

# Monetary Policy Transmission and Firms' Investment: Evidence From the Manufacturing Sector of Pakistan

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## *Abstract*

*This study explores the effects of monetary policy on firms' business fixed investment spending through the interest rate and broad credit channels of monetary policy transmission mechanism in Pakistan. Due to the problem of endogeneity, Generalized Method of Moments (GMM) two step estimation technique is applied on neo-classical investment model by using disaggregated firm level data of manufacturing sector of Pakistan over the period 1974-2010. The results suggest the relevance of both the interest rate and broad credit channels in Pakistan. Firms' investment found to be negatively affected by the monetary contraction while positively influenced by cash flow and the sales. Small firms explored to be more sensitive to the monetary tightening as compared to large firms indicating that monetary policy exerts heterogeneous effects. Results highlight the importance of considering the financial conditions of the firms in formulation of monetary policy.*

*Keywords: Monetary Transmission Mechanism, Firms' Investment, Dynamic Panel Data, Manufacturing Sector of Pakistan*

*JEL Classification: C33, E22, E52*

## 1. Introduction

There is consensus among the economists that monetary policy affects the real economic activity but how the effects of monetary policy are transmitted to the real economic activity is still debatable. A large strand of literature all over the world has attempted to figure out the mechanism through which the monetary

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policy affects the economic agents: consumers, banks and firms. Monetary policy affects the real economic activity by various transmission channels. These transmission channels include interest rate channel, asset price channel and broad credit channel<sup>4</sup>.

By using disaggregated firm level data, literature identifies two most important channels through which monetary policy affects the firms' business fixed investment spending. One is traditional interest rate channel. It implies that changes in the market interest rate leads to the changes in the user cost of capital which in turn affects the firms' capital formation. Second is the broad credit channel which is composed of balance sheet channel and bank lending channel. It is based on the notion that there exist information asymmetries between lenders and borrowers that lead to the agency problem. Monetary policy shock leads to the decline in the firms' cash flow, due to rise in interest expenses, and deteriorates the value of collateral, thus negatively affecting the firms' net worth. Hence, worsening of firms' balance sheet conditions causes the external finance premium to rise due to the higher agency cost. Firms that have severe information problems are affected more strongly by monetary contraction. This channel is known as the balance sheet channel. Monetary contraction also affects the bank ability to supply loans named as bank lending channel. Tight monetary policy leads to the fall in bank deposits and bank reserves leading to the contraction in supply of bank loans that translates into the fall in investment spending. Resultantly, aggregate demand declines in the economy. Small firms are affected more strongly by contraction in loan supply due to monetary tightening as discussed by Mishkin (1996).

Most of the studies investigating the monetary transmission mechanism in Pakistan have relied on the aggregated data set (Agha *et al.*, 2005; Alam and Waheed, 2006; Hussain, 2009; Hussein *et al.*, 2011; Munir and Qayyum, 2012). Few studies (e.g. Shabbir, 2012; Choudhary, 2012) that employed micro data set to investigate the monetary transmission channels in Pakistan have not taken into account the firms' business fixed investment spending despite of its importance in macroeconomic fluctuations as argued by Abel *et al.* (2011). Thus, this paper has made an effort to contribute in the literature on monetary transmission mechanism in Pakistan by investigating the relevance of interest rate and broad credit channels with emphasize on firms' fixed investment spending.

The primary objective of this paper is to discover the significance of interest rate and broad credit channels in Pakistan. This paper intends to explore the credit

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<sup>4</sup> Mishkin (1996) presents excellent overview of monetary transmission channels.

market frictions and role of information asymmetries in the monetary policy effects by analyzing the heterogeneous response of firms to monetary policy in Pakistan. In a recession, half or more of the total decline in spending is attributable to the reduction in investment spending and investment plays a critical role in determining the long term productive capacity of the economy as explained by Abel *et al.* (2011). It makes investment an ideal candidate to gauge the impact of monetary policy on firms' fixed investment and to find out the significance of interest rate and broad credit channels of monetary policy transmission channels in Pakistan. This study also investigates the relevance of sales accelerator mechanism in Pakistan.

The rest of the paper is planned as follows. Section 2 sheds light on the existing literature on monetary transmission mechanism. Section 3 explains the theoretical model while section 4 describes the data and methodological issues. Section 5 discusses the empirical results while section 6 concludes.

## 2 Review of Literature

There exist extensive studies on monetary economics investigating the implications of monetary actions. Literature on monetary transmission channels has emphasized to use micro level data to explore the monetary transmission mechanism since heterogeneous response of economic agents and frictions in capital market can't be exploited with the aggregated data (Chirinko *et al.*, 1999). A large strand of literature has identified the interest and broad credit channels by using user cost of capital and cash flow, respectively. The work on user cost of capital was pioneered by the Jorgenson (1963). Eisner and Nadari (1968) conducted a study to examine the significance of assumptions and precision of conclusions of Jorgenson's neo-classical theory of investment. Their results denied the Jorgenson's assumption of a Cobb-Douglas production function in favor of Constant Elasticity of Substitution (CES) production function.

