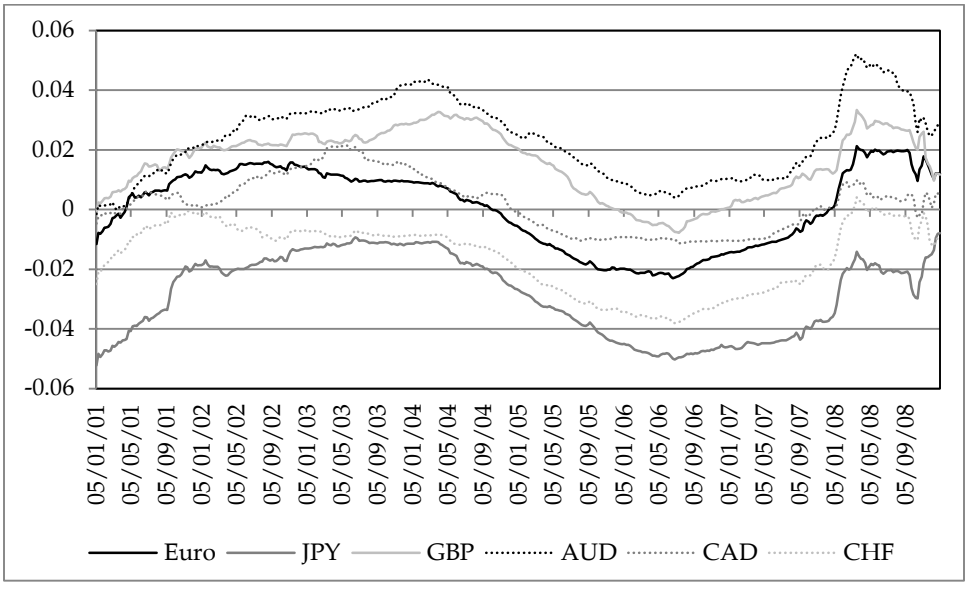
[5] Extending our sample would involve structural break issues. The introduction of the euro, as a single European currency in January 1999, has brought structural changes in the global financial system. In order to make sure that our results are not driven by these changes, we did not include 1999 and 2000. Our sample ends in 2008 in view of the global financial crisis that started in late 2008 with the fall of the Lehman Brothers. In our view, a financial crisis may distort an economic relationship which exists under stable normal circumstances.

[6] http://www.imf.org/external/np/fin/data/param_rms_mth.aspx.

[7] http://www.bbalibor.com/rates/historical.

From daily data we have calculated weekly and monthly data.[8] Figure 1 shows the 6-month interest rate differential for all currencies. Other maturities show more or less similar variation. Figure 1 shows that these series follow similar patterns, and hence are highly positively correlated (see Panel A of Table A1 in the Appendix for the correlation between the first differenced of these series). Importantly, both the Japanese yen and the Swiss franc have negative interest rate differentials since the US dollar LIBOR rates are higher than these currency specific rates.

Figure 1: Movement in 6-Month Interest Rate Differentials



Source: Authors' Calculations

3.2. Methodology

Since our dataset involves a long time series, it is essential to ascertain the nature of the data- generating process of the regressors. Therefore, we have applied unit root tests.

Previous studies generally adopted unit root tests, such as the Augmented Dickey Fuller (ADF) or Phillip and Perron (PP) tests, but these time series tests are limited in scope in the presence of cross correlation

[8] Weekly averages are calculated using five working days. This procedure leads to an overlapping data problem as indicated by the Harri and Brorsen (2009). However, as the long-run covariance matrices are estimated using the Andrews (1991) procedure with data-based bandwidth and quadratic spectral kernel, our analysis does not suffer from this problem.

effects. Therefore, we apply the Cross-sectional Dependence Robust Block Bootstrap (CDRBB) panel unit roots test proposed by Palm et al. (2011).

The CDRBB unit root test does not require modeling the temporal or cross-sectional correlation (dependence) structure between the currency-specific interest rates. Moreover, it uses block bootstrap techniques, a time series version of a standard bootstrap where the dependence structure of the time series is preserved by dividing data into blocks and then re-sampling the blocks. However, the block length selected can have a large effect on the performance of any designed block bootstrap test. Inferences from the CDRBB test are valid under a wide range of possible data-generating processes, which makes it an appropriate tool in dealing with the fixed number of correlated cross-sections and large time series asymptotics.

Although this CDRBB test provides both "pooled" (τ_p) and "group-mean" (τ_{gm}) test statistics, we only show the outcomes for the group mean statistics here (while the pooled statistics are shown in the Appendix). The group mean statistic does not impose restrictions on individual parameters, which is more relevant for the analysis at hand. The null hypothesis assumes that the variable is non-stationary while under the alternative hypothesis a part of the series is stationary. Rejection of the null hypothesis for the first difference of a variable and non-rejection for the level of the same variable indicates that the variable concerned has a unit root.

In equation (5), y_t is the variable tested for unit roots, N is the number of currencies and T is the sample period:

$$\tau_{gm} = \frac{1}{N}\sum_{i=1}^{N} T \frac{\sum_{t=2}^{T} y_{i,t-1}\Delta y_{i,t}}{\sum_{t=2}^{T} y_{i,t-1}^2} \tag{5}$$

Next, we apply Johansen's (1995) cointegration test as well as Westerlund's (2007) ECM based panel cointegration test. The former, being the "individual" time series test, has limited application when there are cross correlation effects, while the latter takes those effects into account. For brevity, we will only report the results of Westerlund's (2007) ECM based cointegration tests.

Westerlund (2007) suggests a panel cointegration test based on the error correction mechanism (ECM) as indicated by Eq. (6):

$$\Delta y_{it} = \delta_i d_t + \alpha_i (y_{i,t-1} - \beta_i^{'} x_{i,t-1}) + \sum_{j=1}^{p_i} \gamma_{1ij} \Delta y_{i,t-j} + \sum_{j=0}^{p_i} \gamma_{2ij} \Delta x_{i,t-j} + u_{it} \quad (6)$$

Here, d_i is the currency-specific deterministic component, δ_i is the associated parameter, α_i is the speed of adjustment for the error correction term, β_i is the cointegrating vector while x_{it} and y_{it} are interest and exchange rate differentials series, respectively. The choice of the appropriate number of leads and lags, given by p_i, using information selection criteria, such as Akaike's Information Criterion (AIC), transforms u_{it} into white noise.

The null hypothesis of the cointegration test is $\alpha_i = 0$, which indicates no cointegration of the variables. The alternative hypotheses depend on the homogeneity assumption of α_i and have four different versions. Two of the tests are termed as "group mean tests (G_α and G_τ)" since they do not require α_i to be equal. The other two are known as "pooled tests (P_α and P_τ)" as they assume equal α_i for all the members of the panel. For the sake of brevity we will present the group mean test statistics (G_α and G_τ) only (while the other test outcomes are shown in the Appendix). The group mean statistics differ in composition. Whereas G_α is calculated by aggregating the individual slope coefficients with the help of conventional standard errors, G_τ is designed by aggregating the individual slope coefficients using Newey and West (1994) long-run standard errors. The alternative hypothesis for the group mean test is that at least one member of the panel is cointegrated. Simulation results of Westerlund (2007) show that G_α has a higher power compared to G_τ in samples where T is substantially larger than N. Asymptotically, both statistics have a limiting normal distribution, and they are consistent. Moreover, Westerlund's (2007) procedure provides robust critical values for the test statistics by applying bootstrapping which accounts for the cross sectional dependence.

For drawing inference on long-run relationships, we use Moon and Perron's (2005) efficient estimation method of a system of SUR equations with integrated regressors. This method provides more efficient estimates by exploiting the correlations among multiple currencies while allowing for individual currency-specific inferences. Conventional system estimation methods, such as GLS, with integrated regressors have a nonstandard limiting distribution that is skewed and shifted away from

the true parameters. This renders inference difficult. Moon and Perron (2005) suggest a method for obtaining efficient estimators with a mixed normal limiting distribution. By adding the leads and lags of the first differences of the regressors, they suggest applying GLS on this augmented dynamic regression model using information on the long-run covariance matrix, hence its name: System Dynamic GLS (SDGLS).

The Monte Carlo simulation results of Moon and Perron (2005) show that SDGLS performs better compared to other estimators.[9] Moreover, the efficiency gain of the SDGLS estimates is greater compared to other estimates obtained in similar fashion. Furthermore, the SDGLS estimator suffers least from distortion due to a small sample. Based on its superior performance, we utilize the SDGLS estimator.

Equation (7) shows the SDGLS estimator using the multivariate format of SUR:

$$\hat{b}_{DGLS} = \left(\sum_{t=k+1}^{T-k} Z_t \hat{\Omega}_{uu.v}^{-1} Z_t'\right)^{-1}\left(\sum_{t=k+1}^{T-k} Z_t \hat{\Omega}_{uu.v}^{-1} y_t\right) = b+\left(\sum_{t=k+1}^{T-k} Z_t \hat{\Omega}_{uu.v}^{-1} Z_t'\right)^{-1}\left(\sum_{t=k+1}^{T-k} Z_t \hat{\Omega}_{uu.v}^{-1} \xi_t^*\right) \quad (7)$$

Here, b is the matrix of coefficients of regressors and the leads and lags of the first difference of the regressors, $Z_t = (\tilde{x}_t', \Delta x_{t-k}' \otimes I_N, \dots, \Delta x_{t+k}' \otimes I_N)', \tilde{x}_t' = diag(\tilde{x}_{1t}, \dots, \tilde{x}_{Nt}), \tilde{x}_{it} = (1, x_{it}'), x_{it} = (x_{it}', \dots, x_{Nt}')', \xi_t^*$ is the error term with the non-estimable part of regressors beyond k. The null hypothesis tests whether the individual slope coefficient (b) is unity, or in other words whether UIP holds on a currency-specific basis.

This direct test of UIP differs from the usual testing methodology in which the null hypothesis is that the coefficient is not different from zero. According to Moon and Perron (2005), such a test design has a strong bias towards the null hypothesis which also affects the interpretation of the test results in an undesirable way. When the null hypothesis cannot be rejected, it is hard to determine whether the theory is rejected or the power of the test is low. Another advantage of the Moon and Perron test design is that it does not require testing cointegration separately. If the error term is non-

[9] Using their proposed method based on the SUR technique Moon and Perron (2005) have suggested a number of estimators such as system dynamic OLS (SDOLS) or fully modified OLS (FMOLS), besides the dynamic GLS estimator. The system dynamic OLS (SDOLS), is given by:

$$\hat{b}_{SDOLS} = \left(\sum_{t=k+1}^{T-k} Z_t Z_t'\right)^{-1}\left(\sum_{t=k+1}^{T-k} Z_t y_t\right) = b + \left(\sum_{t=k+1}^{T-k} Z_t Z_t'\right)^{-1}\left(\sum_{t=k+1}^{T-k} Z_t \xi_t^*\right)$$

Notations have the same meaning as in equation (7). Both estimators $\hat{b}_{SDOLS}$ and $\hat{b}_{DGLS}$ use the long-run correlation information of the system.

stationary for any of the model coefficients, the test statistics diverge to infinity, thereby rejecting the null hypothesis that UIP holds. This alternative test for cointegration based on the coefficient of the cointegrating vector is more powerful than simple cointegration tests (Cheung & Lai, 1993).

4. Results

Table 1 reports the group mean CDRBB panel unit root tests. For both the interest and the exchange rate differential series, at maturities of six months and higher, the null hypothesis of a unit root cannot be rejected at the 5 percent level of significance, indicating that the level of these series are non-stationary. A test on the first differences of these series confirms that these maturities are following an I ($_1$) process (not reported for brevity). The pooled test statistics yield similar results (see Table A2 in the Appendix). In the rest of the paper, we will therefore focus on maturities of 6 months and longer.

Table 1: Block Bootstrap Panel Unit Root Tests

	Exchange Rate Differential Series			Interest Rate Differential Series		
	Statistics	5 percent CV	P-value	Statistics	5 percent CV	P-value
1-week	-314.7570	-19.1730	0.0000	-3.9440	-17.7150	0.8750
2-week	-166.1620	-23.6380	0.0000	-2.8860	-13.9870	0.8540
1-month	-69.8510	-20.6940	0.0000	-2.1160	-9.9800	0.7900
2-month	-32.0290	-14.4190	0.0000	-2.1880	-8.2040	0.6890
3-month	-19.1170	-12.1780	0.0020	-2.2870	-7.9620	0.6490
4-month	-12.6120	-12.3460	0.0450	-2.2060	-7.2350	0.6480
5-month	-8.1130	-11.9260	0.2340	-2.1610	-6.8740	0.6570
6-month	-6.9340	-11.4470	0.3370	-2.1540	-6.7890	0.6620
7-month	-6.5470	-12.1160	0.4220	-2.1300	-6.8150	0.6820
8-month	-5.7180	-12.1480	0.5700	-2.0930	-6.9130	0.7060
9-month	-5.9400	-12.4110	0.6010	-2.0780	-7.0330	0.7270
10-month	-5.7460	-13.2370	0.6740	-2.0730	-7.1480	0.7420
11-month	-5.5980	-13.2420	0.6330	-2.1030	-7.3280	0.7520
12-month	-5.8910	-13.0600	0.5870	-2.1220	-7.5120	0.7690

Source: Authors' Calculations.

Note: Estimated test statistics for equation (5) for exchange rate and interest rate differential series. 5 percent CV indicates robust critical values calculated at 5 percent level of significance. P-values indicate the corresponding probability values of the calculated test statistics.

Next, we apply the Johansen (1995) cointegration tests on individual currency-specific time series. The results do not provide any evidence for a cointegration relationship between interest and exchange rate series (results available on request). In contrast, the Westerlund (2007) ECM based panel cointegration tests as shown in Table 2 indicate that the null hypothesis of no cointegration is rejected for maturities ranging between 6 and 9 months at the 5 percent level of significance. The results indicate that at least one member of the panel is cointegrated for these maturities. For the other maturities, the evidence for "no cointegration" is rather weak as the rejection probabilities (p-values) are very low. So our results suggest that inferences regarding financial market variables based on the Johansen cointegration test can be misleading if cross correlation effects are ignored.

Table 2: Results for the Westerlund Cointegration Test (Group Mean Test)

	G_α			G_τ		
	Value	**Z-value**	**Rob. P-value**	**Value**	**Z-value**	**Rob. P-value**
6-month	-12.2080	-4.5270	0.0000	-2.2560	-3.0120	0.0020
7-month	-9.8120	-3.2370	0.0000	-1.9260	-2.2370	0.0200
8-month	-8.3590	-2.4540	0.0200	-1.7430	-1.8050	0.0540
9-month	-7.6540	-2.0740	0.0360	-1.7510	-1.8240	0.0640
10-month	-6.6340	-1.5250	0.0560	-1.6230	-1.5220	0.0620
11-month	-5.4670	-0.8960	0.1240	-1.4310	-1.0710	0.1440
12-month	-5.3260	-0.8210	0.1220	-1.4430	-1.0990	0.1240

Source: Authors' Calculations.

Note: Estimates of ECM coefficient based on equation (6). The alternative hypothesis of these test statistics are the cointegration relationship exists when the panel taken as whole. 5 and 12 are the maximum number of leads and lags considered for estimation. Values give the estimated values of the coefficients and Z-values are their standardized values. Rob. P-values are the robust probability values calculated using the bootstrap technique. The corresponding values show the level of significance.

As pointed out, the methodology we have adopted here to make inference does not require testing cointegration separately. Therefore, our cointegration results as reported in Table 2 (and Table A3 in the Appendix) should be considered as a robustness check of the system SUR estimates to which we turn now. We have applied SUR on interest and exchange rate differential series for each maturity separately using a maximum of 12 leads or lags. Table 3 shows the estimation results using system DGLS, which includes the individual slope coefficient for each currency *vis-à-vis* the US Dollar.

The Wald test aggregates the individual currency specific slope coefficient and tests the null hypothesis that the joint slope coefficient is unity. In other words, it tests whether UIP holds for the system of currencies taken together. The reported p-values for Wald test statistics show that the null hypothesis cannot be rejected for maturities ranging between 10 and 12-months. Hence, UIP holds for these maturities when all six currencies are taken together.[10]

Table 3: Estimation Results Using System Dgls (SDGLS)

	6-m	7-m	8-m	9-m	10-m	11-m	12-m
Euro	3.0261	2.3765	3.8135	5.1693**	2.9493	2.9231	3.2848
	1.7716	*1.5452*	*1.8149*	*2.2376*	*2.3597*	*2.8520*	*3.6336*
JPY	-1.2921**	-1.1077**	-1.296**	-1.5944*	-1.0286**	-1.6118**	-1.3214
	1.2585	*1.2611*	*1.1870*	*1.0759*	*1.0482*	*1.0551*	*1.5769*
GBP	2.1321	0.4204	0.4771	-0.1292	-0.4108	0.1099	3.1353
	1.6566	*1.3567*	*1.5417*	*1.9650*	*2.3640*	*2.0442*	*2.1757*
AUD	0.5314	-0.4379	0.6683	-0.1183	1.3554	1.9217	1.0261
	1.7308	*1.6050*	*1.9285*	*2.3469*	*3.1521*	*2.2673*	*2.5794*
CAD	-0.1784	1.1095	0.0519	-1.1833	-0.4472	0.0817	-1.4897
	1.6382	*1.9127*	*1.7832*	*1.7276*	*1.6198*	*1.9262*	*2.8642*
CHF	-5.6004*	-3.3885*	-1.8798**	-1.6504**	-1.3616**	-1.1008	-1.5929
	2.4140	*1.7692*	*1.5111*	*1.5988*	*1.3264*	*1.7211*	*1.7633*
Wald Stats	17.3979	16.0100	12.6966	19.2999	9.3929	7.5384	7.8070
Wald p	0.0079	0.0137	0.0481	0.0037	0.1527	0.2739	0.2526

Source: Authors' Calculations.

Note: Estimates of the System DGLS coefficient based on Eq. (7) using average weekly data with maximum leads and lags of 12 weeks. The optimal lag length selected using Bayesian Information Criteria (BIC). The null hypothesis is individual coefficient is unity. The figures in italics show the standard errors. The null hypothesis for the Wald test is the joint beta coefficient of unity. Wald P shows the P-values of the Wald test statistics. The symbols indicates *, < 5 percent and ** < 10 percent level of significance, respectively.

For the individual currency-specific results, the conclusion is similar. The null hypothesis of unit slope coefficients cannot be rejected for almost all maturities at the 5 percent level of significance. Only for the 9-months Japanese yen and the 6- and 7-months Swiss franc is the null rejected. The slope coefficient of the Japanese yen and the Swiss franc are persistently negative. However, as pointed out in section 3.1, both currencies have negative interest rate differentials vis-à-vis the US interest rate. Ballie and Kalic (2006), Bansal and Dahlquist (2000) and Bansal (1997) provide evidence that the exchange rate vis-à-vis the US dollar responds differently to positive and negative interest rate differentials. Specifically, Bansal and Dahlquist

[10] Estimates from monthly data, as reported in Table A4 of the Appendix, also fail to reject the null hypothesis of the Wald tests for all maturities.

(2000) argue that the forward premium puzzle is present only when the US interest rate exceeds the foreign interest rate.

Interestingly, for the negative interest rate differential series, any increase in the domestic (Japanese/Swiss) interest rates vis-à-vis the US interest rate means a decrease in the differential. Some studies have used the US dollar as domestic currency, instead of the foreign currency, to avoid the negative interest rate differential. In a bilateral environment, the flipping of the exchange rate may work, but it is less likely to work in our multi-currency setup. Panel B of Table A1 (in Appendix) shows the correlations between the (first difference of the) interest rate differential series when the Japanese yen and Swiss franc are taken as numeraire currencies against the US dollar. This flipping of currencies solves the problem of the negative interest rate differential since the US dollar becomes the home currency. However, the correlation structure between the interest rate differential of the various currencies gets significantly distorted. Our estimation with this modified Japanese yen and Swiss franc interest rate setup gives a similar distorted picture of the slope coefficients (results are available on request).