Monetary policy effects are propagated through the credit market imperfections. Bernanke and Gertler (1989) figured out that the agency cost declines with increase in the net worth and improvement in net worth leads to increased investment spending. Bernanke and Gertler (1995) discovered that monetary tightening lead to the increase in the external finance premium. It was explored that tight monetary policy leads to the decline in the net cash flow, due to the increased interest payments, thus deteriorate balance sheets of firms as well as of households. Up to 40% decline in the profit explored to be attributable to the rise in interest payments due to monetary contraction with reference to America. Results stress that cash flow is an important factor affecting the inventory

accumulation and investment spending. Bernanke *et al.* (1996) confirmed the results of Bernanke and Gertler (1995) by using disaggregated firm level data obtained from America's Quarterly Financial Report of Manufacturing Firms and concluded that firms facing higher agency cost get larger reduction in loans by the lenders as compared with the borrowers having strong net worth.

Firms' external borrowing is composed on the equity and leverage. Increase in leverage leads to the bankruptcy risk. Developing countries like Pakistan where capital markets are underdeveloped, firms rely on leverage for their financing needs. Due to high use of leverage, bankruptcy risk may arise. Monetary policy affects the firms' business fixed investment spending through leverage as well, first documented by the Fisher (1933). Hu (1999) explored that American manufacturing firms with high leverage are affected more by monetary contraction as compared to the less indebted firms. Ghosh and Ghosh (2006) explored that highly indebted firms are more sensitive to the monetary contraction as compared to the low leveraged manufacturing Indian firms. Angelopoulou and Gibson (2007) highlighted with reference to United Kingdom that the firms having high leverage ratio, due to higher external finance premium, exhibit greater cash flow sensitivity and such firms have higher probability of default.

Collateral plays an important role in the determination of cost of borrowing and firms having good credit rating are affected less by monetary contraction. Gaiotti and Generale (2001) discovered that the small sized firms and the firms having more intangible assets are affected more severely by monetary contraction as compared to the large sized firms and firms having tangible collateral. Valderrama (2001) figured out the interest rate and broad credit channel in Austria and explored that a strong credit channel is operative in Austria. Results indicated that young firms rely heavily on sales to finance their business fixed investment while the effect of interest rate channel found insignificant for young firms. It was discovered that firms having high trade credit and having close association with lender called "Housebank" are affected less by monetary contraction. The results of this study are supported by the findings of Kalckreuth (2001). Kalckreuth (2001) explored that poor rated firms' investment spending is more sensitive to the cash flow as compared to firms with good overall rating ratio and the user cost of capital sensitivity decrease for poor rated firms. No significant difference between the cash flow sensitivity of small and large firms was found in Germany implying possible less information asymmetries between the lenders and firms. In Germany, less information asymmetries seems attributable to the firms' close relationship with a bank called "Hausbank" as suggested by Ehrmann (2004). The studies reasoning that low sensitivity of investment to cash flow is attributable to

the close relationship of borrower with the lender in Germany are criticized by Engel and Middendorf (2009). They explored that there is no particular difference in terms of sensitivity of investment to internal generated funds between the firms linked to banks and the firms that don't have close links with the lender.

Taking into account different subsectors of the manufacturing, Butzen *et al.* (2001) explored the broad credit and interest rate channel in Belgium. It was explored that the manufacturing firms' investment responds negatively to the user cost of capital growth while positively to the cash flow, similar to the results of other studies. Small firms' investment discovered to be more responsive to the internal generated funds than large firms while large and small firms explored to be insignificantly influenced by the user cost of capital growth. This study also found that large firms are sensitive to the growth of value added but not to the cash flow thus implying that large firms have better access to external finance. This study also analyzed the different subsectors of manufacturing and discovered that capital intensive subsectors are affected more by monetary contraction as compared with labor intensive subsectors. Lunnemann and Matha (2001) explored in relation to Luxembourg that younger firms' investment is more responsive to the user cost of capital, sales and cash flow than older firms. Results implies that younger firms face financial constraints and with time, information asymmetries declines and agency problem moderates. Small firms explored to be more sensitive to the liquidity than large firms. Chatelain and Tiomo (2001) by using disaggregated firm level data of French firms explored that firms with high risk of bankruptcy are more sensitive to the internal generated funds since they have to bear high risk premium in case of external finance. Results verified the existence of broad credit channel.