Interestingly, whenever the null hypothesis is rejected in our setup, it implies overshooting/undershooting of exchange rates, consistent with Dornbusch's (1976) exchange rate overshooting hypothesis. According to Frenkel and Rodriquez (1982), the exchange rate overshoots when capital is highly mobile while it undershoots when capital is highly immobile. With LIBOR market rates, we are close to perfect capital mobility. Using a 90 percent confidence level of our interval estimation, we find some evidence of persistent overshooting in line with the view of Frenkel and Rodriquez (1982). For both the Japanese yen and the Swiss franc, the null hypothesis of a unit slope coefficient is rejected at the 10 percent level of significance. However, we find little evidence of overshooting for the other currencies which leads us to suspect that overshooting could be a state dependent phenomenon as well. In other words, when currencies have low interest rates compared to US interest rates, overshooting of the exchange rate becomes a possibility. However, more research is needed to draw strong conclusions.

As a robustness check, Table A5 provides the results for the SDOLS estimator.[11] This estimator is the most efficient alongside the DGLS estimator and suffers less from size distortion compared to fully modified

[11] For the SDOLS estimator: see footnote 9.

estimators. It turns out that the SDOLS estimates are very similar to those reported in Table 3.

Finally, a caveat that has to be made is the high variance of the individual slope coefficients. Fully modified estimators, such as FM-GLS, show relatively low estimated variances (results are shown in Table A6) but these estimators are less efficient compared to the system DGLS or DOLS estimators. Further, the simulation results of Moon and Perron (2005) show that these fully modified estimators suffer more from size distortion than do DGLS or DOLS estimators.

5. Conclusions

In this study, we have tested UIP over short-term horizons using the major international currencies. We find that UIP generally holds over a short-term (but above 5-months) horizon for individual and groups of currencies. This finding deviates from findings of other studies. We are using both a different technique and different interest rates. In principle, both differences might explain why our results are different. However, factor analysis shows that the LIBOR rates are defined by only one factor, i.e. domestic interest rates, suggesting that our results are not driven by the use of LIBOR. We are therefore inclined to conclude that the technique we have adopted is the main reason why our results are different from previous studies.

Our result that UIP holds over a short horizon in advanced economies has important implications for researchers and policy makers. Specifically, macroeconomic models used in the central banks of advanced and emerging economies employ UIP to develop linkages with foreign economies. In the absence of strong empirical support in favor of this theory, the confidence of the policy makers on the performance of these macro models remains weak. The findings of our paper thus provide the necessary support for them. Further, the results of this article are likely to improve the exchange rate forecasting ability of researchers.

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Appendix

Table A1: Correlation Between (First Differenced) Interest Rate Differenced Series

	Euro	JPY	GBP	AUD	CAD	CHF
Panel A: Full Sample differential vis-à-vis US interest rate						
Euro	1.00	0.81	0.72	0.64	0.51	0.82
JPY	0.81	1.00	0.58	0.64	0.54	0.76
GBP	0.72	0.58	1.00	0.62	0.35	0.66
AUD	0.64	0.64	0.62	1.00	0.55	0.63
CAD	0.51	0.54	0.35	0.55	1.00	0.49
CHF	0.82	0.76	0.66	0.63	0.49	1.00
Panel B: Full Sample Japanese and Swiss interest rates differential vis-à-vis US interest rate						
Euro	1.00	-0.81	0.72	0.65	0.51	-0.83
JPY	-0.81	1.00	-0.59	-0.64	-0.54	0.76
GBP	0.72	-0.59	1.00	0.62	0.36	-0.66
AUD	0.65	-0.64	0.62	1.00	0.55	-0.64
CAD	0.51	-0.54	0.36	0.55	1.00	-0.49
CHF	-0.83	0.76	-0.66	-0.64	-0.49	1.00

Source: Authors' Calculations.

Note: This table shows the correlation structure between first differenced, currency specific 6-months interest rate differential series. In Panel A, 6-months interest rate differential series are calculated by subtracting the US Dollar interest rate from other currency interest rate. In Panel B, similar procedure applied for all currencies specific interest rates except for the Japanese yen and the Swiss franc. For these two interest rates, the home currency interest rate is subtracted from the US dollar interest rate.

Table A2: Block Bootstrap Panel Unit Root (Pooled) Tests

	Exchange Rate Differential Series			Interest Rate Differential Series		
	Statistics	5 percent CV	P-value	Statistics	5 percent CV	P-value
1-week	-314.2310	-17.3620	0.0000	-3.5450	-15.5530	0.8620
2-week	-165.2870	-21.6920	0.0000	-2.6540	-12.2880	0.8350
1-month	-69.3440	-19.1670	0.0000	-1.9500	-8.8460	0.7700
2-month	-31.8960	-13.1120	0.0000	-2.0830	-7.4430	0.6580
3-month	-19.1860	-10.8160	0.0010	-2.2100	-7.3500	0.6150
4-month	-12.5510	-11.1170	0.0260	-2.1400	-6.7300	0.6070
5-month	-7.8380	-10.7360	0.1810	-2.1010	-6.4420	0.6100
6-month	-6.4250	-10.2620	0.2970	-2.1020	-6.3700	0.6160
7-month	-6.0270	-10.7850	0.3780	-2.0820	-6.4310	0.6300
8-month	-5.2530	-10.9910	0.5160	-2.0470	-6.5030	0.6520
9-month	-5.8730	-11.0590	0.4550	-2.0340	-6.5780	0.6680
10-month	-5.6170	-12.1350	0.5570	-2.0300	-6.6670	0.6810
11-month	-5.5700	-11.7170	0.5140	-2.0610	-6.8220	0.6920
12-month	-5.9860	-11.8480	0.4570	-2.0800	-6.9580	0.7050

Source: Authors' Calculations.

Note: Estimated test statistics for equation (5) at level of exchange rate and interest rate differential series. 5 percent CV indicates robust critical values calculated at 5 percent level of significance. P-values indicate the corresponding probability values of the calculated test statistics.

Table A3: Results of Westerlund Cointegration Test (Pooled Test)

	Pt			***Pa***		
	Value	**Z-value**	**Rob. P-value**	**Value**	**Z-value**	**Rob. P-value**
6-month	-5.176	-3.3630	0.0040	-11.0840	-8.5090	0.0000
7-month	-4.1930	-2.5210	0.0140	-8.3780	-6.2200	0.0020
8-month	-4.1160	-2.4550	0.0360	-7.7080	-5.6530	0.0040
9-month	-4.1840	-2.5140	0.0280	-7.2070	-5.2290	0.0060
10-month	-4.1150	-2.4540	0.0160	-6.8010	-4.8850	0.0080
11-month	-3.5320	-1.9550	0.0640	-5.4740	-3.7630	0.0240
12-month	-3.4090	-1.8490	0.0620	-5.1820	-3.5160	0.0160

Source: Authors' Calculations.

Note: Estimates of ECM coefficient based on equation (7). The alternative hypothesis of these test statistics are the cointegration relationship exists when the panel taken as whole. 5 and 12 are the maximum number of leads and lags considered for estimation. Values give the estimated values of the coefficients and Z-values are their standardized values. Rob. P-values are the robust probability values calculated using the bootstrap technique. The corresponding values show the level of significance.

Table A4: Estimation Results for System DGLS (Monthly Data)

	6-m	**7-m**	**8-m**	**9-m**	**10-m**	**11-m**	**12-m**
Euro	-0.2891	0.1103	2.8782	0.8791	-0.7631	17.0376*	21.8353*
	2.3187	*3.0917*	*2.8813*	*2.9739*	*6.5479*	*4.3569*	*4.8998*
JPY	-3.4596*	-0.2399	1.1653	1.8085	-2.8062**	-1.4989	0.8416
	2.0816	*2.2002*	*1.6906*	*1.6871*	*2.1245*	*2.0517*	*2.5742*
GBP	-0.2934	-0.1913	1.9738	-1.1612	-6.5941*	-3.1139**	1.5832
	1.6146	*1.8934*	*1.568*	*1.7073*	*3.1399*	*2.3495*	*2.7434*
AUD	-0.7196	-0.1402	0.9967	2.8111	0.8597	2.5259	1.5688
	1.8027	*1.4448*	*1.5513*	*1.4736*	*1.9878*	*1.7369*	*2.3275*
CAD	1.5326	-0.0836	-4.0469*	-1.9124**	5.3586**	0.7959	-2.4556
	1.8467	*2.066*	*2.0445*	*1.5508*	*2.3028*	*1.7798*	*2.3412*
CHF	-3.3382	-4.6011	-8.2813*	-5.3422*	-6.0788*	0.6033	6.1701*
	3.8133	*4.3311*	*2.8784*	*2.2252*	*2.485*	*1.6825*	*2.0713*
Wald Stats	11.4885	4.1313	10.0425	7.8104	12.738	10.1588	6.5247
Wald p	0.0744	0.6589	0.1229	0.2523	0.0474	0.1181	0.3670

Source: Authors' Calculations.

Note: Estimates of System DGLS coefficient based on equation (7) using average monthly data with maximum leads and lags of 4 months. The optimal lag length selected using Bayesian Information Criteria (BIC). The null hypothesis is individual coefficient is unity. The figure in italics shows the standard errors. The Null hypothesis for the Wald test is the joint beta coefficient is unity. Wald P shows the P-values of the Wald test statistics. The symbols indicates *, < 5 percent and ** < 10 percent level of significance, respectively.

Table A5: Estimation Results for System DOLS (SDOLS)

	6-m	7-m	8-m	9-m	10-m	11-m	12-m
				System DOLS			
Euro	-0.278	2.4236	3.5999	4.7121	6.152**	8.3515*	9.7004**
	2.0146	*2.1105*	*2.7217*	*2.8512*	*2.7927*	*3.7077*	*4.5603*
JPY	-0.7075	-1.048**	-1.1609	-1.1378	-0.7956	-0.6515	-1.0312
	1.2539	*1.1603*	*1.3721*	*1.3674*	*1.4037*	*1.7217*	*1.9135*
GBP	-0.6000	-0.1023	-0.6930	-0.4170	-0.6122	0.8814	3.7240
	1.7103	*1.5082*	*1.9771*	*2.0987*	*1.8826*	*2.4351*	*2.7847*
AUD	-0.9933	-0.9490	-0.5355	-0.5590	-0.6936	-0.7358	0.9697
	1.2610	*1.6110*	*2.2190*	*2.0494*	*1.8770*	*2.2867*	*2.6355*
CAD	0.0444	-0.3957	-0.9880	-2.2319**	-2.2188**	-3.0872**	-3.9464**
	1.4682	*1.7028*	*2.0284*	*1.8667*	*1.7915*	*2.1988*	*2.7878*
CHF	-1.4158	-4.0798*	-3.2265*	-2.1787	-1.8461	-1.2688	-0.1325
	2.6703	*2.2338*	*2.5293*	*2.4684*	*2.0253*	*2.3883*	*2.5069*
Wald Stats	12.2551	13.6237	11.5634	14.5290	13.6779	9.6855	7.6626
Wald p	0.0565	0.0341	0.0724	0.0243	0.0334	0.1385	0.2639

Source: Authors' Calculations.

Note: Estimates of System DOLS coefficient using average weekly data with maximum leads and lags of 12 weeks. The optimal lag length selected using Bayesian Information Criteria (BIC). The null hypothesis is individual coefficient is unity. The figure in italics shows the standard errors. The Null hypothesis for the Wald test is the joint beta coefficient is unity. Wald P shows the P-values of the Wald test statistics. The symbols indicates *, < 5 percent and ** < 10 percent level of significance, respectively.

Table A6: Estimation Results for Fully Modified GLS (FMGLS)

	6-m	7-m	8-m	9-m	10-m	11-m	12-m
Euro	-0.1343*	-0.1009*	-0.2798*	-0.2166**	0.9372	0.9682	2.0269
	0.3910	*0.4133*	*0.5771*	*0.6671*	*0.6569*	*0.7542*	*0.8333*
JPY	-2.5297*	-1.9882*	-2.6277*	-2.9759*	-3.1833*	-3.018*	-3.3997*
	0.7423	*0.6328*	*0.7704*	*0.7519*	*0.7710*	*0.9044*	*1.0604*
GBP	-2.7716*	-2.9399*	-3.4442*	-2.9375*	-1.594*	-1.1135*	-0.6979
	0.8325	*0.8597*	*0.9831*	*0.9786*	*1.0246*	*1.0299*	*1.1889*
AUD	-1.6014*	-1.957*	-2.1516*	-2.059*	-1.1999*	-1.4672*	-0.2616
	0.5065	*0.5582*	*0.7257*	*0.7719*	*0.7692*	*0.8853*	*0.9032*
CAD	0.6367	1.2165	0.5112	0.6486	-0.8737*	-0.0695	-0.3639
	0.7251	*0.8215*	*0.8769*	*0.9564*	*0.9486*	*1.0073*	*1.1083*
CHF	-0.0669*	0.0167**	-0.0223	0.1068	-1.5258*	-1.9338*	-2.948*
	0.5270	*0.5661*	*0.6754*	*0.8305*	*0.8261*	*0.9489*	*0.8932*

Source: Authors' Calculations.

Note: System fully Modified GLS (FMGLS) estimates on average weekly data with maximum leads and lags of 12 weeks. The optimal lag length selected using Bayesian Information Criteria (BIC). The null hypothesis is individual coefficient is unity. The figure in italics shows the standard errors. The symbols indicates *, < 5 percent and ** < 10 percent level of significance, respectively.

The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 73–92

Identifying and Understanding High Growth Firms in the Pakistani Textile and Apparel Sectors*

Waqar Wadho and **Azam Chaudhry**

Abstract

In this article, we investigate the distinguishing features of fast growing firms in the Pakistani textile and apparel sectors. We find that the distribution of firm growth- both in terms of employment and sales - is very heavily skewed toward the right-tail, confirming earlier findings that firm growth is generated by a very small number of firms. We found that small and young companies grow faster and generate higher employment. We also used various indicators of a firm's innovation behavior and found that more innovative firms grow faster. Our results suggest that it is not the possession of individual attributes, but rather a combination of particular firm attributes that defines fast growing firms. Specifically, we found that the blend of being small, young and innovative explains the fast growth in firms. on overall these companies also create more jobs.

Keywords: Firm growth, employment creation, young innovative companies, textiles, Pakistan.

JEL Classification: O12, L26.

1. Introduction

The critical role of innovation in the survival and expansion of firms has been emphasized in the literature as far back as Schumpeter (1942). In recent years, there has been significant amount of work looking at the role of various types of innovation in firm-level growth and more recently there has been a growing interest in young, innovative and fast-growing firms by both entrepreneurship scholars and policymakers. Fast growing firms make considerable contributions to economic growth and also generate employment opportunities. This is especially important in the case of

* The authors acknowledge financial support from the International Growth Center (1-VRCVPAK-VXXXX-89222) and the Lahore School of Economics for the project "Measuring Innovation in the Textiles Sector of Pakistan" for the data used to conduct this study. We would like to thank the Bureaus of Statistics of Punjab and Sindh, for their assistance.
** Corresponding: Lahore School of Economics, Barki Road, Lahore, Pakistan. Email: w.wadho@lahoreschool.edu.pk

developing countries where the demographics are such that a large number of young people are entering the labor market every year. Firm growth is also cardinal to the structural transformation of an economy and historically, the manufacturing sector has been considered as driver of economic growth. The expansion of the manufacturing sector also helps increase the employment absorption capacity of the economy. However, the literature from a wide range of countries shows that firm growth is highly uneven, and the majority of employment is created by a very small number of firms, termed 'gazelles' or high growth firms (HGF) (Wadho, Goedhuys, & Chaudhry, 2019; OECD, 2007). Given the key role of fast growing firms in fostering employment generation, an understanding of the mechanisms behind their growth patterns in developing countries is crucial.

The firm growth literature provides some important correlates of employment creation and growth. Younger and smaller firms are shown to grow faster than older and larger firms (Coad & Rao, 2008; Coad, 2009; Coad, 2016). Another important aspect of firm growth is related to innovation. To survive and grow in a competitive industry, a firm needs to innovate through the introduction of new products and processes. Innovation is indeed found to be conducive to employment creation and firm growth (Wadho, Goedhuys, & Chaudhry, 2019; Audretsch et al., 2014). Moreover, in recent years the focus has shifted toward understanding what is the combination of firm attributes associated with superior performance. Specifically, the questions that have attracted considerable attention from the scholars include: How do firm size and age interact with innovation? And does this innovation lead to superior firm performance? A number of recent studies indeed show that small young and innovative companies exhibit superior growth performance and create disproportionate jobs (Wadho, Goedhuys, & Chaudhry, 2019; Czarnitzki & Delanote, 2013; Pellegrino et al., 2011; Schneider & Veugelers, 2010; Veugelers 2009).

Though the literature has focused first on the role of innovation in firm-level growth, much of this work has been based on analysis of data from developed economies. Also, the analysis of managerial innovations is far more recent in the analysis of firm-level innovations and much of the measurement of these types of innovations have also occurred in the context of developed economies. In this study, we attempt to fill these gaps by looking at the role of various types of innovations (including technological and managerial innovations) on firm growth in the context of a developing country. What makes this analysis even more novel is that it focuses on a specific sector (textiles) in a developing country (Pakistan) which is particularly critical from a macroeconomic growth perspective.

This study complements Wadho, Goedhuys, and Chaudhry (2019) by identifying the characteristics of fast-growing firms, and by supplementing their evidence with two case studies of young innovative companies, as well as Wadho and Chaudhry (2018) by providing evidence on the growth impact of technological in addition to managerial innovation.

We present some of the results of a unique innovation survey conducted in 2015 with the textile (textile and apparel) manufacturers in Pakistan. The survey asked manufacturers about their innovation activities and the introduction of various types of innovations (product, process, managerial and marketing) for the period 2013-2015. Textiles is Pakistan's major manufacturing sector, contributing one-fourth of industrial value added, employing 40 percent of the industrial labor force, and contributing 56 percent to national exports.

We find that small and younger firms grow faster and create more absolute jobs and that innovation is conducive to job creation, where job creation is measured by employment growth. However, and more importantly, we found that this superior growth performance is associated with the combination of being small, young and innovative. Furthermore, much of the literature on firm-level innovation has been made up of empirical studies analyzing either cross-sectional or panel datasets to determine the causes and effects of innovation. But in much of this empirical work, there has been a lack of focus on how and why specific firms have innovated and the impact of this innovation. In order to add to the existing literature by looking at specific cases of companies that are young and especially innovative, we held in-depth interviews with two of the young innovative companies (YICs) to learn about the nature and novelty of innovation in the sector and we assessed the entrepreneurs' views on the role of their innovation for corporate success. From this complementary analysis we find success lies with the YICs' focus on introducing new products into the international market. YICs consider an in-house R&D department that works in collaboration with other departments (such as marketing and procurement) to introduce new products combining fashion with performance as critical for survival and growth. Equally important is investing in processes with modernized machinery for the production of new products. While being part of a larger group seemed important in terms of getting access to business networks and initial success, new products with improved processes along with improved managerial practices are considered the most essential ingredients for the persistence of high growth.

The layout of the study is as follows: In the next section we discuss the theoretical framework. In Section 3, we explain the innovation survey and present descriptive statistics. In Section 4 we discuss some of the correlates of growth while Section 5 contains some qualitative case studies. Finally, Section 6 concludes.

2. Theoretical Framework

The theoretical underpinnings of our analysis are based on the idea that both local and international competition can impact demand for products, prices of products and markups and this in turn implies that firms need to innovate (either through new products and process or through managerial innovations) in order to survive (Schumpeter, 1942). Beyond survival, firms must also innovate in order to grow both in terms of sales and employment (Audretsch et al., 2014), so one factor that impacts firm growth is the level of innovation. Furthermore, the literature has found that smaller and younger firms tend to be more flexible in their ability to innovate (since innovation requires changes in products and processes) and this in turn increases their chances of surviving and growing (Wadho, Goedhuys, & Chaudhry, 2019; Coad, 2009; Quatraro & Vivarelli, 2014). So, in theory smaller and younger firms have a greater chance of having higher innovation which in turn can have an impact in their levels of sales and employment growth.

We use our unique dataset to catagorize textile and garment manufacturers based on their size and age and then see if the smaller, younger firms experience higher growth.

3. Innovation Survey and Firm Level Statistics

Description of Survey

In 2015, we surveyed 614 textile and wearing apparel manufacturers from the Punjab and Sindh provinces of Pakistan. The textile and wearing apparel sector is defined as all manufacturing firms classified under Sections 13 and 14 of the Pakistan Standard Industrial Classification, PSIC 2010. We used the Directory of Industries as the initial sampling frame. This frame was then updated with the support of the respective bureaus of statistics in Sindh and Punjab.

For this type of survey, the Oslo manual (OECD, 2005) recommends stratified random sampling where the strata can be based on the size of firm,

principal activity of the business, geographic location of the firms, etc. Due to the limited information available in our frame, we could only stratify our sample based on the geographic location of firms. We drew a stratified random sample which was representative firstly at the provincial level and then at the district/regional level. The total population of the textiles and wearing apparel manufacturers in Punjab and Sindh provinces is 4205 units, and our sample size of 614 is around 15 percent of the population.

The survey questionnaire was designed on the basis of the Oslo manual (OECD, 2005) and its recommendations for developing countries. The core questionnaire related to innovation was similar to the Community Innovation Surveys (CIS) of Europe. Apart from the standard modules on technological (product and process) innovation, the questionnaire included modules on non-technological (organizational and marketing) innovation, competition, and information communication and technologies. The survey was conducted between August and October 2015 and innovation related questions were asked for the previous three years, 2013–2015. The survey response rate was 70 percent and a total of 431 firms voluntarily participated in the survey. The majority of the non-respondents were firms which did not exist or were permanently closed at the time of survey (139 firms out of a total 183 non-respondents). Out of the 431 respondents, there were firms who did not report their annual turnover due to confidentiality issues; however, we did not find systematic refusal based on firm characteristics or geographic location. In order to ensure that the data is suitable for estimations, we remove all firms not reporting turnover in 2015 and this reduced our sample to 377 firms.

Descriptive Statistics

In this section we present some of the characteristics of the firms in our survey. We start with some of the basic firm-level descriptive information and then look at the distribution of employment growth and sales growth of the firms in our sample.

Table 1 gives an overview of the definition of variables used and presents some summary statistics.

Table 1: Description and summary statistics of the variables

Variable	Definition	Mean (Std Dev)
Employment growth	Natural logarithm of employment in 2015 minus natural logarithm of employment in 2013	0.10 (0.86)
Sales growth	Natural logarithm of tunover in 2015 minus natural logarithm of turnover in 2013	0.95 (4.16)
Age	Firm age measured as the natural logarithm of years in 2015.	21.7 (13.9)
Product Innov.	=1 if a firm introduced new or significantly improved products during 2013-15 that were at least new to the firm.	0.334
Process Innov.	=1 if a firm implemented a new or/and significantly improved production process, distribution method, or/and supporting activity during the three years 2013-15.	0.406
Managerial Innov.	=1 if a firm implemented a new organizational method in its business practices, workplace organization, or external relations during previous the three years 2013-15.	0.302
Tech. Innov.	=1 if a firm introduced product and/or process innovation during 2013-15 that were at least new to the firm.	0.496
Cont. R&D	=1 if a firm performed R&D on continuous basis during 2013-15.	0.241
R&D Intensity	Natural logarithm of total expenditure on innovation in 2015. Total expenditure is a sum of expenditure on (i) in-house R&D, (ii) external R&D, (iii) acquisition of machinery, equipment and software, (iv) acquisition of external knowledge, and (v) training for innovative activities.	7.87 (10.0)
YIC_1	=1 if less than 50 workers, less than 10 years old, and technological innovation in 2013-15.	0.040
YIC_2	=1 if less than 50 workers, less than 10 years old, and invested at least 5% of turnover in innovation in 2015.	0.019
YIC_3	=1 if less than 50 workers, less than 10 years old, and continuous R&D in 2013-15	0.020
Human capital	Natural logarithm of the total number of workers in 2015 with a university degree or/and professional diploma.	1.76 (2.23)
$Exports_{2013}$	Natural logarithm of exports as a share of turnover in 2013.	

Source: Authors' Calculations.

Table 2 presents the descriptive statistics on firm size, firm sales, firm age, product innovation, process innovation, continuous R&D and R&D intensity.

Table 2: Firm Characteristics

	Obs	*Empl*	*Sales*	*Age*	[a]*Product Inn.*	[a]*Process Inn.*	[a]*Cont. R&D*	[b]*R&D Intensity*
Total	377	348	731	21.7	33.4	40.6	24.1	9.3
Apparel	71	509	1110	20.1	56.3	52.1	45.1	11.7
Textile	306	311	644	22.1	28.1	37.9	19.3	8.4

Source: Authors' Calculations.
Note: Firm Sales are given in Millions Rupees. a) as a percentage of firms, b) as a percentage of total turnover in 2015 for only those firms who reported investing in innovation.

Overall, one-third of the firms reported introducing new products and around forty percent reported introducing new processes during the 2013-15 period. In terms of innovation efforts, around one-fourth of firms reported that they have an in-house R&D department and that they conduct R&D on continuous basis. Firms who reported investing resources on innovation, spent on average nine percent of their sales on such activities in 2015.

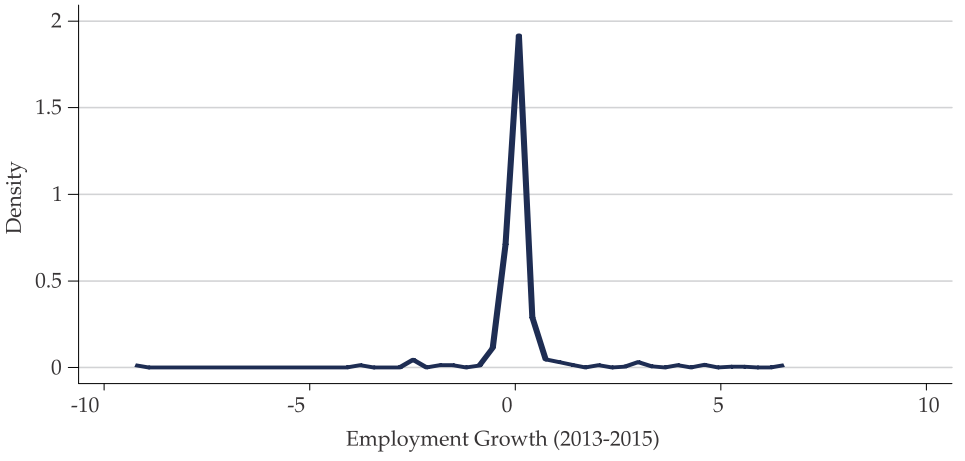
There are also some noticeable differences between the two sub-sectors. On average, firms in the apparel sector employ more than the textile sector, their sales are much higher and are relatively younger than firms in the textile sector. Firms in the apparel sector are also more innovative. On average, there are twice as many firms in apparel that introduced new products as compared to textiles. Likewise, the percentage of firms introducing new processes is also higher in the apparel sector. In addition, apparel firms outperform the textile sector in terms of expenditures as a percentage of turnover on innovation activities as well as performing R&D on a continuous basis.

Employment Growth in Firms

Moving on to employment, Figures 1a, 1b and 1c show the distribution of employment growth (2013-15) in the overall sample, apparel sector, and the textiles sector, respectively.[1]

[1] Where the density refers to the kernel density estimate.

Figure 1a: Employment Growth (2013-2015)



Source: Authors' Calculations.

Overall, the majority of firms are characterized by 0 employment growth, but the right tail suggests that employment growth is concentrated among a small number of firms, and within these there are visible growth differences. At the same time, there is a long left tail which implies that there is a higher number of firms that experienced negative employment growth.

Figure 1b: Employment Growth in Apparel

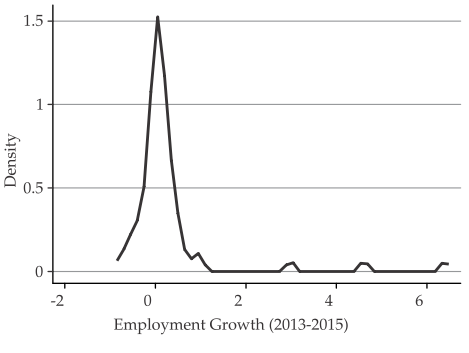
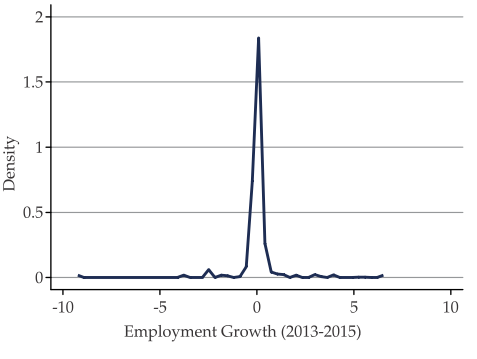


Figure 1c: Employment Growth in Textiles



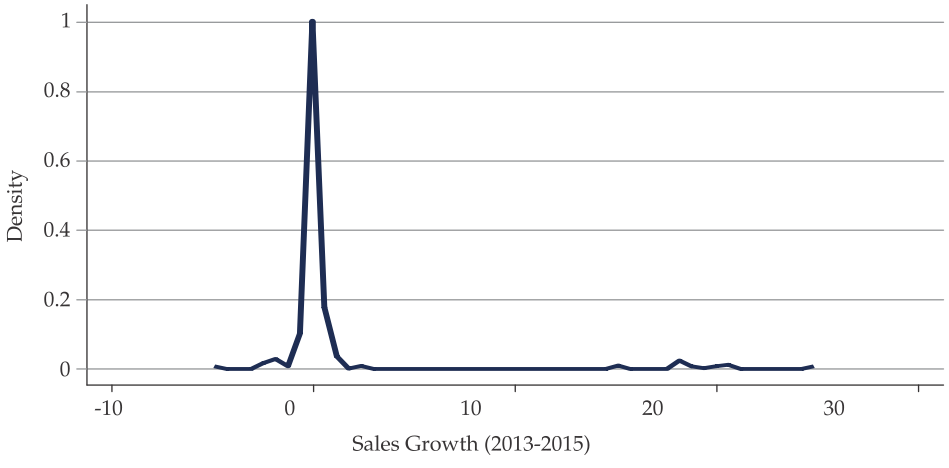
Source: Authors' Calculations.

Figures 1b and 1c break the employment growth down into growth in the apparel and textile sectors respectively. While both distributions are centered around 0 growth, the significant difference that arises between the sectors is that the distribution of employment growth

in the apparel sector contains a large positive tail while the distribution of employment growth in the textile sector has a large negative tail. So the apparel sector is characterized by more positive employment growth than the textile sector.

Moving to the distribution of sales growth amongst textile firms, we present the distributions for all the firms in Figure 2a and then the apparel firms and textile firms in Figures 2b and 2c, respectively.

Figure 2a: Sales Growth (2013-2015)



Source: Authors' Calculations.

Similar to the employment growth distribution, we find that the majority of firms experienced 0 sales growth, but at the same time the major difference in this case is that there is a large positive tail; in other words, there was a higher number of firms that experience positive sales growth and the growth differences between these firms were larger.

Figure 2b and Figure 2c respectively show the distribution of sales growth in the apparel and textile sub-sectors during 2013-2015. Unlike the case of employment, both sectors are characterized by a significant number of firms with positive sales growth, though the majority of firms in both sectors still experience 0 growth.

Figure 2b: Sales Growth in Apparel

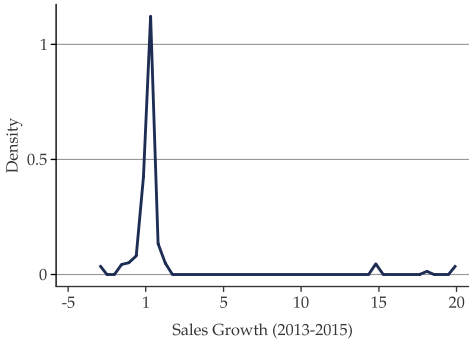
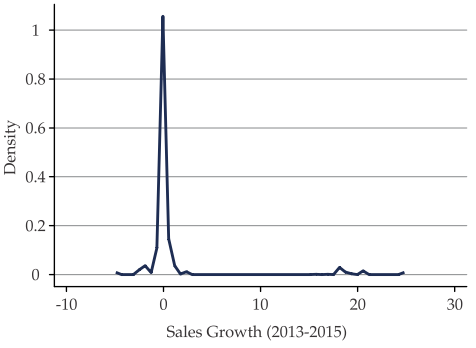


Figure 2c: Sales Growth in Textile



Source: Authors' Calculations.

4. Correlates of Firm Growth

In this section we provide some basic correlates for firm growth for the manufacturers in our sample. We start by looking at the correlates of employment growth and then we look at how small and young firms differ from other firms in terms of growth as well as how innovative firms differ from non-innovative firms in terms of growth. Finally, we put this all together and see how young, small and innovative firms differ from other firms in terms of growth. Table 3 presents the correlates of employment growth.

Table 3: Correlates of Employment Growth (2013-15)

	Emp_{2013}	**$Sales_{2013}$**	**Age_{2013}**	**$Exports_{2013}$**	**R&D intensity**	**Human capital**
Empl growth	-0.37***	-0.48***	-0.43***	-0.14***	0.10*	0.10**

Source: Authors' Calculations.
Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

In line with much of the existing literature, we find that there is a negative correlation between firm size and employment growth (see Mansfield, 1962; Storey, 1994; Roper, 1997; Heunks, 1998; Freel, 2000; Coad et al., 2016; Wadho, Goedhuys, & Chaudhry, 2019). Both smaller employment and smaller sales in 2013 are associated with higher employment growth. Similarly, there is also a negative association between firm age and employment growth suggesting that younger firms experience higher employment growth. Furthermore, we find that there is a negative association between a firm's export intensity and its growth. Firms with higher export intensity experienced lower employment growth. This could potentially be because export intensive firms may be older and larger and

create less employment or may be because exporting leads to more automation and capital intensive technologies that reduce demand for labor.

We find that there is a positive correlation between a firm's innovation efforts and employment growth. Firms investing more on innovation grow faster. This could potentially be because firms who invest more on innovation are successful in introducing new products and processes that contribute to their expansion and result in more employment.

Finally, Table 3 reports a positive correlation between skilled labor and employment growth. Firms employing more skilled workers may be better able to absorb and implement new technologies and may also be more able to introduce new products and processes leading to business expansion and more employment.

The preceding correlation analysis provides clear evidence that smaller and younger firms are associated with more employment growth. In Table 4, we dig deeper and evaluate how different sized firms have shown growth in employment as well as how many net jobs have they created. Table 4 also reports how younger firms, and smaller younger firms tend to have greater employment growth and greater employment.

Table 4: Job Creation: Size and Age (2013-15)

Types	Mean growth in employment in %	Mean net employment creation
Total sample	9.7	24.78
Small (<50 employees)	26	11.96
Medium (≥ 50 but <250 employees)	-3.5	00.18
Large (≥ 250 employees)	-12	84.36
Young (<10 years old)	53	25.15
Small and Young	79	35.83

Source: Authors' Calculations.

Results in Table 4 show that firm growth and employment creation vary substantially with firm size. While small sized firms experienced mean employment growth of 26 percent, both medium and large sized firms on average experienced negative growth. Similarly, the results in Table 4 show that younger firms experienced significantly more employment growth. While the mean employment growth in the sample was 9.7 percent, young firms experienced a mean employment growth of 53 percent. Focusing on firms that are both small and young i.e. combining the two attributes, one finds that the smaller younger firms experienced

even higher employment growth. On average smaller, younger firms recorded mean employment growth of 79 percent which is 8 times higher than the average firm-level employment growth in our sample.

Another factor that is reported as being very conducive to employment growth is a firm's innovation behavior. Innovative firms introduce new products that create new markets and expand their shares in the existing market resulting in firm expansion. Expanding firms engaging in innovative processes may create more employment which leads to employment growth (see Martinez-Ros & Labeaga, 2009; Miravete & Pernías, 2006; Polder et al., 2009; Ballot et al., 2011; Wadho, Goedhuys, & Chaudhry, 2019). So while process innovation is often associated with automation and cost-saving including reductions in labor, if process innovation leads to quality improvement in products, it can contribute to employment creation in a similar way as the introduction of new products does. Our data contains rich information on different innovative attributes of firms that we exploit to see if innovation is conducive to employment creation in our sample.

Table 5 shows the difference in employment growth for firms that are innovative versus firms that did not innovate over the period covered by the study.

Table 5: Job Creation Innovator Vs Non Innovators (2013-15)

Types	Mean growth in employment in %	Mean net employment creation
Total sample	9.74	24.78
Technological Innovation		
Yes	12.53	53.47
No	06.99	-03.47
Managerial innovation		
Yes	15.37	54.87
No	07.30	11.73
Technological and Managerial innovation		
Yes	20.28	68.53
No	06.18	10.03
R&D investing		
Yes	17.45	59.56
No	04.81	02.54
High R&D intensity (≥ 5%)		
Yes	36.65	82.80
No	02.37	8.90
Continuous R&D performing		
Yes	23	118.87
No	06	-05.16

Source: Authors' Calculations.

The first observation noticeable from Table 5 is that, irrespective of the innovation proxy used, innovating firms on average experienced higher employment growth than the mean firm growth of 9.7 percent in the overall sample. Firms who introduced technological innovations experienced almost twice as much employment growth as the firms who did not introduce technological innovations. Similarly, technological innovators contributed around 54 new jobs whereas non-innovators shed jobs.

The same message comes through from the firms that performed managerial innovations: these firms experienced twice as much employment growth as the firms that did not perform these types of innovations. Firms that performed both technological and managerial innovations experienced three times the employment growth as firms that did not perform both of these innovations. This finding contributes to the larger debate on the role of innovation in firm performance in developing countries with low-tech industries. These results show that even though innovation in developing countries is characterized by an incremental nature or capabilities toward catch-up, it is still significantly correlated with firm performance in terms of growth and job creation.

We find even more striking differences when comparing firms investing in innovation, investing with higher intensity, and performing R&D on continuous basis. We find that firms that performed R&D, firms that had high levels of R&D investment intensity, and firms that performed R&D on a continuous basis experienced significantly higher employment growth. In contrast, firms who did not invest in R&D, who did not invest enough, or who did not perform R&D on continuous basis experienced very low employment growth.

There are also noticeable differences among innovators depending on which definition of innovation is used, which also sheds some light on the indicators used to capture innovation behavior in our particular context. Overall, firms who spent at least 5 percent of their turnover on innovation and firms who performed R&D on a continuous basis experienced much higher employment growth and net employment creation than any other innovative firm. In particular, firms who performed R&D on a continuous basis increased net employment by 119 workers (on average) in comparison to firms not performing R&D on a continuous basis who fired 5 (mean) workers (on average).

Finally, building on the growing literature on young innovative companies reported to be the major contributors to employment growth (see

Veugelers, 2008; Czarnitzky & Delanote, 2013; Schneider & Veugelers, 2010), in Table 6 we look at the growth differences between YICs and young non-innovative companies. This analysis will also shed new light on the impact of innovation on job creation by small young enterprises. We combine size, age and innovation attributes to define YICs and then compare them with other innovative companies that are not small and young. We create three different types of young innovative companies by altering the definition of what it means to be innovative. In the first definition, YIC_1, we define an innovative firm as an enterprise that introduced a technological innovation; in the second definition, YIC_2, we define an innovative firm as one that performs R&D on a continuous basis; and in the third definition, YIC_3, we define innovative firms as those that spent at least 5 percent of their turnover on innovation. Throughout, a firm is considered small if it employed less than fifty workers and young if it was less than 10 years old. We then compare the employment growth performance of these YICs versus innovative companies that are not young and small. Moreover, since we vary the definition of what constitutes an innovative firm, this analysis could also reveal which attribute of innovation is most impactful in terms of job creation in our context.

Table 6: Job Creation YICs Vs Non-YIC Innovators (2013-15)

Types	Mean growth in employment in %	Mean net employment creation
YIC_1		
Yes	182.50	80.73
No	-00.90	55.10
YIC_2		
Yes	248.08	136.57
No	05.92	55.70
YIC_3		
Yes	366.44	164.00
No	-00.003	54.34

Source: Authors' Calculations.

Note: Non-YIC innovator = Firms who invest in innovation activities but are not YICs; YIC_1 = 1 if age < 10 & employment < 50 & Technological innovation =1, YIC_2=1 if age < 10 & employment < 50 & Continuous R&D = 1, YIC_3=1 if age < 10 & employment < 50 & with R&D intensity $\geq$ 5% of turnover.