The strength of interest rate and broad credit channels varies from country to country. Chatelain *et al.* (2001) discovered interest rate channel in four countries of euro-area comprising on France, Germany, Spain and Italy while broad credit channel was explored only in Italy. Chatelain *et al.* (2003) explored that poorly rated firm in France and Germany, small services firms in Belgium and French equipment manufacturers exhibit high liquidity to investment sensitivity. Karim (2010) discovered that small firms are affected more strongly by cash flow than large firms thus indicating the significance of broad credit channel in Malaysia.

The ability to arrange finance from the non-bank sources can alleviate the pressure of monetary contraction. Nagahata and Sekine (2005) explored a strong interest rate channel but credit channel was not discovered operative in Japan. Their study highlighted that non-bond issuing firms are affected more by the monetary policy

through the interest rate channel then the bond issuing firms<sup>5</sup>. Rungsoboon (2005) found out the strong balance sheet channel in Thailand. Results figured out that small and non-bond issuing firms are affected more by the financial crisis than the large sized and bond issuing firms, indicating the presence of balance sheet channel. The study of Rungsoboon (2005) lacks in the respect that it did not focus to find out the relevance of the interest rate channel.

Large number of studies has investigated the monetary transmission mechanism channels with reference to Pakistan. Agha *et al.* (2005) figured out that in Pakistan monetary contraction leads to the fall in domestic demand and eventually results in reduction in overall price level. They explored that interest rate, credit channel, asset price channel and exchange rate channel simultaneously operates in Pakistan but the exchange rate channel explored to be of less importance. Their results are contradicted with the results of Hassan (2011), who by using reserve equation, explored that SBP actively manages the exchange rate. Alam and Waheed (2006) analyzed the sectoral effects of monetary policy and explored that manufacturing, wholesale trade, retail trade, financial and insurance sectors are affected more by monetary contraction while agriculture, mining and construction sector explored not to be significantly affected by monetary tightening. Khan and Qayyum (2007) explored that as compared to interest rate channel, exchange rate channel is more important in Pakistan, giving weight age to the results of Hassan (2011) who also found similar result. Hussain (2009) explored that in Pakistan inflation is not only caused by monetary expansion but also by the government spending and exchange rate. It was concluded that exchange rate channel has special importance in Pakistan and monetary authorities can control the inflation by targeting the exchange rate. Choudhary *et al.* (2012) explored the role of credit market frictions in transmission of monetary policy in Pakistan. It was explored that monetary tightening leads to the increase in the interest rate on loans. Shabbir (2012) found the strong balance sheet channel in Pakistan. Results revealed that monetary tightening negatively affects the firms' net worth and their cash flows. It is measured that 1% increase in the overnight interest rate deteriorates the small firms' net worth by 4.3% while net worth of large firms decline by only 3.8%. Analysis shows that 1% increase in financial expenses reduces the cash flow in case of large firms by 1% but small firms' cash flow declines by 8.4%. Hashmi (2011) analyzed firm level data of manufacturing sector of Pakistan over the period 1974 to 2006. He explored firm level bankruptcy risk and observed that

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5 Bond issuing firms can raise the capital from capital market due to which such firms are not significantly affected by monetary contraction.

bankruptcy cost is associated with external finance in case of manufacturing sector of Pakistan.

The present study explores the relevance of interest rate and broad credit channels of monetary policy by taking firms' business fixed investment spending as the focal point, thus bridging the gap in literature on monetary transmission channels in Pakistan.

### 3 Theoretical Framework

There exists a large strand of literature discovering the interest rate and broad credit channels with emphasize on firm level fixed investment. This task is accomplished by using neo-classical investment model.

This paper similar to other empirical studies derives the investment model from the neo-classical demand for capital theory<sup>6</sup>. The first order condition for a firm's optimization problem yields the following equality:

$$F_K(K_{it}, L_{it}) = UC_{it} \quad (3.1)$$

Following other studies (e.g. Eisner and Nadari, 1968; Chatelain *et al.*, 2001), this paper parameterizes the production function as a constant elasticity of substitution (CES) production function:

$$F(K_{it}, L_{it}) = TFP_{it} \left[ \beta L_{it}^{\frac{\sigma-1}{\sigma}} + \alpha K_{it}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1} \nu}, \quad \alpha + \beta = 1 \quad (3.2)$$

Where in the equation (3.2)  $\sigma$  denotes the elasticity of substitution between capital and labor,  $\nu$  indicates the returns to scale and  $TFP_{it}$  represents total factor productivity. It is assumed that the total factor productivity consists on year specific and firm specific components.

Differentiating the equation (3.2) with respect to capital, inserting the resultant into equation (3.1) and simplifying the expression yields the equation (3.3):

$$\log K_{it} = \theta \log Y_{it} - \sigma \log UC_{it} + \log H_{it} \quad (3.3)$$

Where  $\theta = \left( \sigma + \frac{1-\sigma}{\nu} \right)$  and  $H_{it} = (TFP_{it})^{\frac{\sigma-1}{\nu}} \cdot (\nu \alpha_i)^\sigma$

$Y_{it}$ ,  $UC_{it}$  and  $H_{it}$  represents sales, the user cost of capital and total factor productivity, respectively. Capital to sales elasticity is unity ( $\theta = 1$ ) if production

<sup>6</sup> See Jorgenson (1963) for detailed review of neo-classical demand for capital theory.

function exhibit constant returns to scale ( $\nu = 1$ ) or if the elasticity of substitution is unity ( $\sigma = 1$ ), indicating the case of Cobb-Douglas.