Table 6 shows some very striking differences in employment growth as well as in employment creation between the YICs and non-YIC innovators. While the YICs experienced extremely high employment growth, the non-YIC innovators were characterized by low or negative growth. Overall, this reinforces our hypothesis that the majority of growth that is taking place in our sample is because of the YICs. This also highlights the fact that even though innovation is conducive to employment growth as

shown in the previous analysis, it is the combination of being both small young and innovative that is correlated with higher employment growth. This could potentially be due to the differences in innovation strategies of young firms versus more established incumbents. In order to compete with the incumbent firms, young enterprises engage more in radical innovations that are riskier but result in greater expansion and growth when successful. In a broader context, since YICs disproportionately contribute to job creation and employment growth, they could be very suitable candidates for targeted government support.

5. Qualitative Analysis

Finally, to give a richer interpretation to the findings, we approached two of YICs from our sample and conducted in-depth interviews with their managers to get additional insights on the relative importance of innovation for their employment and sales growth. Both companies have YIC status irrespective of the definition used for innovation. As the experiences of these two companies are very illustrative for the findings of the quantitative analysis, we present in a nutshell the main findings derived from the interviews. These two companies were chosen on the basis that they were both young and extremely innovative relative to other firms in the sample.

Samad Textiles

The first case study is Samad Apparel, located in Lahore. The company was created in 2007. It is part of a larger group, called Samad Rubber Works Private Ltd, a group that has since 1948 been active in the production of innovative rubber products for defense, including rubber boats, air mattresses with high insulation capacity, anti-mine shoes, backpacks for ammunition, life jackets and other war-related equipment and more recently diversified to other products such as the production of soccer balls. Building on our analysis above, it is useful to see a young firm like Samad textiles particularly focused on innovation-related activities and the impact that these activities had on its growth.

In terms of innovativeness, what makes Samad stand out from other firms in the sample is the company's heavy focus on product and process innovations combined with state-of-the-art managerial and organizational improvements. This is necessary as the company is serving international markets where customers require products with superior performance in combination with high fashion standards. Examples of its product innovations include denim jeans for bikers using thread used for bullet-proof jackets which is four thousand times more resistant than

cotton In order to protect bikers from injuries and; waterproof breathable denim jeans for cold climates which are exported to Europe; a light-weight and easily folded jacket made of goose feathers for European; a waterproof breathable fire retardant jacket for disaster management purposes.

Samad Apparel's business model is export-oriented with major international customers including Takko, LPP, and Mango. For this, the company houses its own marketing, R&D and fabrics department who all work together to develop up to 1500 to 2000 samples of new products every month that are then taken to customers for their feedback. This regular interaction of fashion designers with customers helps them to understand customer tastes and market demand. The company regularly sends its representatives to attend international fashion shows and exhibitions to learn new fashion trends, which helps them bringing novel products to international markets. While the development of fashionable and highly sophisticated new products in collaboration with customers is the most important driver of the company's success, process innovation in the form of investment in machinery capable of producing these products is needed and implemented as a simultaneous process.

The company's in-house R&D department performs R&D on a continuous basis and it considers this to be essential to the survival of any textile company in Pakistan. Product innovation is the basic driver of both sales and employment growth. Process innovation, encompassing the introduction of innovative machinery for reaching productive capacity to address demand, reduces the man-to-machine ratio, but this is largely compensated by increased demand for products, resulting in substantial, employment growth. The company seeks multi-skilled labor that can operate machinery and be flexibly shifted across job posts. For this purpose, it hires specialized people to train workers for the firm. The company invests in the skill development of its workers and offers them competitive wages along with basic health insurance and social security.

Apart from product and process innovations, Samad Apparel is very keen to improve management and workplace organization. The company reports state-of-the-art management systems including lean management, an Oracle based system, external auditing of its systems. These systems enabled workers to come up with the idea of taking a 30-second break every two hours in the stitching department to clean machines and collect waste material.

The question arises of what is the impact of Samad's innovativeness on its growth. We find that Samad Apparel has grown spectacularly since

its start and especially since 2013 when it began production of denim products. Between 2013 and 2015, sales doubled every 6 months to reach Rs. 627 million in 2015 while employment grew to 750 employees.

The example of Samad Textiles is a clear case of a successful young innovative firm that managed to enter international markets and boost sales and employment growth through a strong focus on innovative products combined with better processes, with a heavy investment in continuous R&D, in line with the findings of the econometric analysis.

Sarena Apparel

The second case study is Sarena Apparel located in Sheikhupura. Like Samad, Sarena is part of a larger group called Sarena Industries. Sarena Industries is a textiles company specialized in weaving, dyeing, finishing, printing and manufacturing woven, non-denim fabric for apparel. The group has been producing clothing for the local market since 2001 mostly under own-brand names called Leisure Club, Minnie Minor, Kayseria and Bareeze. It also exports fabrics to many international brands. Initially the fabrics were exported to Bangladesh and India, where they were stitched. Serena Apparel was set up in 2014 with an aim to do the entire production of the garments for their own brands as well as for the major customers of Sarena Industries.

Like Samad, Sarena Apparel is convinced that its innovative approach lies at the heart of its successful expansion. Sarena Apparel cooperates with the R&D department of Sarena Industries working on innovation in design and fabric. In 2014, the company attracted the attention of a major international buyer namely Primark, who placed an order of around 300,000 pieces of different garments. As a result of the order, the employment and sales performance of the firm peaked in the year 2015.

To accommodate to this order, 600 employees were hired, explaining the extreme employment growth performance of the company. To produce these products, the company made a huge investment in new automated machinery. The process innovation had an impact on labor quality as more qualified labor had to be hired. Primark also imposed social security payments for the workers as a condition to win the deal, which improved the employment contracts of workers.

Sarena differs from Samad in that the growth was actually a temporary yet exceptional performance, as such an employment level could not be sustained over time. The company is also more traditional in

its management organization and management-to-worker relations. Ultimately, in 2017, Sarena Apparel was merged with Sarena Industries, its parent company. So this case study is more an example of a firm that grew steeply thanks to the innovative orientation of its group, but was taken over in a later stage by the same group.

Nonetheless, Sarena Textiles remains another example of how a small innovative firm can experience high rates of growth.

6. Conclusions

Firm growth is a critical feature of economic growth in developing countries and growth in textile sector firms is especially critical in the case of Pakistan. We find that the growth of firms in this sector (in terms of both employment and sales) is generally stagnant for a significant majority of firms and that positive growth is actually driven by a small number of firms.

We also move beyond the standard empirical analyses of innovation and growth to look at the case studies of two young firms that were heavily engaged in innovation. The impetus behind these case studies was to see what uniquely characterizes the young innovative firms in our sample, especially since the majority of the firms in the sector were old, non-innovative and experiencing little or no growth. The idea was also to show that it is still possible to be an innovative, high growth firm even in a sector that has existed for many decades and may have a tendency to stagnate.

When we look at the characteristics of these firms that drive growth, we find that they tend to be younger, smaller, and more innovative firms. This result is especially useful for policymakers trying to identify sector-specific growth drivers since the focus had previously been to simply focus on firms of certain sizes or firms from certain sectors. Also in the context of Pakistan, there has been a heavy emphasis on providing incentives for older, larger textile manufacturers although this emphasis has failed to lead to any significant increases in exports and has also failed to spur Innovation by these older, larger firms which was required to produce higher value-added goods. Rather, previous policies seem to have led to stagnation in exports as well as a reliance of most manufacturers on producing low-value added goods without expanding into new products or improving product quality. Our results point to the need for policymakers to focus on firms that are not only small but rather on firms that are small and innovative if they want to promote higher employment and long-run economic growth.

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The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 93–114

Surplus Education and Earnings Differentials in Pakistan: A Quantile Regression Analysis

Maqbool H. Sial[*], Ghulam Sarwar[**], and Mubashra Saeed[***]

Abstract

This study empirically investigates the effect of surplus education on the earnings distribution in Pakistan using quantile regression. The method of realized matches is used to measure the required level of education in each occupation from the Pakistan Social and Living Standards Measurement (PSLM) 2013-14 survey data. There is heterogeneity in returns to surplus education among overeducated workers. These returns are higher for workers at the upper half as compared to the lower half of the earnings distribution. Surplus education earns positive returns but less than the returns associated with the level of education required for jobs. Further, the difference in returns among the overeducated is higher than the difference in returns among workers who have the required education for the job. The findings imply that the surplus education factor is significant in explaining how education contributes in earnings differentials and inequality.

Keywords: Surplus education, earning inequality, labor markets, Pakistan.

JEL classification: I24, J31.

1. Introduction

Analyzing and identifying the underlying factors affecting earnings distributions has always been a source of heated debate among economists since the seminal work of Kuznets (1955). There are a range of factors that affect the distribution of earnings distribution including globalization, skill-biased technological change, labor market institutions, inflation and unemployment (Hoeller, Joumard, & Koske, 2014). Much of the current literature on earning inequality underlines education as a contributing factor towards earning inequality (Reis, 2017; Goel, 2017; Flinn & Mullins 2015; Sattinger & Hartog, 2013).

[*] Professor, School of Business and Economics, University of Management and Technology, Lahore, Pakistan.
[**] Assistant Professor, Faculty of Business and Economics, University of Sargodha, Pakistan.
[***] MS Student, Department of Economics, The University of Lahore.

Policies that aim to expand the average schooling of individuals are expected to reduce earnings inequality. Equalization of educational attainment is therefore given as a reason for reducing income inequality (Budria, 2011). The supply of educated labor has risen in the last two decades in Pakistan. However, it is likely that the traditional structure of the labor market is not capable of absorbing the educated workers in jobs that require their attained education; thereby resulting in surplus education in the labor market. In such a situation, where demand for educated labor is stagnant, the Increase in the supply of educated labor can decrease returns to education (Pritchett, 2001). The existence of surplus education suggests that benefits to be gained from the expansion of education could potentially be lower than expected. Thus, an expansion in educational attainment maybe relatively unproductive for society and unprofitable from the individual's perspective (Duncan & Hoffman, 1981; Ordine & Rose, 2009).

Due to an increase in the relative supply of educated workers as compared to the skill requirements of the labor market for specific occupations, some workers take the jobs that require less education than they actually possess. These overeducated workers receive less wages than the correctly matched workers with the same level of education, but over-educated workers receive more wages than their undereducated co-workers, holding other characteristics constant (Nieto and Ramos, 2017; Rubb, 2003; Dolton and Vignols, 2000). This evidence is a warning to policymakers that the unregulated expansion of education for some groups may increase earning differentials, hence income inequality.

The empirical literature on the nexus of surplus education and earnings has emerged with the seminal contribution of Duncan and Hoffman (1981). In their work, an extended version of the Mincer wage equation was proposed that allows a separate estimation of the returns to required education, surplus education and deficit education. They found that the returns to "surplus education" are substantially smaller than the returns to "required education". Subsequent studies (for example, Bauer, 2002; Cohn & Ng, 2000; Lee & Lee, 2016) also confirm their findings. The empirical research of Budria (2011), Budria and Moro-Egido (2009) and Hartog et al. (2001) has reported, using quantile regression, that returns to surplus education are heterogeneous.

In recent years, the returns to surplus education have attracted considerable attention among researchers and policymakers in developed countries due to its effect on earning inequality (for example Leuven &

Oosterbeek, 2011; Ordine & Rose, 2011; Slonimczyk, 2013). However, the contribution of surplus education towards earnings inequality is mostly ignored in developing countries such as Pakistan. Education, as a major determinant of earnings, contributes positively to earnings inequality in Pakistan. To date, the factors that are responsible for a positive link between education and earnings inequality are mostly unknown. Among many possible explanations, one is an educational mismatch (Martins & Pereira, 2004). But how education by its surplus nature contributes to earnings inequality, especially within a group of overeducated workers, is an unexplored area of research in Pakistan.

This study estimates a model where earnings inequality is related to educational mismatch in the labor market. It shows that earnings inequality may arise within occupations, because of the existence of heterogeneity in the education levels of workers employed in similar roles along with differential returns to required and surplus education. Data from the Pakistan Social and Living Standards Measurement Survey for 2013-14 is utilized, which collects comprehensive information on social, demographic and economic indicators from respondents.

The rest of the study is organized as follows. Section 2 discusses some of theories or frameworks presented in the context of surplus education. Section 3 outlines the empirical earnings function and discusses the methodology for its estimation. Further, the measurement of required, surplus and deficit education and the data are explained in section 3. Section 4 presents the empirical findings of the study. Concluding remarks are provided in section 5.

2. Theoretical Framework

There are a number of labor market theories that partially explain the observed mismatch between actual and required education in a particular job and the resulting earnings effect. Human capital theory implies that workers are paid according to their marginal productivity which is determined by their human capital (Becker, 1964). Human capital can be acquired through education, work experience and on-the-job-training. Attained education and work experience indirectly measure the worker's marginal productivity, and hence earnings as well. It is argued that when the supply of highly educated workers increases, employers adopt their production techniques in order to avail the advantage of a cheaper educated labor force. On the other side, productivity and earnings

are fixed in a particular job. Thus mismatched workers receive the earnings that are similar to those workers who are correctly matched in their jobs.

According to the signaling model, in an imperfect labor market, education is used to identify more able, productive and ambitious workers. Therefore, individuals invest more in education with the hope that this will permit them to be distinguished from other applicants competing for the jobs (Spence, 1973).

The job competition model (Thurow, 1975) considers surplus education as demand driven and is a long-term problem in the labor market. It suggests that productivity and earnings depend upon job characteristics instead of individual characteristics. That is, Thurow's (1975), job competition model describes a labor market situation where workers compete for jobs based on their training costs. Employers consider overeducated workers more able and capable and hire them first to save training costs. In this way education serves as a proxy for training.

Matching theory and occupational mobility theory see an educational mismatch as transient. In matching theory (Jovanovic, 1979), a mismatch between required and actual education represents the quality of match between the job and the worker and results from imperfect information about jobs and job search costs. Workers with surplus education represent a poor match because their actual education implies that they are more able to obtain a better job. Over time they may obtain a higher-level job. According to occupational mobility theory, individuals with high levels of education may accept low or entry-level jobs while they gain specific human capital and experience through on-the-job training. It allows them to readily be promoted to higher level jobs (Sicherman & Galor, 1990).

Assignment theory (Sattinger, 1993) holds that an individual's marginal productivity and earnings are determined by both the productivity ceiling of jobs as well as human capital. In a dynamic economy, workers differ in attributes and jobs differ in their complexities. There exists an allocation problem in allocating differentiated jobs to heterogeneous workers. Therefore, educational mismatch will tend to be a lasting feature of the labor market.

Ordine and Rose (2009) present a theoretical framework where within group earnings, inequality is related to surplus education in the labor market. They specify possible theoretical mechanisms that lead to the

incidence of overeducation in the labor market. Within-group earnings inequality arises because of the existence of potential differences in the returns to education as well as heterogeneity in the productivity "signal" conveyed by the attained education of workers.

3. Methodology and Data

The details of the empirical earnings function and the measurement of required, surplus and deficit education are explained below. Further, this section provides information about the data, including the data source, sampling methodology, number of observations used in the regressions and summary statistics of the relevant variables.

3.1. Empirical Model

To quantify the effect of educational mismatch, i.e. over, required and under education on earnings distributions, the study adopts an extended Mincerian earnings function introduced by Duncan and Hoffman (1981). We begin with the basic Mincerian earnings function:

$$lnY_i = X_i \cdot \delta + \beta^a Edu_i^a + \varepsilon_i \tag{1}$$

Where Edu_i^a is years of attained education and β^a is return to attained education. Duncan and Hoffman (1981) decomposed the years of attained education (Edu_i^a) into years of required education for job (Edu_i^r), years of surplus or overeducation (Edu_i^s) and years of deficit or undereducation (Edu_i^d). Therefore, the following identity holds for years of attained education (Edu_i^a):

$$Edu_i^a \equiv Edu_i^r + \underbrace{\max(0, Edu_i^a - Edu_i^r)}_{Edu^s} - \underbrace{\max(0, Edu_i^r - Edu_i^a)}_{Edu^d} \tag{2}$$

where Edu_i^a was replaced in the Mincerian earnings function by these three components. The earnings function of Duncan and Hoffman (1981) is specified as follows:

$$lnY_i = X_i \cdot \delta + \beta^r Edu_i^r + \beta^s Edu_i^s + \beta^d Edu_i^d + \varepsilon_i \tag{3}$$

where lnY_i is the natural logarithm of earnings the i^{th} individual, vector X_i includes a constant, characteristics of workers and other explanatory variables that affect earnings. These variables include experience, square of experience and dummies for gender, marital status, area, provinces and

industries. The description of these variables is given in Appendix Table A1. δ is the vector of parameters to be estimated and coefficients $\beta^r, \beta^s and\ \beta^d$ are the returns to required, surplus and deficit education respectively. ε_i is the error term. This specification, with the variables of surplus, required and deficit education is referred to as the ORU (over, required and under education) model in the literature (Hartog, 1997).

An attractive feature of this earning function is that it fits in the human capital and job competition equation as special cases. By applying the restriction $\beta^r = \beta^s = -\beta^d$, equation (1) arrives at the standard human capital model, i.e. the returns to surplus, required and deficit education are equal. Equation (1) reduces to the Thurow (1975) job competition model by setting $\beta^s = \beta^d = 0$ where only required education is rewarded.

The study empirically tests where workers are located along the earnings distribution, conditional on their educational mismatch. Therefore, the study intends to estimate the earning function using the quantile regression approach. This technique allows us to estimate how the relationship changes between an explanatory variable and dependent variable along the conditional distribution of earnings.

OLS allows the effect of explanatory variable(s) to be estimated on the conditional mean of the dependent variable. In this approach one implicitly assumes that the marginal effect of independent variable(s) is constant over the distribution of the dependent variable. Therefore, it describes only a limited aspect of the statistical relationship between variables. In contrast, quantile regression estimates the effect of the explanatory variable(s) on a particular percentile of the dependent variable (Budria, 2011; Martins & Pereira, 2004; Hartog et al., 2001; Machado & Mata, 2001). Thus, quantile regression estimates provide a snapshot of the effect of independent variable(s) on the whole distribution of the dependent variable.

The quantile regression model was proposed by Koenker and Basset (1978). Quantile regressions estimate the relationship between independent variable(s) and the θ^{th} conditional percentile of the dependent variable. The quantile regression model is written as:

$$Y_i = X_i'\beta_\theta + u_{\theta i}\ with\ Quant_\theta(Y_i|X_i) = X_i'\beta_\theta \qquad (4)$$

$$(i = 1,2,3, \dots \dots \dots, n)$$

Where β is the vector of parameters, X is the vector of independent variables and u_θ is the disturbance term. $Quant_\theta(Y_i|X_i)$ represents the θ_{th} conditional percentile of the dependent variable (Y) given X. By variation of θ, the entire distribution of the dependent variable can be traced out. That is, the marginal effect of X is not necessarily identical across different percentiles of the conditional distribution of Y. Quantile regression estimates are interpreted likewise as OLS estimates. This study intends to estimate ORU earning functions at multiple deciles. Thus, it implements a simultaneous-quantile regression. Simultaneous-quantile regression obtains the variance–covariance matrix of the estimators (VCE) via bootstrapping according to the procedure described by Buchinsky (1998). Simultaneous-quantile regression can estimate a coefficient at different percentiles simultaneously which allows to test for the equality of coefficients across percentiles.

The study estimates the ORU earnings functions at nine different deciles using the overall sample of workers. The prevalence of the gender gap in educational attainment is obvious in Pakistan. Generally, the analysis based on the overall sample of workers is deficient in estimating the returns to education due to structural differences in gender outcomes. Therefore, a gender-based analysis is also carried out, and the ORU earning function is estimated for samples of male and female workers separately.

3.2. Measurement of Over, Under and Required Education

Given the data on the years of attained education and occupations of the workers, the variable of required education is measured using the realized matches method to measure the required education that was proposed by Kiker et al. (1997). Once a measure of required education is established, variables of surplus and deficit education are measured as:

$$Edu_i^s = Edu_i^a - Edu_i^r \quad if \quad Edu_i^a > Edu_i^r \tag{5}$$

$$= 0, otherwise$$

$$Edu_i^d = Edu_i^r - Edu_i^a \quad if \quad Edu_i^r > Edu_i^a \tag{6}$$

$$= 0, otherwise$$

Therefore, $Edu_i^a = Edu_i^r + Edu_i^s - Edu_i^d$ must hold.

All education components are computed in years of formal education. In this study, required education in a given occupation is measured as the

mode (i.e. most frequent) years of education of workers in that occupation. Only workers, whose attained education deviates from years of required education, are considered as mismatched. Therefore, for matched workers $Edu_i^a = Edu_i^r$ or $Edu_i^s = Edu_i^d = 0$. A worker has surplus years of education if his/her attained education is above the mode value of education in a particular occupation. Conversely, a worker has deficit years of education if his/her attained education falls below the mode value of education in his/her occupation. Workers are classified as correctly matched if their attained education equals the modal value within a specific occupation.

3.3. Data Source and Sample

The data is taken from the Pakistan Social and Living Standard Measurement (PSLM) survey for 2013-14. The PSLM survey data is collected by the Pakistan Bureau of Statistics. The survey is conducted at the provincial level for alternate years using a two-stage stratified sample design. At the first stage, enumeration blocks in urban areas and villages in rural areas are taken as primary sampling units (PSUs). At the second stage, 12 households from the urban domain and 16 households from the rural domain within each PSU were selected. These households within the PSUs were considered for the selection of secondary sampling units. The survey covers a sample of 17,989 households distributed over 1307 PSUs in the four provinces of Pakistan. It collects comprehensive information on individual and household characteristics including earnings, education, demographic and economic indicators. In this study, the sample is restricted to the employed workers aged 15-65 years who reported their occupation. Observations with missing values were dropped from the sample.

Table 1 presents the summary statistics of variables for the overall sample as well as for the split male and female samples. The overall sample consists of 15,366 individuals, among whom the vast majority, 13,927, are male. Table 1 reports the means and standard deviations of all variables used in the regressions. The average of log monthly earning of the males is higher than that of female workers. The required education for jobs is considerably different for males and females; average years of required education are higher for female than male workers, while average years of surplus education are lower among female workers than male workers. Further, the sample data shows the average deficit years of education is almost the same for female as for male workers. Note that there are no women employed in a number of occupations, including mining and quarrying, extraterritorial organizations, water supply, sewerage, waste management, construction, administrative and support activities.

Table 1: Summary statistics

Variables	Overall		Male		Female	
	Mean	SD	Mean	SD	Mean	SD
Log Monthly Earnings	9.310	0.943	9.424	0.796	8.211	1.423
Required Education	8.279	3.571	8.133	3.346	9.698	5.060
Surplus Education	1.582	2.287	1.637	2.305	1.058	2.027
Deficit Education	1.109	1.968	1.100	1.959	1.200	2.054
Experience	20.521	12.141	20.978	12.186	16.097	10.730
Experience Squared	568.48	613.18	588.551	624.172	374.185	450.364
Area	0.457	0.498	0.450	0.497	0.533	0.499
Gender (Male)	0.906	0.291	-	-	-	-
Marital Status	0.713	0.453	0.730	0.444	0.547	0.498
KPK	0.183	0.387	0.188	0.391	0.136	0.342
Sindh	0.269	0.444	0.276	0.447	0.203	0.402
Balochistan	0.081	0.273	0.086	0.280	0.038	0.192
Ind1	0.004	0.062	0.004	0.065	0	0
Ind2	0.169	0.374	0.158	0.365	0.268	0.443
Ind3	0.012	0.107	0.013	0.112	0.001	0.026
Ind4	0.005	0.068	0.005	0.071	0	0
Ind5	0.109	0.312	0.121	0.326	0	0
Ind6	0.180	0.384	0.198	0.398	0.013	0.111
Ind7	0.071	0.257	0.078	0.269	0.001	0.037
Ind8	0.018	0.134	0.020	0.140	0.003	0.053
Ind9	0.011	0.106	0.012	0.109	0.003	0.059
Ind10	0.012	0.108	0.012	0.109	0.008	0.087
Ind11	0.005	0.071	0.006	0.074	0.001	0.026
Ind12	0.009	0.095	0.010	0.099	0.001	0.026
Ind13	0.005	0.072	0.006	0.076	0	0
Ind14	0.048	0.214	0.052	0.223	0.008	0.087
Ind15	0.084	0.278	0.059	0.235	0.333	0.471
Ind16	0.027	0.162	0.022	0.145	0.080	0.271
Ind17	0.002	0.039	0.002	0.041	0.001	0.026
Ind18	0.036	0.186	0.030	0.172	0.087	0.282
Ind19	0.008	0.089	0.006	0.078	0.026	0.158
Ind20	0.000	0.018	0.000	0.019	0	0
Sample Size	15366		13927		1439	

Source: Authors' calculations from PSLM 2013-14.

4. Results and discussion

This section presents estimates of the effect of educational mismatch on earnings distributions using quantile regression on the overall sample. In the second part, estimates of the effect of educational mismatch on earnings distributions are presented for males and females separately.

4.1. Analysis of overall sample

The study tests for alternative specifications to Duncan and Hoffman's (1981), specification in equation (1) to verify that this specification fits the sample data better. Table 2 provides the values of F-statistics for the hypothesis together with p-values. The null hypothesis that returns to surplus, required and deficit education are equal, in other words the standard Mincer earnings function and the job competition model that hypothesize that only required education is rewarded, is rejected by the sample data. This allows the estimation of an earning function that estimates separate returns for surplus, required and deficit education. That is, the Duncan and Hoffman's (1981), specification in the ORU model is correct for the overall sample.

Table 2: Empirical specification test

Mincer earnings function $H_{\circ}: \beta^r = \beta^s = -\beta^d$	112.47 (0.00)
Job Competition Model $H_{\circ}: \beta^s = \beta^d = 0$	918.18 (0.00)

Note: p-values in parenthesis.
Source: Authors' calculations.

The study estimated the ORU earning function by using the quantile regression for the overall sample. The earning function was estimated at nine different deciles: θ =.10, θ =.20, θ =.30, θ =.40, θ =.50, θ =.60, θ =.70, θ =.80 and θ =.90. The estimated coefficients of surplus education (β^s), required education (β^r) and deficit education (β^d) at the nine deciles are reported in Table 3.[1] These coefficient estimates illustrate the percentage change in earnings resulted from an additional year of surplus, required or deficit education at the estimated decile. The OLS estimates of $\beta^r, \beta^s and\ \beta^d$ are also provided. In the last panel, the Wald F-test for the equality of coefficients across deciles demonstrates that differences in the rate of return to the surplus, required and deficit education are significantly different at different deciles.

The rate of returns to an additional year of required education, surplus education or deficit education is different across the earning distribution. That is, there are earning differentials among workers with

[1]Complete results are available on request.

surplus education or deficit education. Returns to required education exhibit a decreasing trend until θ=0.20 and an upward trend is observed after that. Returns to required education increase from 9.3 percent at the lowest decile to 12.5 percent at the highest. The returns to surplus education approximately double as we move from the bottom to the top of the earning distribution. These returns reveal an increasing trend from the lowest to the highest decile. The findings are similar to that found by Ramos (2011) for Spain and Hartog et al. (2001) for Portugal.

Table 3: Returns to Surplus, Required and Deficit Education

Quantiles	Required Education	Surplus Education	Deficit Education
θ=0.10	0.0934***	0.0593***	-0.0622***
	(19.67)	(10.13)	(-12.72)
θ=0.20	0.0922***	0.0608***	-0.0630***
	(25.22)	(16.56)	(-17.18)
θ=0.30	0.0966***	0.0670***	-0.0711***
	(32.68)	(14.23)	(-23.28)
θ=0.40	0.101***	0.0737***	-0.0712***
	(26.77)	(17.79)	(-22.89)
θ=0.50	0.104***	0.0773***	-0.0739***
	(33.09)	(21.99)	(-23.57)
θ=0.60	0.110***	0.0814***	-0.0763***
	(34.75)	(29.36)	(-23.55)
θ=0.70	0.109***	0.0861***	-0.0723***
	(35.55)	(23.57)	(-22.45)
θ=0.80	0.114***	0.0904***	-0.0743***
	(42.72)	(26.70)	(-24.43)
θ=0.90	0.125***	0.104***	-0.0749***
	(35.55)	(27.27)	(-27.21)
OLS	0.118***	0.0825***	-0.0793***
	(43.39)	(29.44)	(-24.22)
Wald F statistics	9.12	19.06	2.34
	[0.00]	[0.00]	[0.02]
$H_0: \beta_{.10} = \beta_{.20} = \cdots\cdots\cdots = \beta_{.90}$			

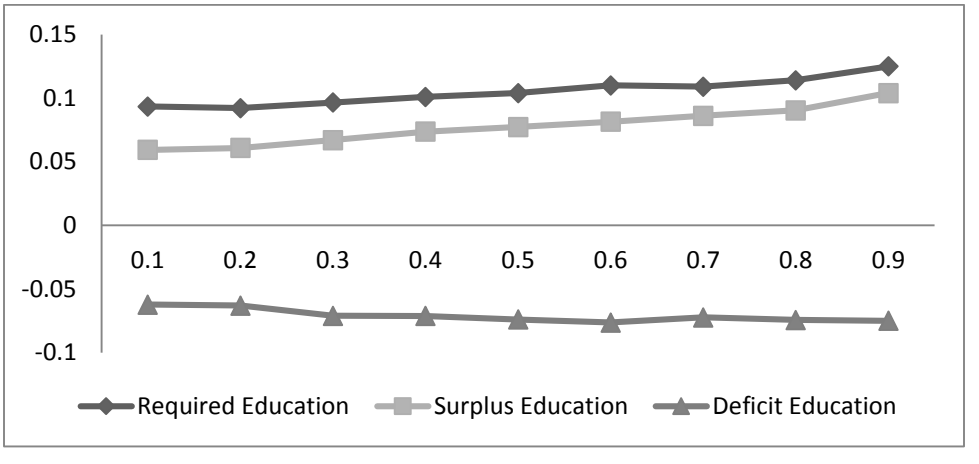
Notes: t-statistics in parentheses and p-values in brackets, ***p<0.001
Source: Authors' calculations.

The earning differential between surplus and required education is lower at the upper deciles compared to bottom deciles of the earnings distribution. Returns to years of education below the job requirements are negative indicating a penalty for undereducated workers. This is consistent with the findings of Budria (2011) and Verdugo and Verdugo (1989). The penalty of deficit education grows slowly up to θ=0.60 then remains consistent at the upper deciles.

In line with the studies of Budria (2011), Hartog et al. (2001) and Duncan and Hoffman (1981), this study also found that surplus education brings positive returns but less than those associated to required education. The study based on OLS by Abbas (2008) also found superior returns to required education as compared to surplus education in Pakistan. OLS estimates also verify that returns to a year of required education are higher than the returns to a year of surplus education. The average pay-off to required education and surplus education is 11.8 percent and 8.3 percent respectively. On average, the penalty of pay for deficit years of education is 7.9 percent. OLS estimates show differences in the returns to surplus and required education. This implies that an educational mismatch is a contributing factor to earning differential/inequality between workers with surplus and required education.

The estimated coefficients of surplus education (β^s), required education (β^r) and deficit education (β^d) are plotted for each decile in Figures 1.

Figure 1: Returns to Surplus, Required and Deficit Education



Source: Authors' compilation using data from Table 3.

4.2. Gender-Based Analysis

The coefficient of the gender dummy was statistically significant in estimated earning functions which use overall sample data. This shows that there are structural differences in the earnings of male and female workers. Hence, the study extends the analysis in order to estimate returns to the educational mismatch separately for male and female workers. To this end, the ORU earning function is estimated for the sub-samples of men and

women. Table 4 reports the F-statistics together with p-values for the test of the basic Mincerian model (versus the alternative ORU specification). These results reject the null hypothesis of the basic Mincerian earnings function and job competition model for both male and female samples.

Table 4: Empirical Specification Test

	Male	**Female**
Mincer earnings function	59.14	20.20
$H_\circ: \beta^r = \beta^s = -\beta^d$	(0.00)	(0.00)
Job Competition Model	799.40	121.27
$H_\circ: \beta^s = \beta^d = 0$	(0.00)	(0.00)

Source: Authors' calculations.
Note: p-values in parenthesis.

On the basis of this finding, separate pay offs to surplus, required and deficit education should be estimated. In doing so, the ORU earning function was estimated at nine different deciles for both samples by including the same control variables listed in the Appendix Table A1 except for the gender dummy. Only the coefficients of surplus, required and deficit education are given in Table 5 for male and female workers separately. The OLS estimates of $\beta^r, \beta^s \; and \; \beta^d$ are also provided by gender.

In the last panel of Table 5, Wald F statistics for the joint equality of coefficients across deciles and p-values are displayed. It shows that differences in the rate of return to surplus and required education are statistically significantly different across the deciles for the male sample. This indicates that the rate of returns to an additional year of required education, or surplus education is different for male workers as we move along the earnings distribution.

For male workers, returns to required years of education increases from 8.3 percent at the lowest decile to 11.5 percent at the highest decile. It shows that the returns differential, between workers who have required years of education to perform their job but located at two extreme deciles of the earning distribution, amounts to 3.2 percentage points. Returns to surplus education amount to 5.2 percent and 10.2 percent at the 0.10 and 0.90 quantiles respectively. The superior returns to required education as compared to surplus education are also obvious. OLS estimates show that average returns to required and surplus education are 10 percent and 7.6 percent respectively. The average pay penalty for males who are undereducated is 6.95 percent. This indicates that educational mismatch is

related to the earnings differential between male workers who have surplus and required education.

Table 5: Returns to Surplus, Required and Deficit Education of Male and Female

Quantiles	Required Education		Surplus Education		Deficit Education	
	Male	Female	Male	Female	Male	Female
θ=0.10	0.0826***	0.233***	0.0523***	0.0633	-0.0602***	-0.206***
	(17.91)	(11.60)	(13.54)	(1.89)	(-11.73)	(-7.39)
θ=0.20	0.0840***	0.219***	0.0558***	0.0894***	-0.0614***	-0.218***
	(31.42)	(11.39)	(22.91)	(4.35)	(-14.87)	(-11.98)
θ=0.30	0.0852***	0.230***	0.0606***	0.108***	-0.0663***	-0.200***
	(31.82)	(9.79)	(16.36)	(5.92)	(-23.86)	(-9.84)
θ=0.40	0.0905***	0.234***	0.0703***	0.111***	-0.0657***	-0.190***
	(29.85)	(12.95)	(19.90)	(9.88)	(-24.10)	(-12.16)
θ=0.50	0.0942***	0.232***	0.0749***	0.118***	-0.0687***	-0.201***
	(37.17)	(17.65)	(20.92)	(7.74)	(-26.54)	(-10.35)
θ=0.60	0.0970***	0.232***	0.0770***	0.135***	-0.0684***	-0.175***
	(40.28)	(15.62)	(22.02)	(10.01)	(-24.41)	(-7.84)
θ=0.70	0.101***	0.231***	0.0824***	0.141***	-0.0677***	-0.163***
	(32.92)	(13.37)	(22.33)	(7.43)	(-17.18)	(-10.30)
θ=0.80	0.105***	0.226***	0.0882***	0.151***	-0.0689***	-0.155***
	(28.35)	(12.77)	(25.05)	(4.82)	(-18.52)	(-10.16)
θ=0.90	0.115***	0.213***	0.102***	0.150***	-0.0670***	-0.136***
	(36.13)	(11.60)	(19.23)	(5.77)	(-13.25)	(-6.19)
OLS	0.0998***	0.228***	0.0761***	0.113***	-0.0695***	-0.177***
	(38.33)	(14.80)	(28.31)	(8.23)	(-21.91)	(-12.35)
Wald F statistics	35.28	0.30	11.34	1.08	1.25	1.50
	[0.00]	[0.97]	[0.00]	[0.38]	[0.27]	[0.15]
$H_{\circ}: \beta_{.10} = \beta_{.20} = \cdots\cdots = \beta_{.90}$						

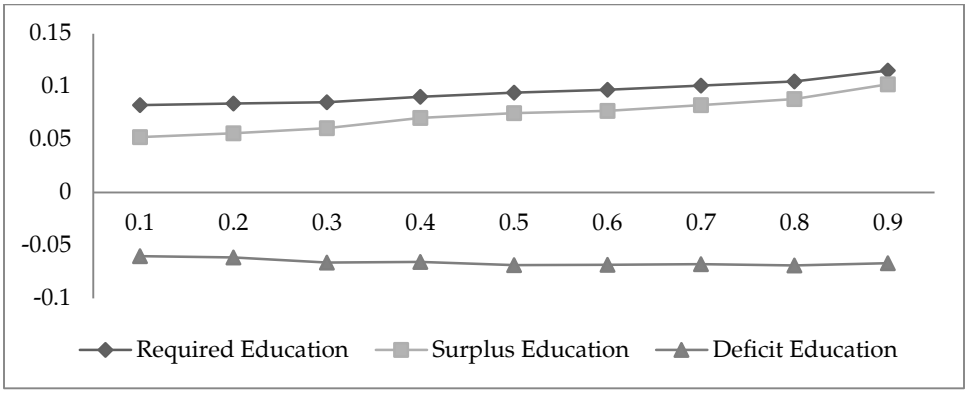
Source: Authors' calculations.
Note: t-statistics in parentheses and p-values in brackets, *p<0.05, **p<0.01, ***p<0.001.

For the female sample, Wald F-statistics show that differences in the rate of return to surplus, required and deficit education are not statistically significant. It suggests that rate of returns to an additional year of required, surplus or deficit education is the same for female workers across the earnings distribution. However, OLS estimates show that average returns to surplus and required education amounts to 11.3 and 22.8 percentage points respectively. This indicates that returns to surplus education are approximately half of returns to those of required education. On average, the pay penalty for females is 17.7 percent for those who are undereducated. Similar to male workers, educational mismatch is a source of earning differential between female workers who have surplus and required education.

These findings are similar to Hartog et al. (2001) for Portugal, McGuinness and Bennett (2007) for Northern Ireland and Santos and Sequeira (2013) for European countries.

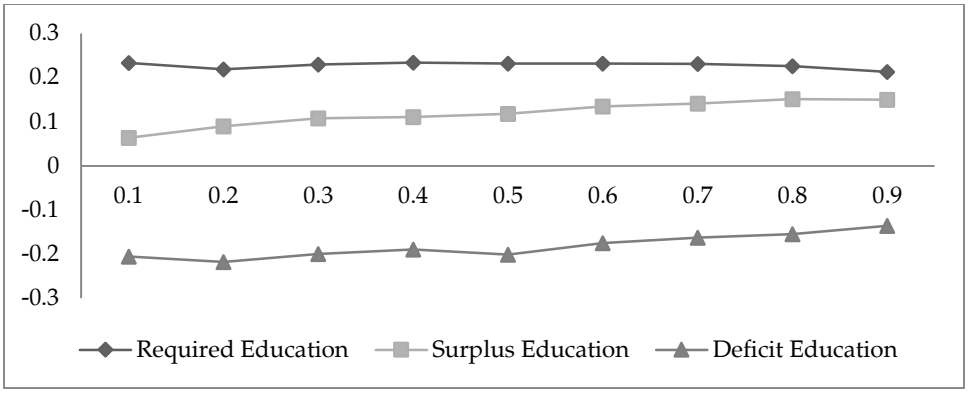
The estimated coefficients of surplus, required and deficit education are plotted against the decile numbers in Figure 2 and Figure 3 for males and females respectively. The surplus and required education affects earnings differently at different points of the earning distribution for male workers. The pattern of returns for female workers is different from those found for the males.

Figure 2: Returns to Required, Surplus and Deficit Education (for Male Workers)



Source: Authors' compilation using data from Table 5.

Figure 3: Returns to required, surplus and deficit education (for female workers)



Source: Authors' compilation using data from Table 5.

There are some factors that may explain why earnings vary from person to person in the labor market even if they have similar observed characteristics. Discrimination is a key explanation of why labor market outcomes differ among people with similar characteristics, such that heterogeneous opportunities are offered to similar workers that result in earning differentials. Other factors include compensating differences in earnings, efficiency wage, unionization of workers and most importantly (unobserved) natural ability and efforts that determine the productivity of workers.