Firm want to achieve the optimal capital stock and firm accumulate capital to achieve optimal capital stock which is defined as:

$$\log K_{it}^* = \theta \log Y_{it} - \sigma \log UC_{it} + \log H_{it} \quad (3.4)$$

Since firm's long run target value of capital stock or optimal capital stock is unobservable, an adjustment process has to be formulated. In this way one can identify the adjustment between optimal and current capital stock. Thus, an autoregressive distributed lag model (ARDL (3, 3))<sup>7</sup> is specified as:

$$\begin{aligned} k_{it} = & \omega_1 k_{i,t-1} + \omega_2 k_{i,t-2} + \omega_3 k_{i,t-3} + \theta_0 y_{it} + \theta_1 y_{i,t-1} + \theta_2 y_{i,t-2} + \theta_3 y_{i,t-3} - \sigma_0 uc_{it} - \sigma_1 uc_{i,t-1} \\ & - \sigma_2 uc_{i,t-2} - \sigma_3 uc_{i,t-3} + \phi_0 h_{it} + \phi_1 h_{i,t-1} + \phi_2 h_{i,t-2} + \phi_3 h_{i,t-3} \end{aligned} \quad (3.5)$$

Lower case letters indicate the level variables in logs. Here ARDL model represents reduced form of some unknown structural model of capital stock adjustment. It is argued by Chatelain *et al.* (2001) that long run coefficients can consist on the expectational and technology parameters, leading to biased results; hence these should be interpreted carefully. In this case literature suggests either to transform ARDL model into the error correction model (ECM) or to apply first differencing on the ARDL model (e.g. Mairesse *et al.*, 1999; Chirinko *et al.*, 1999). Since firm specific effects are supposed to impact the level of productivity and its growth rate, Chirinko *et al.* (1999) suggests of first differencing the ARDL model as a viable solution to deal with this issue<sup>8</sup>. First differencing the equation (3.5), utilizing the approximation<sup>9</sup>  $\log K_t - \log K_{t-1} = I_t/K_{t-1} - \delta$  and substituting the year specific productivity growth ( $\Delta \log A_t$ ) and firm specific effect productivity growth ( $\Delta \log TFP_i$ ) by time dummies  $\lambda_t$  and firm specific effects  $\eta_i$ , respectively, including a random term  $\varepsilon_{it}$  and subsuming the depreciation rate  $\delta$  into the firm specific effects yields the equation (3.6):

<sup>7</sup> This paper found lags of order three appropriate for all explanatory variables.

<sup>8</sup> See Chatelain and Tiomo (2001) for the discussion on difference ARDL and ECM.

<sup>9</sup>  $\Delta k_{it} = \log \left[ \frac{K_{it}}{K_{i,t-1}} \right] = \log \left[ 1 + \frac{\Delta K_{it}}{K_{i,t-1}} \right] \cong \frac{\Delta K_{it}}{K_{i,t-1}} \cong \frac{I_{it}}{K_{i,t-1}} - \delta$  where  $\Delta k_{it}$  represents net growth of capital stock and  $\delta$  implies the average depreciation rate.



$$\begin{aligned} \frac{I_{it}}{K_{i,t-1}} = & \omega_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \omega_2 \frac{I_{i,t-2}}{K_{i,t-3}} + \omega_3 \frac{I_{i,t-3}}{K_{i,t-4}} + \theta_0 \Delta y_{it} + \theta_1 \Delta y_{i,t-1} + \theta_2 \Delta y_{i,t-2} + \theta_3 \Delta y_{i,t-3} - \sigma_0 \Delta uc_{it} - \sigma_1 \Delta uc_{i,t-1} \\ & - \sigma_2 \Delta uc_{i,t-2} - \sigma_3 \Delta uc_{i,t-3} + \lambda_i + \eta_i + \varepsilon_{it} \end{aligned} \quad (3.6)$$