5. Conclusion

The present study empirically investigates the effect of surplus education on the earning distribution in Pakistan. Data from the Pakistan Social and Living Standards Measurement Survey for 2013-14 is utilized for the analysis. Duncan and Hoffman's (1981), earning function is estimated using quantile regression. The study tests for two alternative specifications: A basic Mincer earnings function hypothesizes that returns to surplus, required and deficit education are equal, and the hypothesis of the job competition model is that only required education is rewarded. Both are rejected by the sample data.

For the overall sample, quantile regression estimates show that returns to an additional year of surplus education is different across the earnings distribution. That is, there exists earning differentials among workers who have surplus education. The returns to surplus education are positive but less than returns to required education. The earnings differential between overeducated workers and workers who have required education for the job is lower at the upper deciles compared to the bottom quantiles. OLS estimates show the difference in the returns to surplus and required education. This implies that educational mismatch contributes in earning differential/inequality between workers with surplus and required education.

The gender-based analysis indicates that rates of returns to an additional year of required education, or surplus education varies for male workers along the earnings distribution. Earning differences within overeducated workers are found to be higher than those of workers who have required education for the job. Returns to surplus education are higher for workers at the upper tail of the earnings distribution. The returns to surplus education are almost double at the ninth decile compared to the first decile. That is, there is a difference in returns to

education for male workers who have surplus education. For the female sample, the difference in the rate of return to surplus education across the earning distribution is not statistically significant. It suggests that rates of return to an additional year of surplus education is the same for all overeducated female workers. Therefore, surplus education does not contribute further to earning differentials among female workers who are overeducated. Further, OLS estimates show that the returns to surplus and required education are different for male workers. This implies that educational mismatch is related to the earnings differential between male workers with surplus and required education. Similar to male workers, educational mismatch is a source of the earnings differential between female workers who have surplus and required education.

The findings of the study show that there is a difference in return to education for male workers with surplus education. Also, the returns to surplus and required education are different for male and female workers. An important policy implication arises from these findings as households and public resources extensively invest in education. It is necessary to make sure that the educational programs are useful and their benefits are being distributed equitably. Further, the surplus education phenomenon highlights the imperfections in the labor market that limit the absorptive capacity of society to fully utilize and compensate the workers with surplus years of education. In this respect, changes in the supply of educated workers and the skill demand of the labor market should be in order.

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Appendix

Table A1: Description of variables

Variables	Description
Log Monthly Earnings	= Natural logarithm of monthly income
Required Education	= Most frequent years of education within a specific occupation
Surplus Education	= Number of years of education above required education
Deficit Education	= Number of years of education below required education
Experience	= max (0, Age — years of completed education — 5)
Experience Squared	= Squared of experience
Area	= 1 for urban, 0 otherwise
Gender	= 1 for male, 0 otherwise
Marital Status	= 1 for currently married, 0 otherwise
Provincial Dummies*	
KPK	= 1 if the worker form KPK, 0 otherwise
Sindh	= 1 if the worker form Sind, 0 otherwise
Balochistan	= 1 if the worker form Baluchistan, 0 otherwise
Industrial Dummies**	
Ind1	=1 for Mining and quarrying, 0 otherwise
Ind2	=1 for manufacturing, 0 otherwise
Ind3	=1 for Electricity, gas, steam and air conditioning supply, 0 otherwise
Ind4	=1 for Water supply; sewerage, waste management and remediation activities, 0 otherwise
Ind5	=1 for Construction, 0 otherwise
Ind6	=1 for wholesale and retail trades; repair of motor vehicles and motorcycles, 0 otherwise
Ind7	=1 for transportation and storage, 0 otherwise
Ind8	=1 for accommodation and food services activities, 0 otherwise
Ind9	=1 for information and communication, 0 otherwise
Ind10	=1 for financial and insurance activities, 0 otherwise
Ind11	=1 for real estate activities, 0 otherwise
Ind12	=1 for professional, scientific and technical activities, 0 otherwise
Ind13	=1 for administrative and support services activities, 0 otherwise
Ind14	=1 for public administration and defense; compulsory social security, 0 otherwise
Ind15	=1 for education, 0 otherwise
Ind16	=1 for human health and social work activities, 0 otherwise
Ind17	=1 for arts, entertainment and recreation, 0 otherwise
Ind18	=1 for other services activities, 0 otherwise
Ind19	=1 for activities of households as employers, 0 otherwise
Ind20	=1 for activities of extraterritorial organizations and bodies, 0 otherwise

Notes: *Punjab is omitted category; **Agriculture, forestry and fishing is omitted category.

The Lahore Journal of Economics
24: 2 (Winter 2019): pp. 115–148

Sources of Market Power among Firms in Sub-Saharan Africa: Do Institutions Matter in Competitive Policies?

Musa Abdu* **and Adamu Jibir****

Abstract

In the context of a high prevalence of both poverty among households and business failures among firms in the majority of Sub-Saharan African (SSA) countries, competition is seen as one of the viable tools for transforming and improving these economies. This can be achieved by boosting productivity, improving output markets, increasing innovation and promoting economic growth. This study examines the sources of market power among firms within a variety of institutional settings using a large sample of data from 23 SSA countries. Tobit panel models comprising both fixed and random effects are used to estimate the determinants of market power. The study reveals that a large number of firms control less than 5 percent of the market with a few firms controlling between 5 and 34 percent of the market. At the same time, there are a small number of firms controlling between 30 and 100 percent of the markets in Sub-Saharan Africa. The findings further show that economic and political institutions significantly matter in the determination of power among firms in SSA. However, the influence of institutions varies significantly depending on the type of institutions and regional differences.

Keywords: Competition, institutions, firm, market power, Sub-Saharan Africa.

JEL Classifications: D41, K20, L22, L41, O55.

1. Introduction

Firms have for centuries been committed to activities geared towards increasing market power[1] by offering their buyers variety in the presence of competition. This favors consumers and is not seen as undesirable. However, the situation has changed in recent decades, as firms have tended to increase their profits through anti-competitive

* Department of Economics, Gombe State University, Nigeria.
** Department of Economics, Gombe State University, Nigeria.
[1] Market power is the ability of a firm or group of firms to raise and maintain the price above the level that would prevail under a competitive market.

measures – colluding with rivals, blocking the entry of new firms and other actions that make consumers worse off.

As a consequence, countries have enacted laws and policies aimed at regulating market power and the concentration of firms for societal wellbeing. Despite that, the market power and concentration of firms have been growing rapidly not only in capitalist societies but also in developing economies, like in regions of Africa, Asia and Latin America.[2] According to the United Nations Conference on Trade and Development (UNCTAD) (2017), over the past two decades, market concentration increased steeply in terms of revenues, physical assets and other assets. Further, global mergers and acquisitions, a major factor affecting market power, have increased to $5 trillion in 2015, almost double the average of 21 percent between 2010 and 2014 (UNCTAD, 2017).

Sub-Saharan Africa (SSA) is not an exception to this growing phenomenon. The World Bank (2016) posits that the majority of SSA countries are perceived to have a lower level of competition compared to other regions of the world and this causes high business risks generated by price control, vested interests and a high level of favoritism. Along the same lines, the World Economic Forum (2015) notes that more than 70 percent of SSA countries ranked in the bottom half on the perceived intensity of local competition. This has resulted in the prevalence imperfect markets characterized by lack of competition (Diez, Leigh & Suchanan, 2018; Grau & Hockmann, 2017; Memanova & Mylonidis, 2019). This concern in SSA is largely overlooked but it is now resurfacing with various economic implications. Highly concentrated markets, if left unregulated and uncontrolled, can produce socially undesirable results such as higher prices and the survival of unproductive firms through blocking the entry of new firms (De Loecker & Van Biesebroeck, 2016; Golombek, Irarrazabal & Ma, 2018; UNCTAD, 2017). In addition, concern over increasing market concentration in the leading sectors of SSA countries is appropriate as it seems to have paved the way for rentier capitalism to the detriment of balanced and inclusive growth. The World Bank (2016) states that in the services sector, a single firm holds more than half the market share in over 50 percent of SSA countries. While some industries, such as power generating and transmission companies, railway companies and other utility providing industries may be *natural monopolies* (due to large fixed costs but very low marginal costs), there may still be the need for strong

[2] The resulting harm of market power may extend beyond individual markets but would harm the economy as a whole in the form of slow economic growth, low productivity and increased inequality.

legislation and government regulations to control exploitative industries. The World Bank (2016) observes that Africa has much to gain by promoting competition through various institutions.

The study of market power and concentration of firms in SSA, especially in the services sector, has been largely overlooked in the literature. The objective of this study is to examine empirically how the institutional setting and government regulations among SSA countries affect market power and the concentration of firms.

The contribution of this study is threefold: Firstly, it serves as one of the few pieces of research in this area particularly for the developing countries of SSA. Secondly, the study applied a micro-econometric approach which proves to be more robust and efficient in firm-level analysis. Lastly, using detailed firm-level data, we are able to study the sources of market power using a different set of institutional variables across different sub-regions in SSA, which enable us to examine the sources of market power in a comparative manner.

The subsequent sections of this paper are organized in five sections: Section 2 provides a theoretical framework and a related review of literature. Section 3 and 4 discuss the methodology and results and discussions are given in sections 3 and 4 followed by conclusions and policy recommendations in the last section.

2. Theoretical Consideration and Review of Related Literature

The underlying factors responsible for a decrease in competition and equivalent expansion in market power and monopolistic tendencies remain unclear in the economic literature.[3] It is well known that the absence of competition tends to make consumers worse off because of the reduction of quality, increase in prices, and blocking the entry of new firms. Further, monopolistic power in the labor market may lead to restrictions in employment and the lowering of wages below what is obtainable in a competitive market (Berger, Herkenhoff & Mongey, 2019; De Loecker & Eeckhout, 2018; Naidu, Posner & Wayl, 2018). It is a truism that competition brings uncountable benefits to consumers, workers, small businesses and other economic agents in a country (World Bank, 2016). These benefits can be achieved through the elimination of

[3] While there is evidence that market power exists but surprisingly there is little or no evidence of the pattern of market power on the aggregate economy and the role of institutions in reducing monopolistic tendencies (De Loecker & Van Biesebroeck, 2017).

anti-competitive practices with sound legislation which, in most cases, are either absent or ineffective in most developing economies.[4] Government action can help to check market and encourage competition through anti-trust authorities and other relevant policies.[5]

Building on existing empirical and theoretical studies, there are many indices used in measuring market power and the concentration of firms in the literature. Some of these indices include a concentration ratio, which is mostly applied when there are large firms; the entropy index developed by Hart (1971); the Linda index; Horvath index developed by Horvath (1970); the Lerner index propounded by Lerner (1934); the Hirschman-Herfindhal index proposed by Herfindhal (1950) and Hirschman (1964), among others. Among all these indices, the Hirschman-Herfindhal index and concentration ratio have been the most widely used for the empirical analysis of market power.

Empirical studies specifically aimed at the effects of institutional policies and regulations on market power are extremely scarce. Most studies are skewed towards the effects of institutions on the firm's growth and in a broader sense on the general wellbeing of the economy (example include: Henrekson, 2005; Henrekson & Rosenberg, 2001; Klapper, Laeven & Rajan, 2006). There are a few empirical studies (like: Davidsson & Henrekson, 2002; Henrekson & Johansson, 1999; Memanova & Mylonidis, 2019) that provide insight on institutions that harmonize the activities of different actors with competencies which can bring about high economic growth and a competitive economy. Bresnahan (1989) finds that it is likely that institutional policies at the industry level will affect firm conduct and concentration. Formal institutions, both underlying and specific, provide the context and environment within which firms operate (Rodrik, 2008).[6]

Using panel data from U.S. airports, Bilotkash and Lakew (2014), analyze the sources of market power in the U.S. airline industry, and find that airport dominance is a more important source of market power than route dominance. Van Dender (2007) examines the relationship between airport level fares and concentration using 55 airports in the US and the

[4] The benefits can be achieved even with a few or a single firm in the market provided there are credible threats of entry of new firms (Cabral, 2000; Dixit, 1980).

[5] However, it is paramount to know that consumers are not necessarily worse off when a firm's market power/market share increases as sometimes it may increase due to innovations which in turn increases the demand for the firm's products and services.

[6] Political, judicial and economic regulations and policies are important mechanisms for managing market power and firms concentration. Moreover, whether or not institutional policies are effective in regulating market power and firm's concentration to a large extent depends on their settings and efficacy.

results reveal an insignificant relationship between them. On the contrary, Borenstein, (1991) finds that an airline with a dominant position has greater market power. Also, Bilotskash (2007) establishes similar evidence that dominant firms control prices on international routes.

On the other hand, a substantial literature argues that competition among firms benefits consumers through lower prices (De Loecker & Van Biesebroeck, 2017; Kovacic & Shapiro, 2000; Memanova & Mylonidis, 2019). These benefits can also be greater product variety, quality and innovations which improve productivity and living standards (Aghion, Bloom & Blundell, 2005; Chen & Yu, 2018; Dunn & Shapiro, 2012; Memanova & Mylonidis, 2019). Market power is associated with lower economic growth, lower savings and investment and higher costs of financial intermediation (see Asongu, Nwachukwu & Tchamyou, 2016; Berger, Herkenhoff & Mongey, 2019; De Loecker & Eeckhout, 2018; De Loecker & Eeckhout, 2017; Morrison 1990; Naidu, Posner & Wayl, 2018).

Ciriani and Lebourges (2016) examine the effects of market power on economic growth and find that economic policies tend to limit the incentives and capabilities to invest in new technologies. Promoting competition goes beyond the enforcement of antitrust policies and laws; it is more appropriate when pro-competitive policies are enhanced.

Asongu, Le-roux and Tchamyou (2019) further stress that both consumers and producers can gain and lose depending on the circumstances. For instance, from the perspective of the consumer, market power is associated with efficiency because the consumer's marginal value is more than the market price. On the other hand, from the side of the producer, when the marginal cost of production is substantially lower than the supply price, the producer will make considerable gain. Navo (2001) investigates the extent to which firms exercise market power in ready-to-eat cereal industries and found that the demand and production approaches mainly agree on the mean level of mark-ups in the industry. Cruz-Garcia, de Guevara and Maudos (2017), in their analysis of market power, observe that the disparity in market power among banks in the Eurozone has decreased over time partly due to the convergence in average levels of market power and concentration.

Further, some research studies indicate that labor market power has contributed to wage inequality and economic stagnation (Berger, Herkenhoff & Mongey, 2019; Naidu, Posner & Weyl, 2018). This suggests that many labor markets around the world are not competitive but instead

exhibit considerable market power enjoyed by the employers, who use their market power to suppress wages.

Sylos-Labini (1967) find that the degree of competition or market power in any industry mainly depends on the barriers to entry of new firms, rather than the incumbent firm's size. Further, Cotterill (1986) find that the emergence of market power is mainly associated with technological factors rather than institutional factors. Vickers (2005) shows that the weakness of antitrust legislation in the US and parts of Europe has significantly contributed to the emergence of market power in recent decades. Asongu et. al, (2016) in their study of the role of information in reducing market power reveals that information-sharing offices completely neutralize the negative effect of market power on financial access. Other studies on market power and the banking industry show a strong positive correlation between foreign bank ownership and market power (Delis, Kokas & Ongena, 2016; Asongu & Odhiambo, 2019; Asongu & Biekpe, 2018; Akande, 2018). Egarius and Weill (2016) in their analysis of market power and switching costs in the banking industry using data for France, Germany and Italy, find a positive relationship between switching costs and market power. On the effect of mergers on market power, Kim and Singal (1993) found that prices increased for routes served by the merging firms relative to routes unaffected by the mergers. Liski and Montero (2011) show that a dominant firm tends to use its market power to increase prices. Hintermann (2011) shifts the focus away from exclusionary manipulation and show that a dominant firm with market power will manipulate prices for higher gains. Asker, Wexler and Loecker (2017) examine the effect of market power on the misallocation of resources in oil production. They found that there is substantial productive inefficiency due to market power.

The entry of new firms in the market is also found to have a significant effect on monopolistic power (Adebayo & Adeniji, 2018: Dafny, 2005; Goolsbee & Syverson, 2008; Seamans, 2012; Tenn & Wendling, 2014). It is important to note that the presence of many firms in a market does not guarantee competition. Sometimes firms collude to create market power (see Ajide, Bankefa & Ajisafe, 2018; Milgrom & Roberts, 1982). There is also evidence of increasing market concentration around the world. For example, Gaynor, Ho and Town (2015) reveal that between the early 1990s and 2006, the average Herfindahl-Hirschman Index (HHI) for hospitals increased by about 50 percent. In the same vein, Prater et al. (2012) found an increase in railroad market concentration between 1985 and 2007 in the US.

Generally, from the above survey of literature, it is clear that the question of the appropriate measures and sources of market power is not definitively answered and there are only a few studies that fully explore the nexus between institutions, monopolistic tendencies and market concentration – particularly for SSA countries. Thus, it is useful to look at the role of political, economic and legal institutions on monopolistic tendencies and the ability of firms to gain market power.

3. Methodology of the Study

3.1. Data Sources

The study used the Enterprise Panel Survey data sets by the World Bank (2017) for 23 Sub-Saharan Africa countries. The countries are selected based on the availability of data and are representative of the diversity of national incomes in SSA. The merged data set is an unbalanced panel with coverage ranging between 2003 and 2017 as described in appendix B. The Enterprise Survey is nationally representative of the various business establishments across the countries, involved mainly in manufacturing, retail and other services. Data was collected on firms' experiences and enterprises' perception of the environment in which they operate and focus on several factors that shape the business environment. These factors either constrain the firms' performance, or are viewed as *sine qua non* for the firms' prosperity. Data on economic institutions, institutionalized democracy and market size were sourced from the Index of Economic Freedom by The Heritage Foundation (2003-2017), Polity IV data set by the Centre for Systemic Peace (2003-2017) and World Development Indicators by the World Bank (2003-2017). The institutional variables are country average values reported by the data collection agencies.

3.2. Measures of Market Power

There are many measures of concentration propounded in industrial economics as highlighted in section 2. As a result, Pavic, Galetic and Piplica (2016) categorized them into two main groups. The first group is made up of measures that are easy to understand and simple to compute. The Concentration Ratio (CR) and Herfidahl-Hircschman Index (HHI) are the examples of this first group. In contrast, the second group is very complex and designed to serve particular purposes which include the Lerner index, Linda index, among others. This study used the first group's measures, particularly CR and HHI because they are easy to calculate, interpret and capture many aspects of market concentration. The CR is

computed by taking the proportion of output of the k biggest firms in the industry. The CR is calculated as:

$$CR_k = \sum_i^k S_i \quad (1)$$

Where k=4, 8, 10, ……, 20, …… and S_i is the market share of the i^{th} firm in descending order. The CR usually takes the four biggest firms (k=4) but if the total number of firms operating in the market is large, then an 8-firm or even 20-firm CR is used to assess the market concentration. The CR lies between 0 and 100 percent; 0 is a perfectly competitive case and 100 percent is seen as a monopoly situation. Although the measure is the simplest one, it has shortcomings like failing to indicate the presence or absence of potential entry and it does not measure local or regional market power. Thus, we also calculate the HHI index partly to complement the CR index and obtain a robust analysis of the subject matter. The group of measures, especially HHI, is also highly dynamic as it changes when there is new entry or exit into the market, and is a well-accepted indicator of competition (Brezina, Pekar, Ciˇckova & Reiff, 2016).

HHI is the sum of squares of the market shares of all firms in the industry or market. It is the most widely used measure of market concentration and has been widely applied in the United States to enforce anti-trust (competition) laws on firms (Bikker & Haff, 2002; Barthwal, 2010). Symbolically HHI is calculated as:

$$HHI = \sum_i^n S_i^2 \quad (2)$$

Where $S_i=q_i/Q$, q is the sales of the i^{th} firm, Q is total output of all firms in the market and n is the total number of firms. HHI lies between 0 and 1. It considers all firms and their relative sizes, and as such, it is popularly used. In this study, HHI is computed and used relative to industry, year and country. Generally, the choice of the CR and HHI indices is motivated by the fact that they are the most widely used approaches of measuring market power – especially when the market is characterised by a significant degree of market power and monopolistic tendencies (Kwoka, 1985).[7]

3.3. Model Specification and Estimation Technique

Generally, the sources of monopoly power among firms are numerous. Mankiw (2012) and Reynolds (2011) note that market power

[7] For details see Gaynor, Ho & Town (2015).

comes from the following sources: natural monopoly through unique sources of raw materials, large sunk costs, market size, government ownership and legislation. Thus, the baseline model for this study could be specified as in equation 3:

$$mktpower_{it} = f(rmat_{it},\ mktsize_{it},\ govown_{it}, cost_{it}, age_{it}) \quad (3)$$

Where *mktpower* is the market power, *rmat* is the expenditure on raw materials as a proportion of sales, *govown*, the "government ownership," *cost* is a vector of costs of production (capital and labor) and *age* is the years of the firm's operation. Equation (3) could be modified to capture other variables as in equation 4:

$$mktpower_{it} = \delta_0 + \delta_1 age_{it} + \delta_2 cost_{it} + \delta_3 rmat_{it} + \delta_4 mktsize_{it} + \delta_5 govown_{it} + \delta_7 inst_{it} + \mu_{it} \quad (4)$$

where *exprt* is a dummy for the firm's exports, and *inst* is a vector of economic, legal and political institutions. μ is the error term and *it* represents firm *i* in time *t*. The choice of these control variables is consistent with the recent market power literature (Chen & Yu, 2018; Diez, Leigh & Suchanan, 2018; Grau & Hockmann, 2018; Memanova & Mylonidis, 2019).

This study applied a Tobit panel regression model to estimate the determinants of market power in Sub-Saharan Africa. The model is selected because it is the most suitable when there is either left- or right-censoring in the dependent variable (also known as censoring from below and above, respectively). Besides, the model is also chosen because HHI is truncated between 0 and 1 while CR lies between 0 and 100 percent. The Random effects Tobit model is estimated given the inconsistency of the fixed effects Tobit estimator as observed by Cameron and Trivedi (2005). The model is specified in equation 5:

$$mktpower_{it}^{*} = \beta_0 + \beta_n \mathrm{x}_{it} + v_{it} + \mu_{it} \quad (5)$$

Where $mktpower_i$=0 if $mktpower_i^* \leq 0$ and $\mathrm{mktpower_i} = mktpower_i^*$ if $\mathrm{mktpower_i^*} > 0$, x_{it} is a vector of explanatory variables and v_{it} is a random effect and μ_{it} is an error term of the ith firm in time t.

4. Results and Discussions

Appendix A reports the definitions of the variables used in the analysis while Appendix B contains the descriptive statistics of the variables. Appendix C lists the countries and years of survey. Appendix D presents

partial correlations between measures of market power and explanatory variables and the results show that there is significant correlation with the exception of market size, which is only moderately correlated with the HHI index. This means that the possibility of reverse causality between the variables is very low. Table 1 reports the distribution of market power among firms based on their types, sub-regions and sizes. The table reveals that the manufacturing, retail and service firms hold sizeable shares of their respective markets, which are all less than 0.50 or 50 percent. Specifically, the average HHI of manufacturing firms is just 0.11, which is far lower than those of retail and services firms of 0.23 and 0.21 respectively. However, there are still a few manufacturing, retail and service firms that control more than 80 percent of the markets. This can affect the efficiency of markets due to a significant probability of monopolistic behavior (see Akande, 2018). Again, when the firms were further disaggregated (using the CR), it is observed that the four biggest manufacturing, retail and service firms hold sizeable shares of their respective markets. But then again, there are some firms among the four biggest manufacturing firms that hold about 97 percent of the market. This means that there is a strong element of high market concentration, possibly by way of collusion or cartelization among the firms (see Chen & Yu, 2018).

Table 1 suggests further that, in terms of average HHI, firms from all regions hold a moderate share of the markets of less than 0.02 or 2 percent, with Central African firms holding the largest average share of 0.01 or 1 percent. Conversely, Western Africa has a few firms controlling up to 34 percent of the markets. To confirm this, the firms in the regions were also disaggregated; it is again found that the average market share held by the four biggest firms in the regions is less than 40 percent. Yet, some of the biggest firms hold about 100 percent of some markets in Eastern and Western Africa. This is in conformity with the result obtained by Adebayo and Adeniji (2018). It implies that some markets in Eastern, Central and Western Africa are highly monopolized, which could be due to a weak institutional framework. On the other hand, market power is lower in Southern Africa, and this may be the result of relatively strong institutions in the region. This finding is in line with the results obtained by Roberts (2004) and Sitko, Burke and Jayne (2018) in their studies on market power and competition in southern Africa.

Additionally, the average market shares (using HHI) held by micro, small, medium and large firms are also modest because the average shares are below 0.02 or 2 percent of the market. Nevertheless, some of the micro, small, medium and large firms control up to 34 percent of their respective markets.

Table 1: Distribution of Market Power in Sub-Saharan Africa

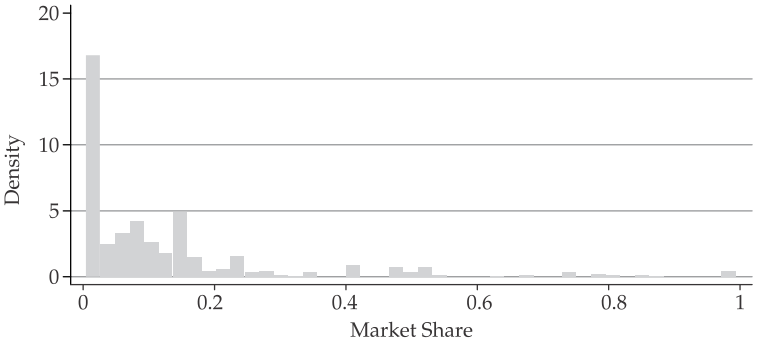
Firm-Type	Distribution		Average Market Share		Minimum Market Share		Maximum Market Share	
	Frequency	Percentage	HHI	CR (%)	HHI	CR (%)	HHI	CR (%)
By Firm-Type								
Manufacturing	10,915	48.34	0.004	38.75	0.001	16.05	0.03	97.44
Retail	5,294	23.45	0.01	35.76	0.001	19.64	0.34	42.48
Service	6,370	28.21	0.01	36.50	0.001	13.28	0.04	46.20
By Region								
Eastern Africa	9,016	26.87	0.005	39.33	0.002	19.64	0.02	100
Central Africa	2,604	7.76	0.01	38.64	0.01	37.01	0.02	40.74
Southern Africa	1,961	5.84	0.005	38.99	0.002	37.01	0.04	40.74
Western Africa	19,970	59.52	0.004	37.82	0.0002	8.64	0.34	100
By Firm-Size								
Micro	266	0.95	0.01	37.01	0.001	0	0.08	37.01
Small	17,421	61.89	0.004	38.85	0.0002	8.64	0.34	100
Medium	7,752	27.54	0.004	37.01	0.0002	8.64	0.34	100
Large	2,708	9.62	0.01	40.74	0.0002	8.64	0.08	97.44
Total	-	-	0.01	38.20	0.0002	8.64	0.34	100

Source: Authors' Calculations using World Bank Enterprise Survey Datasets.

When the CR is considered, the four biggest firms among micro, small, medium and large firms hold significant shares of their markets of about 41 percent and the four biggest firms hold between 97 and 100 percent of the markets. This is strong evidence for the existence of monopolies which also threatens social welfare and efficiency of markets.

Table 1 and Figure 1 depict that a large number of the firms control less than 0.2 or 20 percent of the markets with a few firms holding between 20 and 60 percent of the markets. But there are a small number of firms holding between 70 and 99 percent of the markets in Sub-Saharan Africa.

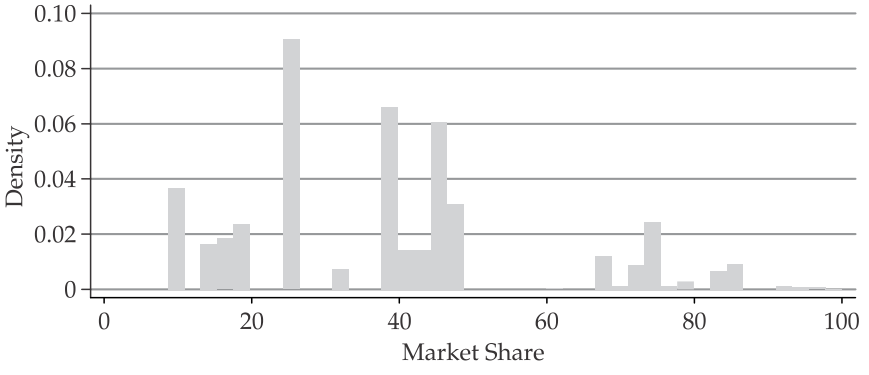
Figure 1: Market Power Base on Herfidahl-Hircschman Index (HHI)



Source: Authors' Calculations.

This signals the presence of monopolies in the region. The monopolies may have taken advantage of the high cost of doing business in the region to occupy the markets. This provides support for the findings of studies by Chen and Yu (2018), Adebayo and Adeniji (2018) and Akande (2018).

Figure 2: Market Power Based on Concentration Ratio (CR) in SSA



Source: Authors' Calculations.

Figure 2 shows that the four biggest firms in SSA control between 10 and 50 percent of the markets with the four biggest firms holding the equivalent of 70-100 percent of the markets. This is a typical case of collusion, which is detrimental to competition in SSA as argued by Roberts (2004) and Sitko, Burke and Jayne (2018).

Table 2 reports Panel Tobit regression models on sources of market power in SSA using HHI consisting of an unconditional[8] fixed effect, random-effect and pooled Tobit regression models. The coefficients of both the fixed-effect and random-effect Tobit models appear to be almost the same in terms of signs, size and significance. This implies that we cannot reject the random-effect Tobit regression model. Again, the rho estimate of the random-effect model suggests that the panel-level variance component is important, and the panel estimator is different from the pooled estimator. This means the random-effect Tobit model is appropriate here. In Table 2, the results of the random effects model indicate that only institutionalized democracy matters in determining the market power of

[8] An unconditional fixed-effect Tobit regression model is estimated due to the lack of the formal process of estimating the conditional one. Following Zambrano (2005), we fitted the fixed-effect Tobit model by estimating linear Tobit with the time-variant factor since there many firms (33,551) and including the cross-sectional units to capture firm-level effects would create a problem. However, this estimation does not also give room for estimating the Hausman test.

firms in SSA and it seems to have increased market dominance of firms in the region by about 0.004 percent, and this may not be unconnected with political patronage and lobbyists' activities.

Additionally, the random effects model in Table 2 incorporates interaction terms and the results imply that when democracy becomes more institutionalized and firm size increases simultaneously, the market power of the firms decreases and this may be due to competition. This is so because many newer firms might have grown strong enough to compete both legitimately and illegitimately with the existing ones. Further, the results show that as democracy becomes more institutionalized and firm exports increase, then such firms tend to dominate the market. This, of course, could be linked to the expansion of the political networks of such firms and the possibility of engaging in collusive activity at both the local and international markets. Among the controls in the random-effect Tobit model, significant variables include age, cost of labor, firm size, domestic market size, imported raw materials as a proportion of sales and a more expansive market-size variable created through the interaction between domestic market size and exporting status.

Table 2: Sources of Herfidahl-Hircschman-Index-Based Market Power in SSA

Variables	Unc. FE Tobit	RE Tobit	Pooled Tobit
Age	-1.65e-05***	-1.65e-05***	-2.48e-05***
	(4.00e-06)	(4.00e-06)	(4.46e-06)
Lab cost (log)	0.000280***	0.000281***	8.66e-05***
	(2.91e-05)	(2.91e-05)	(2.99e-05)
Phy capital (log)	5.15e-05	5.17e-05	0.000122***
	(3.15e-05)	(3.15e-05)	(3.55e-05)
Firm size	-0.00078***	-0.00078***	-0.000673**
	(0.000249)	(0.000249)	(0.000279)
Sales' Prop. of Imported r/w	6.56e-06***	6.62e-06***	2.14e-05***
	(2.03e-06)	(2.03e-06)	(2.27e-06)
Exporting status	0.00948***	0.00950***	0.0164***
	(0.00297)	(0.00297)	(0.00334)
Domestic Market size	-0.00204***	-0.00204***	-0.00221***
	(8.24e-05)	(8.24e-05)	(6.80e-05)
Govt ownership	-0.000364	-0.000364	-0.000253
	(0.000351)	(0.000351)	(0.000394)
Domestic Priv. Own	-0.000104	-0.000103	-0.000367*
	(0.000174)	(0.000174)	(0.000195)
Econ inst.	2.51e-05	2.50e-05	-6.97e-05***
	(1.64e-05)	(1.64e-05)	(1.79e-05)
Court sys fairness	-1.43e-05	-1.47e-05	-0.000228***
	(5.66e-05)	(5.67e-05)	(6.30e-05)
Inst. Democ.	4.04e-05***	4.04e-05***	3.42e-05***
	(7.98e-06)	(7.98e-06)	(8.54e-06)
Market size * exporting status	-0.00059***	-0.00059***	-0.000989***
	(0.000169)	(0.000169)	(0.000190)
Econ inst. * firm size	3.79e-06	3.81e-06	6.42e-06
	(4.54e-06)	(4.54e-06)	(5.10e-06)
Econ inst. * exporting status	-1.76e-06	-1.76e-06	-1.77e-06
	(2.93e-06)	(2.93e-06)	(3.31e-06)
Inst. Democ. * exporting status	3.88e-05*	3.87e-05*	3.03e-05
	(2.10e-05)	(2.10e-05)	(2.37e-05)
Inst. Democ.* firm size	-0.00024***	-0.00024***	-0.000180***
	(5.78e-05)	(5.79e-05)	(6.37e-05)
Southern Africa	-0.00275***	-0.00275***	-0.00295***
	(0.000214)	(0.000214)	(0.000193)
Eastern Africa	-0.000576	-0.000570	-0.00200***
	(0.000363)	(0.000363)	(0.000331)
Western Africa	-0.00081***	-0.0008***	-0.000565***
	(0.000247)	(0.000247)	(0.000214)
Constant	0.0741***	0.0442***	0.0484***
	(0.00188)	(0.00385)	(0.00161)
Sigma u		0.0114***	
		(0.00244)	
Sigma e	0.00616***	0.00616***	0.00696***
	(3.78e-05)	(3.78e-05)	(4.27e-05)
Rho		0.7744***	
		(0.0748)	
Time-Variant Factor	X	-	-
Observations	13,295	13,295	13,295
Number of year	11	11	11

Source: Authors' Calculations.

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

In particular, the model shows that as the firm ages, market power decreases by 0.002 percent meaning that the age of the firms in SSA does not increase market power. This may be due to lack of dynamism and competitiveness of the firms in SSA that adhere to a given strategy of doing business because of low technological development. Domestic market size is also observed to have a negative effect on market power in SSA, that is, as domestic market size expands a firm's market power reduces by 0.204 percent. This implies that a large market makes it less likely for any firm to strive to occupy the market. In order to see the effect of market size across exporting and non-exporting firms, an interaction term of market size and exporting status was created, which shows that market size generally reduces the market power of firms by an additional 0.057 percent when they are exporters.

Furthermore, exporting firms tend to have greater market power, by 0.95 percent, which could be due to high competitive advantage and access to more opportunities than non-exporting firms in SSA. Imported raw materials as a proportion of sales positively affect the firms' market power, which indicates that an increase in the proportion of imported raw materials leads to rise in market power by 0.001 percent. The ability to import (unique) raw materials gives such firms a competitive edge, and may result in greater market power. It is also shown in Table 2 that as the size of the firms increases, the tendency toward market power decreases by 0.078 percent, which could also be linked to improvement in competition as more firms are able to compete with the existing market leaders. As the labor cost goes up, the firms' market power also increases and this is so because the high cost of doing business may discourage some firms from producing goods and services. Finally, firms from Southern, Eastern and Western Africa have less market power than those from Central Africa.

Table 3 reports Panel Tobit regression models on sources of market power in SSA using the Concentration Ratio of the four biggest firms consisting of unconditional fixed-effect, random-effect and pooled Tobit regression models. Again, the unconditional fixed-effect Tobit regression model is estimated due to lack of a formal process of estimating the conditional one.

Table 3: Sources of Concentration Ratio-based Market Power in SSA

Variables	Unc. FE Tobit	RE Tobit	Pooled Tobit
Age	0.0151***	0.0151***	0.00980***
	(0.00225)	(0.00225)	(0.00264)
Lab cost (log)	0.0939***	0.0929***	-0.191***
	(0.0163)	(0.0163)	(0.0176)
Phy capital (log)	0.0483***	0.0482***	0.0536**
	(0.0177)	(0.0177)	(0.0210)
Firm size	0.805***	0.807***	1.231***
	(0.139)	(0.139)	(0.164)
Sales' Prop. of Imported r/w	-0.00841***	-0.00843***	-0.00733***
	(0.00115)	(0.00115)	(0.00135)
Exporting status	0.527	0.535	6.208***
	(1.683)	(1.684)	(1.995)
Domestic Market size	0.959***	0.959***	0.557***
	(0.0478)	(0.0478)	(0.0408)
Govt ownership	-0.206	-0.207	-0.446*
	(0.197)	(0.197)	(0.233)
Domestic Priv. Own	0.615***	0.615***	0.616***
	(0.0976)	(0.0977)	(0.116)
Econ inst.	0.0335***	0.0337***	0.0717***
	(0.00916)	(0.00916)	(0.0106)
Court sys fairness	0.136***	0.136***	-0.0857**
	(0.0319)	(0.0319)	(0.0374)
Inst. Democ.	0.0320***	0.0319***	-0.00345
	(0.00446)	(0.00446)	(0.00502)
Market size * exporting status	-0.0177	-0.0183	-0.380***
	(0.0958)	(0.0959)	(0.114)
Econ inst.* firm size	-0.0157***	-0.0157***	-0.0177***
	(0.00253)	(0.00254)	(0.00300)
Econ inst. * exporting status	0.00208	0.00207	-9.43e-05
	(0.00164)	(0.00164)	(0.00195)
Inst. Democ.* exporting status	-0.00969	-0.00957	0.0169
	(0.0118)	(0.0118)	(0.0140)
Inst. Democ.*firm size	0.0974***	0.0968***	-0.0661*
	(0.0336)	(0.0336)	(0.0391)
Southern Africa	-0.194	-0.197	-1.212***
	(0.124)	(0.124)	(0.117)
Eastern Africa	6.535***	6.518***	-0.364*
	(0.205)	(0.205)	(0.198)
Western Africa	4.717***	4.702***	0.0271
	(0.142)	(0.142)	(0.130)
Constant	13.19***	15.20***	26.42***
	(1.072)	(1.303)	(0.962)
Sigma u		2.817***	
		(0.604)	
Sigma e	3.436***	3.437***	4.094***
	(0.0212)	(0.0212)	(0.0253)
Rho		0.4018*** (0.1031)	
Time-Variant Factor	X	-	-
Observations	13,097	13,097	13,097
Number of year	11	11	11

Source: Authors' Calculations.
Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

The results of the unconditional fixed-effect and random-effect Tobit regression models, show that the models produce the same results in terms of sign, size and significance. This implies that the unconditional fixed-effect Tobit regression model is neither more efficient nor more consistent than the random effect model and vice versa. Given the significance of rho, it could be stated that the panel-level variance component is important and the panel estimator is different from the pooled estimator. Thus, random effect estimates could be considered appropriate here.

In Table 3, it is observed that in the random-effect Tobit model, economic institutions, a fair court system and institutionalized democracy positively affect the market power of the four biggest firms, which implies that the firms may have co-opted these institutions. But if the quality of economic institutions and size of firms increase jointly, then the market power held by the four biggest firms reduces by 1.57 percent. This indicates that as both economic institution and other firms become stronger, competition improves in SSA. However, as democracy becomes more institutionalized and the size of firms goes up concurrently, market power of the four firms is found to increase by 9.74 percent. This could be also related to improved competition which compels the biggest to lobby political office holders so as to maintain their dominance of the market in the region.

The random-effect Tobit model of Table 3 also shows that expansion in the size of the domestic market increases the market power of the four biggest firms. This is clear as market leaders always seek to take advantage of any increase in the quantity demanded for products in their industries in order to maintain and sustain their leadership in the market. The model reveals further that sales' share of imported raw materials negatively affects the firms' market power, which implies that upswing in the sales' share of imported raw materials causes a decrease in market share of the four biggest firms by 0.843 percent. This could be due to the high cost of importing raw materials which thereby reduce the competitive advantage of the biggest firms. However, the model shows that labor cost has a positive and significant effect on the market share of the four biggest firms as it increases their market share by 9.39 percent, which may be due to economies of scale.