Cash flow plays a vital role in affecting the firms' investment as a source of internal funds. Thus, considering the importance of cash flow, equation (3.6) is augmented with the cash flow to previous year capital stock ratio:

$$\begin{aligned} \frac{I_{it}}{K_{i,t-1}} = & \omega_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \omega_2 \frac{I_{i,t-2}}{K_{i,t-3}} + \omega_3 \frac{I_{i,t-3}}{K_{i,t-4}} + \theta_0 \Delta y_{it} + \theta_1 \Delta y_{i,t-1} + \theta_2 \Delta y_{i,t-2} + \theta_3 \Delta y_{i,t-3} - \sigma_0 \Delta uc_{it} - \sigma_1 \Delta uc_{i,t-1} \\ & - \sigma_2 \Delta uc_{i,t-2} - \sigma_3 \Delta uc_{i,t-3} + \phi_0 \frac{CF_{it}}{K_{i,t-1}} + \phi_1 \frac{CF_{i,t-1}}{K_{i,t-2}} + \phi_2 \frac{CF_{i,t-2}}{K_{i,t-3}} + \phi_3 \frac{CF_{i,t-3}}{K_{i,t-4}} + \lambda_i + \eta_i + \varepsilon_{it} \end{aligned} \quad (3.7)$$

By using equation (3.7), long run elasticity of investment to capital stock ratio with respect to the user cost of capital growth  $\sigma = (\sigma_0 + \sigma_1 + \sigma_2 + \sigma_3)/(1 - \omega_1 - \omega_2 - \omega_3)$ , cash flow to capital stock ratio  $\phi = (\phi_0 + \phi_1 + \phi_2 + \phi_3)/(1 - \omega_1 - \omega_2 - \omega_3)$  and sales growth  $\theta = (\theta_0 + \theta_1 + \theta_2 + \theta_3)/(1 - \omega_1 - \omega_2 - \omega_3)$  can be obtained. Equation (3.7) states that investment spending is positively affected by the sales growth and cash flow to capital stock ratio while negatively influenced by the user cost of capital growth.

User cost of capital and cash flow can be used to explore the interest rate and broad credit channels of monetary policy transmission mechanism, respectively. Monetary policy alters the interest rate that in turn affects the user cost of capital. Contractionary monetary policy leads to the increase in the real long term interest rate. It in turn raises the cost of capital. The increased cost of capital discourages the investment and output (Mishkin, 1996). So, the traditional interest rate channel can be identified through the firm specific user cost of capital. There is heterogeneous response of small and large firms' investment to the user cost of capital since large firms have better access to external finance and have to bear low external finance premium than small firms. Thus, this study explores the differential response of firms' investment to the user cost of capital as well.

Monetary policy affects the firms' business fixed investment spending not only by the traditional interest rate channel but also by the broad credit channel. There exists asymmetric information between lenders and borrowers that creates a wedge between the cost of external finance and opportunity cost of internal financing. In other words, lenders charge the borrowers interest rate depending upon the borrowers' risk. In the presence of information asymmetries the agency

cost increases which in turn increases the external finance premium. External finance premium incorporates the cost of valuation, monitoring and collection by the lenders (Bernanke and Gertler, 1995). Bernanke *et al.* (1996) state the inverse relationship between the net worth and external finance premium. Monetary contraction due to rise in the nominal interest rate reduces the cash flow, the equity prices and value of collateral. Also, firms' sales declines and this decline is severe for the financially constrained firms (Bernanke and Gertler, 1995; Bernanke *et al.*, 1996). Decline in the borrower's net worth leads to the costly monitoring by the lender since borrower can default while agency cost increases due to the higher probability of auditing.

Broad credit channel of monetary transmission mechanism can be identified by using the cash flow. Since small firms face a greater wedge between the costs of external and internal generated funds due to the high agency cost arising from costly monitoring as compared to large firms, small firms are expected to be more sensitive to the cash flow. Thus, this study has used cash flow to capital stock ratio as an indicator of broad credit channel. Higher cash flow sensitivity in case of small firms will be regarded as an indication of broad credit channel.

To summarize, increase in the interest rate lead to the rise in the user cost of capital and deterioration of the firms' balance sheets and to identify the interest rate and broad credit channel, user cost of capital and cash flow can be used. Neo-classical investment model makes this task doable.

#### **4 Data, Variables' Construction and Methodology**

##### **a. Data and Sample Selection**

Data related to manufacturing sector has been obtained from the "Financial Statements Analysis of Companies (Non-Financial) listed at Karachi Stock Exchange" prepared by State Bank of Pakistan. Data period spans from 1974-2010 (37 Years). This study has utilized the data of 498 firms of manufacturing sector of Pakistan. To find out the heterogeneous impact of monetary policy on firms' investment, the sample is divided into the small and large firms on the base of total assets.

## b. Variables' Construction

User cost of capital growth, sales growth and cash flow to capital stock ratio are taken as explanatory variables while total assets are used to classify firms into small and large. Variables are constructed in the following fashion:

### i. Investment ( $I$ )

Business fixed investment spending for a specific firm  $i$  at a specific time period  $t$  broadly refers to the current period capital expenditures on property, plant, equipment and machinery (Karim, 2010). Investment is measured as the difference of current fixed assets at cost at time period  $t$  to previous year fixed assets at time period  $t-1$  plus depreciation.

$$I_{it} = K_{it} - K_{it-1} + D_{it}$$

Where  $I_{it}$  indicates the investment,  $K_{it}$  is current period fixed assets,  $K_{it-1}$  represents previous year fixed assets and  $D_{it}$  represents the annual depreciation measured in Pakistani Rupees with unit of account in million. Higher the investment, higher will be the capital formation that will increase the net worth and production capacity of the firm. Investment today determines the future productive potential. It has been calculated by using fixed assets at cost taken from the financial statement analysis of the companies.