As firms become more experienced (represented by an increase in age) and physical capital increases, the market power of the four biggest firms goes up by 1.51 and 4.83 percent respectively. Similarly, an increase in the size of firms and being domestic and privately-owned raises the

market power held by the four biggest firms in the region. Finally, the market power held by the four biggest firms is higher in Eastern and Western Africa than that of Central Africa.

To check the robustness of our findings, we estimated the standard linear fixed effect, the random effect and pooled regression models. The results of the robust test of HHI models are presented in Table 4 and the findings of the standard linear fixed effect model are similar to those of the fixed and random effect Tobit regression models reported in Table 2. The Hausman test was conducted and the result implies that the standard linear fixed effect model is more efficient or appropriate than the random effect model. Therefore, this corroborates the reliability of our findings in the tables. Further, the findings of ordinary random effect and pooled regression models in Table 4 are similar to each other and to those of the pooled Tobit regression model of Table 2. The rho result in Table 2 confirms that the findings of fixed- and random-effect Tobit regression models are consistent with each other.

Also, the findings of the standard linear random effect and pooled regression models in Table 5 are similar to each other and to those of the pooled Tobit regression model of Table 3. And the insignificance of the Breusch and Pagan Langrangian Multiplier Test shows that the random effect is not important, which means the random effect panel estimator in this case is different from the pooled estimator. However, the rho result in Table 3 shows otherwise, and this still confirms that the findings of fixed and random-effect Tobit regression models are consistent with each other.

Table 4: Robustness Check of HHI Models

Variables	HHI Robust FE	RE	Pooled
Age	-1.65e-05***	-2.48e-05***	-2.48e-05***
	(4.01e-06)	(4.46e-06)	(4.46e-06)
Lab cost (log)	0.000280***	8.66e-05***	8.66e-05***
	(2.92e-05)	(3.00e-05)	(3.00e-05)
Phy capital (log)	5.15e-05	0.000122***	0.000122***
	(3.15e-05)	(3.55e-05)	(3.55e-05)
Firm size	-0.000778***	-0.000673**	-0.000673**
	(0.000250)	(0.000279)	(0.000279)
Sales' Prop. of Imported r/w	6.56e-06***	2.14e-05***	2.14e-05***
	(2.03e-06)	(2.27e-06)	(2.27e-06)
Exporting status	0.00948***	0.0164***	0.0164***
	(0.00298)	(0.00335)	(0.00335)
Domestic Market size	-0.00204***	-0.00221***	-0.00221***
	(8.25e-05)	(6.80e-05)	(6.80e-05)
Govt ownership	-0.000364	-0.000253	-0.000253
	(0.000351)	(0.000395)	(0.000395)
Domestic Priv. Own	-0.000104	-0.000367*	-0.000367*
	(0.000174)	(0.000195)	(0.000195)
Econ inst.	2.51e-05	-6.97e-05***	-6.97e-05***
	(1.64e-05)	(1.80e-05)	(1.80e-05)
Court sys fairness	-1.43e-05	-0.000228***	-0.000228***
	(5.67e-05)	(6.30e-05)	(6.30e-05)
Inst. Democ.	4.04e-05***	3.42e-05***	3.42e-05***
	(7.99e-06)	(8.54e-06)	(8.54e-06)
Market size * exporting status	-0.000592***	-0.000989***	-0.000989***
	(0.000169)	(0.000191)	(0.000191)
Econ inst. * firm size	3.79e-06	6.42e-06	6.42e-06
	(4.55e-06)	(5.10e-06)	(5.10e-06)
Econ inst. * exporting status	-1.76e-06	-1.77e-06	-1.77e-06
	(2.93e-06)	(3.31e-06)	(3.31e-06)
Inst. Democ.. * exporting status	3.88e-05*	3.03e-05	3.03e-05
	(2.11e-05)	(2.37e-05)	(2.37e-05)
Inst. Democ..* firm size	-0.000236***	-0.000180***	-0.000180***
	(5.79e-05)	(6.37e-05)	(6.37e-05)
Southern Africa	-0.000576	-0.00200***	-0.00200***
	(0.000363)	(0.000331)	(0.000331)
Eastern Africa	-0.00275***	-0.00295***	-0.00295***
	(0.000214)	(0.000193)	(0.000193)
Western Africa	-0.000806***	-0.000565***	-0.000565***
	(0.000248)	(0.000215)	(0.000215)
Constant	0.0385***	0.0484***	0.0484***
	(0.00172)	(0.00162)	(0.00162)
Observations	13,295	13,295	13,295
Number of year	11	11	
Hausman Test	2046.58 [0.0000]****		
Breusch and Pagan LM Test		0.0000[1.0000]	

Source: Authors' Calculations.

Notes: Standard errors in parentheses, probability values in [ ], *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Robustness Check of CR Models

Variables	FE	RE	Pooled
Age	0.0151***	0.00980***	0.00980***
	(0.00225)	(0.00264)	(0.00264)
Lab cost (log)	0.0939***	-0.191***	-0.191***
	(0.0163)	(0.0177)	(0.0177)
Phy capital (log)	0.0483***	0.0536**	0.0536**
	(0.0177)	(0.0210)	(0.0210)
Firm size	0.805***	1.231***	1.231***
	(0.139)	(0.164)	(0.164)
Sales' Prop. of Imported r/w	-0.00841***	-0.00733***	-0.00733***
	(0.00115)	(0.00135)	(0.00135)
Exporting status	0.527	6.208***	6.208***
	(1.685)	(1.997)	(1.997)
Domestic Market size	0.959***	0.557***	0.557***
	(0.0479)	(0.0409)	(0.0409)
Govt ownership	-0.206	-0.446*	-0.446*
	(0.197)	(0.233)	(0.233)
Domestic Priv. Own	0.615***	0.616***	0.616***
	(0.0978)	(0.116)	(0.116)
Econ inst.	0.0335***	0.0717***	0.0717***
	(0.00917)	(0.0106)	(0.0106)
Court sys fairness	0.136***	-0.0857**	-0.0857**
	(0.0320)	(0.0374)	(0.0374)
Inst. Democ.	0.0320***	-0.00345	-0.00345
	(0.00446)	(0.00502)	(0.00502)
Market size * exporting status	-0.0177	-0.380***	-0.380***
	(0.0959)	(0.114)	(0.114)
Econ inst. * firm size	-0.0157***	-0.0177***	-0.0177***
	(0.00254)	(0.00300)	(0.00300)
Econ inst. * exporting status	0.00208	-9.43e-05	-9.43e-05
	(0.00164)	(0.00195)	(0.00195)
Inst. Democ.. * exporting status	-0.00969	0.0169	0.0169
	(0.0118)	(0.0140)	(0.0140)
Inst. Democ..* firm size	0.0974***	-0.0661*	-0.0661*
	(0.0336)	(0.0391)	(0.0391)
Southern Africa	6.535***	-0.364*	-0.364*
	(0.206)	(0.198)	(0.198)
Eastern Africa	-0.194	-1.212***	-1.212***
	(0.125)	(0.117)	(0.117)
Western Africa	4.717***	0.0271	0.0271
	(0.142)	(0.130)	(0.130)
Constant	15.00***	26.42***	26.42***
	(0.988)	(0.962)	(0.962)
Observations	13,097	13,097	13,097
Number of year	11	11	
Hausman Test	5770.83 [0.0000]***		
Breusch and Pagan LM Test		0.0000[1.0000]	

Source: Authors' Calculations.
Notes: Standard errors in parentheses, probability values in [ ], *** p<0.01, ** p<0.05, * p<0.1

Generally, the findings signify that institutions significantly matter in determining market power among firms in SSA. However, the influence of institutions vary greatly depending on the circumstances. When all

firms are considered in the analysis, the impacts of institutions are found to fairly meet theoretical expectations. However, institutionalized democracy is found to be encouraging firms to dominate the market, which could be related to political patronage and lobbyist activities of some firms during and after elections.However, as democracy becomes more institutionalized and there is greater growth of firms, there is less chance of firms dominating the market (see Memanova & Mylonidis, 2019). This is of course the combined effect of highly institutionalized democracy and increased competitive capability of many firms.

Conversely, the findings show that the four biggest firms exploited the weak institutions to dominate the industries in the region which may be through lobbyist and collusive activities, and unsubstantiated innovation and invention[9]. Again, the results show that as economic institutions become stronger and firms grow simultaneously bigger, there is a smaller possibility of the four biggest firms dominating the market. This could be linked to the fact that many firms have grown adequately to compete with the biggest firms and at the same time economic institutions guarantee an enabled 'playing field' for all the firms in the region through freedom of property rights, investment, monetary accessibility and fiscal freedom, which together encourage the entry of new firms into many industries or markets. Thus, the entry of new firms reduces the market power of the existing firms. It is noteworthy that market size has a significant impact on market power. Therefore, with large markets firms do not concern themselves too much to dominate the market.

5. Conclusion and Policy Recommendations

This paper examines the sources of market power among firms in SSA. To actualize this objective, a firm-level unbalanced panel dataset (Enterprise Surveys) by the World Bank was used and analysed using a random-effects Tobit regression model. The study finds that a significant number of firms hold less than 20 percent of the markets with a few firms holding between 20 and 60 percent of the markets. But there are a small number of firms holding between 70 and 99 percent of the markets in SSA. When high institutionalized democracy is supported by the growth of firms, then market power is reduced. Conversely, when high institutionalized democracy is supported by high exports, the market power held by some firms increases and this could be said to support the findings of Adebayo and Adeniji (2018).

[9] Patent right is usually granted to firms that innovate and/or invent.

Other factors determining the firms' market power in SSA countries include domestic market size, age of firms, labor costs, exporting capacity, proportion of imported raw materials, overall market size, and regional effects. Labor costs, proportion of imported raw materials and exporting status positively affect market power, while the size of firms, domestic market size, overall market size, age of firms, and regional factors (due to lack of or weak competition policies) negative significant impact market power as established by Vickers (2005).

Similarly, the study established that economic, legal and political institutions encourage the four biggest firms to dominate their respective industries as they collude or form a cartel to collectively innovate or invent in their respective areas of businesses – which paves the way for them to gain market power easily. The study also found that as economic institutions become stronger and firms also grow, market domination by the four biggest firms is curtailed, perhaps through easy entry of the new firms into the markets – which can be explained as a clear case of weak legal and political institutions that do not properly regulate cartel or collusive activities in the markets. Also, the four biggest firms from Eastern and Western Africa dominate their markets more than those from Central and Southern Africa. This also confirms the finding of Vickers (2005), Adebayo and Adeniji (2018).

In line with the above findings, the study recommends some measures to improve the institutional framework in SSA. First, it is necessary to introduce legislations of competition in the region through constitutional amendments – particularly in Western Africa where there is evidence of weak institutions. Second, specific strong competitive policies on collusion, cartel, merger and acquisition should also be introduced in all countries such as the ones in South Africa, Togo and Kenya (Economic Commission of Africa, ECA, 2000). Third, there needs to be greater penalties for uncompetitive practices thereby serving as a deterrence. Fourth, competition commissions (such as the Zambian Competition Commission) ought to be introduced across all countries as an executive unit to monitor, control and prohibit acts or behavior which could adversely affect competition in the countries. Finally, in order to effectively implement the policies, there is a need to consider reducing the cost of doing business through infrastructural development.

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Appendix

Appendix A: Description of Variables

Variable	Definition
Dependent	
Market Power	Measured by Herfidahl-Hircschman Index (HHI) and Concentration Ratio (CR) computed using firms' sales
Explanatory	
Age	The number of years a firm has been in operation (natural logarithm)
Firm size	Logarithmic of total number of firms' permanent and full-time employees
Domestic Ownership	Dummy for the dominance of domestic private ownership of the firms
Government	Dummy for the firms or portion of firms owned by owned government
Market Size	Logarithm of country's population
Exporting status	Dummy for firms that export their output
Imported Raw Materials	Expenditure on imported raw materials as a proportion of sales
Economic Institutions	Measured by the countries' average economic freedom index
Legal Institution	Measured by a dummy for fairness of court system whereby 1 for strongly disagree, 2 for tend to disagree, 3 for tend agree and, 4 for strongly agree that the court system is fair, impartial and uncorrupted.
Institutionalized Democracy	Measured an index of how institutionalized a country's democracy is. The index ranges from 0 for completely weak to 10 for perfectly strong political institution
Central Africa	Dummy for firms operating in Central Africa
Eastern Africa	Dummy for firms operating in Eastern Africa
Western Africa	Dummy for firms operating in Western Africa
Southern Africa	Dummy for firms operating in Southern Africa

Source: Authors' Calculations

Appendix B: Descriptive Statistics

Overall					
Variables	**Observation**	**Mean**	**Standard Dev**	**Min**	**Max**
Concentration R	31,045	38.37553	14.31501	8.636711	100
HHI	33,551	.0045534	.0068221	.0001599	.3366609
Age	32,597	19.1433	13.37347	0	168
Lab Cost (log)	17,778	15.03359	2.797457	6.907755	25.80839
Phy Cap (log)	29,759	14.69501	3.153637	0	27.01484
Firm size	33,167	2.686643	1.25106	0	11.06664
Imported r/m	32,545	22.90073	26.83659	0	100
Exporting status	33,509	.0864842	.281082	0	1
Market size	33,551	17.75324	1.139574	13.07792	18.99435
Govt. Own	33,550	.0208048	.1427324	0	1
Dom Priv Own	33,027	.9201865	.2710083	0	1
Econ Institution	33,551	54.67886	6.823078	22.1	68.5
Court Sys Fairn	28,814	2.395641	1.017183	1	4
Inst. Democ.	33,551	3.243957	10.40677	-77	10
Eastern Africa	33,551	.2687252	.4433033	0	1
Central Africa	33,551	.0776132	.2675659	0	1
Southern Africa	33,551	.0584483	.2345928	0	1
Western Africa	33,551	.5952133	.490858	0	1
Central Africa					
Concentr Ratio	2,397	38.63603	1.081977	37.01178	40.7422
HHI	2,604	.0087635	.002906	.0045563	.016073
Age	2,526	17.78424	12.28528	0	114
Lab Cost (log)	2,378	15.38401	2.482742	8.411833	25.35141
Phy Cap (log)	2,547	14.5137	1.915485	2.995732	23.94214
Firm size	2,590	2.754355	1.153462	0	8.517193
Imported r/m	2,602	27.53412	27.29746	0	100
Export status	2,604	.0837174	.2770167	0	1
Market size	2,604	17.24982	.5887074	16.73552	18.09983
Govt. Own	2,604	.0280338	.1651011	0	1
Dom Priv Own	2,588	.8531685	.3540063	0	1
Econ Institution	2,604	46.78568	5.872152	39.6	54.6
Court Sys Fairn	2,456	1.939739	.9421303	1	4
Inst. Democ.	2,604	3.006528	2.191459	1	6
Eastern Africa					
Concentr Ratio	9,016	39.33413	7.840897	19.64077	100
HHI	9,016	.0051703	.0032809	.0015468	.0173102
Age	8,576	20.27624	16.30653	0	133
Lab Cost (log)	6,821	15.13496	2.993181	6.907755	25.12999
Phy Cap (log)	8,419	14.69095	2.118266	0	25.82861
Firm size	8,829	3.010988	1.318202	0	10.30895
Imported r/m	8,755	26.72147	27.60933	0	100
Export status	8,995	.1136187	.3173652	0	1
Dome mk size	9,016	17.23844	.704514	16.03808	18.41457
Govt. Own	9,015	.014975	.1214596	0	1
Dom Priv Own	8,769	.9054624	.2925918	0	1

Overall					
Variables	**Observation**	**Mean**	**Standard Dev**	**Min**	**Max**
Econ Institution	9,016	53.46977	10.24213	22.1	63.9
Court Sys Fairn	7,854	2.406799	.9556095	1	4
Inst. Democ.	9,016	3.682786	2.843969	0	9
Southern Africa					
Concentr Ratio	1,358	38.99267	.6588058	37.01178	40.7422
HHI	1,961	.0047724	.0058747	.0014934	.0361381
Age	1,956	26.48262	19.91925	2	149
Lab Cost (log)	1,885	14.29894	2.302975	6.907755	21.69329
Phy Cap (log)	1,664	13.99374	1.990115	4.382027	22.51503
Firm size	1,947	3.606962	1.65519	0	11.06664
Imported r/m	1,961	22.75144	28.89438	0	100
Export status	1,954	.1596725	.3663958	0	1
Dome mk size	1,961	17.20656	1.127029	14.50385	17.70496
Govt. Own	1,961	.0081591	.0899814	0	1
Dom Priv Own	1,946	.8766701	.3289	0	1
Econ Institution	1,961	64.08419	6.368682	49.7	68.5
Court Sys Fairn	1,314	2.429224	.9001641	1	4
Inst. Democ.	1,961	8.922998	.2666619	8	9
Western Africa					
Concentr Ratio	18,274	37.82254	17.79956	8.636711	100
HHI	19,970	.0037044	.0081018	.0001599	.3366609
Age	19,539	18.08701	10.73136	0	168
Lab Cost (log)	6,694	15.01269	2.787106	6.907755	25.80839
Phy Cap (log)	17,129	14.33413	1.661739	0	27.01484
Firm size	19,801	2.442672	1.101548	0	8.723882
Imported r/m	19,227	20.54914	25.90379	0	100
Export status	19,956	.0674484	.2508032	0	1
Dome mk size	19,970	18.10498	1.217427	13.07792	18.99435
Govt. Own	19,970	.0237356	.1522281	0	1
Dom Priv Own	19,724	.9398195	.237827	0	1
Econ Institution	19,970	55.3304	2.118205	48.7	61.3
Court Sys Fairn	17,190	2.453112	1.046582	1	4
Inst. Democ.	19,970	2.519129	13.18656	-77	10

Source: Authors' Calculations

Appendix C: Countries in the Panel Dataset

Countries	Sub-Region	Years of Panel Surveys
Angola	Central Africa	2006, 2010
Benin	Western Africa	2005, 2009
Burkina Faso	Western Africa	2006, 2009, 2016
Cameroon	Central Africa	2006, 2009, 2016
Cape Verde	Western Africa	2006, 2009
Coted Ivoire	Western Africa	2009, 2016
Democratic Republic of Congo (DRC)	Central Africa	2010, 2013
Ethiopia	Eastern Africa	2011, 2015
Ghana	Western Africa	2007, 2013
Kenya	Eastern Africa	2007, 2013
Lesotho	Southern Africa	2009, 2016
Malawi	Eastern Africa	2009, 2014
Mali	Western Africa	2003, 2007, 2010
Niger	Western Africa	2005, 2009, 2017
Nigeria	Western Africa	2007, 2009, 2014
Rwanda	Eastern Africa	2006, 2011
Senegal	Western Africa	2003, 2007
South Africa	Southern Africa	2003, 2007
Tanzania	Eastern Africa	2006, 2013
Togo	Western Africa	2009, 2016
Uganda	Eastern Africa	2006, 2013
Zambia	Eastern Africa	2007, 2013
Zimbabwe	Eastern Africa	2011, 2016

Source: Authors' Calculations

Appendix D: Parts of Pairwise Correlation for Possibility of Causality

	HHI	**CR**
HHI	1.000	
CR	-0.0004	1.0000
Age	-0.0206	-0.0541
Lab cost (log)	0.0796	-0.0333
Phy capital (log)	0.0919	-0.0055
Firm size	0.0379	0.0609
Sales′ Prop. of Imported r/w	0.2278	-0.0611
Exporting status	0.0456	0.0385
Domestic Market size	-0.5330	-0.0352
Govt ownership	-0.0051	0.0072
Domestic Priv. Own	-0.1079	-0.0014
Econ inst.	-0.0528	-0.0008
Court sys fairness	-0.0581	0.0014
Inst. Democ.	-0.0044	-0.0026
Central Africa	0.1790	0.0053
Eastern Africa	0.0548	0.0428
Southern Africa	0.0080	0.0092
Western Africa	-0.1509	-0.0462

Source: Authors′ Calculations

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