### ii. Capital ( $K$ )

Capital stock is defined as the firm's fixed assets after excluding depreciation. Fixed assets include real estate, plant, equipment and machinery. Capital stock is calculated as the operating fixed assets at time period  $t$  excluding depreciation. Depreciation represents the wear and tear of the capital counted at annual basis.

$$K = \text{Operating Fixed Assets at Cost} - \text{Depreciated on}$$

It is an important determinant of firms' production. Firms produce goods and services by using labor and capital. Hence capital is one of the most important factors determining the productive capacity of the firms. Building up of capital determines economic activity and significantly impact the business cycles (Baddeley, 2003).

### iii. Cash Flow ( $CF$ )

Cash flow is defined as the profit after tax plus depreciation. Cash flow is measured as retention in business plus depreciation where retention in business is

defined as the net profit after tax less total amount of dividends. Cash flow is used here as an indicator of broad credit channel of monetary policy transmission mechanism. The sensitivity of the firms to cash flow is likely to be heterogeneous depending upon the firms' financial position. Cash flow indicates firms' financial health and balance sheet condition thus cash flow is an important factor to determine the borrowing capacity of the firms and external finance premium. Fazzari *et al.* (1988) argue that reduction in firms' cash flow reduces investment sharply. They explored the strong positive correlation between borrowing and cash flow thus indicating the importance of cash flow. They discovered cash flow as an important determinant of firms' investment spending and found the sensitivity of cash flow with investment spending present even for those firms that have high level of cash flow then investment needs. The cash flow positively affects the firms' investment as documented by Chatelain *et al.* (2001), Karim (2010) and Angelopoulou and Gibson (2007).

### *CF = Retention in Business + Depreciation*

#### **iv. Sales (*Y*)**

Sales represent the revenue generated from the sale of goods and services to the customers. As per Baddeley (2003), the accelerator theory of investment claims that there is positive association between sales growth and investment. Accelerator theory postulates that firms build up capital stock if they expect output to rise. Sales act as an indicator of expected demand for goods and services and future outlook of the firms. Thus increase in sales produce a signal of higher expected future demand which in turn stimulates firms to form capital. It is found out by many studies like Karim (2010), Bryson (2009), Kalckreuth (2001) and Lunnemann and Matha (2001) that sales is an important determinant of firms' investment.

#### **v. User Cost of Capital (*UC*)**

Following Bryson (2009) who used a slightly modified version of user cost of capital on the footsteps of Chatelain *et al.* (2003), and as discussed by Lunnemann and Matha (2001), the user cost of capital is measured as the weighted sum of the cost of debt and the equity. Both of which are weighted by their respective share of firms' total liabilities.

$$UC_{it} = AI_{it} \left( \frac{DB_{it}}{DB_{it} + E_{it}} \right) + LD_{it} \left( \frac{E_{it}}{DB_{it} + E_{it}} \right)$$

Where  $AI_{it}$  is the apparent interest rate calculated as the interest expenses over gross debt calculated by utilizing data from the financial statement analysis of companies of manufacturing sector of Pakistan. Here  $LD_t$  indicates the long term debt rate used as the proxy for the opportunity cost of equity. This study uses the government bond yield as the long term debt rate taken from the International Financial Statistics (IFS). Here  $E_{it}$  refers to the book value of equity measured as the total shareholders' equity while  $DB_{it}$  indicates the book value of debt. User cost of capital negatively affects the firms' investment as documented by Chatelain *et al.* (2003), Chirinko *et al.* (1999), Chatelain and Tiomo (2001) and Karim (2010).

#### vi. Total Assets

Total assets include current assets plus non-current assets. This variable has been used to split the firms into small and large firms on the footsteps of, among others, Chatelain *et al.* (2001), Angelopoulou and Gibson (2007) and Shabbir (2012). The rationale behind splitting the sample into small and large firms is to figure out the heterogeneous response of firms' investment to the user cost of capital growth, sales growth and cash flow to capital stock ratio. Following Karim (2010), in order to divide the firms into small and large, the average of total assets for each firm is calculated. In the next step, the grand median of the averages is calculated to classify firms into large and small firms. A firm is classified as small if its mean assets are less than the grand median while large if its mean assets are greater than the grand median assets.

#### c. Methodology

This study adopts the Generalized Method of Moments (GMM) two step estimation procedure in dynamic panel data models. Inclusion of the lagged dependent variable among the regressors and individual effects results in the problem of endogeneity. These issues are addressed by using GMM two step estimation method that potentially removes the problem of endogeneity.

GMM estimation method works on the notion to choose the estimate of unknown parameters vector  $\theta$ , the value of  $\theta$  in such a way that estimated moments gets equal to their expected value. In the case of a moment condition like "explanatory variables should be uncorrelated with the error term", parameters estimates are chosen in such a way that estimated correlation between the regressors and error term gets equal to zero. If there are  $K$  unknown parameters and  $L$  moment conditions and  $L = K$ , then parameters that causes the estimated moment condition equal to zero can be found by solving this set of equations. This method is known as method of moments but in case of more

moment conditions then parameters to be estimated  $L > K$ , it is not possible to find out parameters estimates that equates all moment conditions equal to zero due to more equations than unknowns. To solve this problem, the parameters are chosen in such a way that minimizes the violation of the moment conditions. So, GMM minimizes weighted sum of squares of all the estimated moments (Kennedy, 2008).

Following Baltagi (2002), an autoregressive model with no regressors is specified as below:

$$y_{it} = \delta y_{it-1} + \mu_{it} \quad i = 1, \dots, N; t = 1, \dots, T \quad (4.1)$$

Where  $\mu_{it} = \mu_i + v_{it}$ . Both the terms  $\mu_i$  and  $v_{it}$  are assumed to have zero mean and constant variance. Here  $\mu_i$  refers to the unobservable individual specific effect while  $v_{it}$  indicates the remainder disturbance. Equation (4.1) is first differenced to eliminate individual specific effects (in case of our analysis firm specific effects).

$$y_{it} - y_{it-1} = \delta(y_{it-1} - y_{it-2}) + (v_{it} - v_{it-1}) \quad (4.2)$$

Where differenced disturbance  $(v_{it} - v_{it-1})$  is moving average of order one  $MA(1)$  process and have unit root. For the period  $t = 3$ , the relationship becomes:

$$y_{i3} - y_{i2} = \delta(y_{i2} - y_{i1}) + (v_{i3} - v_{i2})$$

In the above equation  $y_{i1}$  can be used as instrument since it has high correlation with  $(y_{i2} - y_{i1})$  but uncorrelated with differenced disturbance  $(v_{i3} - v_{i2})$ . For the time period  $t = 4$  the relation is given below:

$$y_{i4} - y_{i3} = \delta(y_{i3} - y_{i2}) + (v_{i4} - v_{i3})$$

In the above equation  $y_{i2}$  and  $y_{i1}$  can be used as instruments. By adding additional valid instrument each period, one gets a set of valid instruments. This instrumental variable procedure still does not account for the differenced error term in equation (4.2). In fact the variance-covariance matrix of the error term takes the following form:

$$E(\Delta v_i \Delta v_i') = \sigma^2_v G$$

Where  $\Delta v_i' = (v_{i3} - v_{i2}, \dots, v_{iT} - v_{i,T-1})$  and  $G$  is  $(T-2) \times (T-2)$  matrix of lags of disturbance:

$$G = \begin{pmatrix} 2 & -1 & 0 & \dots & 0 & 0 & 0 \\ -1 & 2 & -1 & \dots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \dots & -1 & 2 & -1 \\ 0 & 0 & 0 & \dots & 0 & -1 & 2 \end{pmatrix}$$

Since  $\Delta v_i$  is MA(1) with unit root, matrix of the instruments is then defined as:

$$W = \left[ W_1', \dots, W_N' \right]'$$

Since the instruments are orthogonal to the error by construction, the moments conditions are described as:

$$E\left( W_i' \Delta v_i \right) = 0$$

Premultiplying the equation (4.2) in vector form by the  $W'$  yields

$$W' \Delta y = W' (\Delta y_{-1}) \delta + W' \Delta v$$

By applying the Generalized Least Square (GLS) on the above equation, Arellano and Bond one step consistent estimator is obtained:

$$\hat{\delta}_1 = \left[ (\Delta y_{-1})' W (W' (I_N \otimes G) W)^{-1} W' (\Delta y_{-1}) \right]^{-1} \times \\ \left[ (\Delta y_{-1})' W (W' (I_N \otimes G) W)^{-1} W' (\Delta y) \right]$$

Where

$$W' (I_N \otimes G) W = \sum_{i=1}^N W_i' G W_i$$

is replaced by

$$V_N = \sum_{i=1}^N W_i' (\Delta v_i) (\Delta v_i)' W_i$$

This GMM estimator requires no knowledge concerning the initial conditions or the distributions of  $\nu_1$  and  $\mu_i$ . To operationalize this estimator,  $\Delta v$  is replaced by differenced residuals obtained from the one step GMM estimator that yield the GMM two step estimators.

$$\hat{\delta}_2 = \left[ (\Delta y_{-1})' W \hat{V}_N^{-1} W' (\Delta y_{-1}) \right]^{-1} \left[ (\Delta y_{-1})' W \hat{V}_N^{-1} W' (\Delta y) \right]$$

To deal with the issues arising from the dynamic panel data model, GMM estimation technique is considered appropriate. Hence this study adopts GMM two step estimation technique to empirically test the data.

## 5 Results and Discussion

This paper empirically analyzes the interest rate and broad credit channels of monetary policy transmission mechanism in this section. Firstly, neo-classical investment model is estimated for the full sample. Secondly, firms are divided into small and large firms to explore the heterogeneous effects of monetary policy on firms' investment. Before estimating the dynamic panel data model, this study tests for the detection of unit root and multicollinearity problem.

Since panel data may have unit root problem due to its nature, it is necessary to evaluate the data for the detection of unit root before further analysis. There are many panel unit root tests like Levin, Lin and Chu, Breitung, Im, Pesaran and Shin, Fisher –ADF (Augmented Dickey Fuller), Fisher –PP (Philip- Perron) and Hadri. Each test can present different and contradictory results. Im, Pesaran and Shin, Fisher –ADF and Fisher –PP tests treat unit root heterogeneous across all cross sections. In other words these tests suppose individual unit root for each cross sections while Levin, Lin and Chu, Breitung and Hadri panel unit root test consider the unit root homogenous across all cross sections. The results of the unit root tests are presented below in Table 1 of the **Annexure**. All the variables used in this study don't face the problem of the unit root. Moreover, both the tests lead to the same conclusion that weights to the finding that variables under study are stationary.

High correlation among the variables can lead to the misleading results. Correlation matrix is one approach widely used in the literature to detect the problem of multicollinearity. Table 2 reported in **Annexure** shows that all the variables used by this study have correlation coefficient less than 0.50 in absolute terms. It indicates that the variables used in this study don't face the problem of multicollinearity. All explanatory variables have expected signs.



### a. Full Sample Results (1974-2010)

Under the full sample results all the firms are considered in the estimation process to gauge the impact of explanatory variables on the firms' investment without considering firms' sizes. Full sample covers 498 firms of the manufacturing sector and data period spans from 1974-2010. The results are presented in table 3 of the **Annexure**. Results found by this study are in line with the findings of the literature. The dynamics of the model are captured by the lagged dependent variables. All the lags of dependent variable are found to be highly significant. The lagged dependent variable have negative signs, indicating that there is no spillover effect of investment spending to the next years' investment. Negative signs on the lagged dependent variables are indicative of the less smooth investment process (Butzen *et al.*, 2001). The results of this paper regarding the lagged dependent variables are consistent with the findings of Chatelain *et al.* (2001) and Bryson (2009).

As sales accelerator theory suggests, sales growth expands the firms' business fixed investment spending. This study explores that the sales growth positively and significantly affects the firms' investment spending. The contemporaneous effect of sales growth on investment spending is strongest as compared to all its lags. Results in case of sales growth reveal sort of a cyclical pattern. At lags one and three the magnitude of sales growth drops as compared to the contemporaneous effects and lag two, implying that the effect of sales growth on investment spending is higher after the gap of one year. Results point out that that a strong sales accelerator mechanism is operative in Pakistan. These results are consistent with the findings of Karim (2010), Bryson (2009), Kalckreuth (2001) and Lunnemann and Matha (2001).

This paper is particularly interested in the user cost of capital to explore the significance of the interest rate channel. User cost of capital growth is found to be highly significant in negatively affecting the firms' investment spending. Results highlights the relevance of the interest rate channel in Pakistan and implies that the interest rate is quite an influential factor in affecting the firms' investment decision through the user cost of capital. This is due to the reason that manufacturing firms in Pakistan are dependent on banks for their financing needs. These findings are in line with those of Karim (2010), Kalckreuth (2001), Bryson (2009) and Chatelain *et al.* (2001).

The neo-classical investment model is augmented with cash flow to capital stock ratio in order to gauge the impact of liquidity on firms' investment spending. Cash flow is discovered to be significantly affecting the firms' investment spending.

First lag of the cash flow to capital stock ratio is explored to be negative<sup>10</sup>. The overall positive effect of cash flow to capital ratio on firms' investment spending indicates that manufacturing firms in Pakistan are financially constrained due to which cash flow plays an important role in their investment spending. These results are supported by the findings of Karim (2010), Kalckreuth (2001), Chatelain and Tiomo (2001) and Chatelain *et al.* (2001).

To summarize, results of full sample are as expected and in line with literature on the subject. A strong interest rate channel explored to be operative in Pakistan as indicated by strong impact of user cost of capital growth on firms' investment. Firms' investment is explored to be positively affected by the sales and cash flow.

#### **b. Firms' Size and Monetary Policy**

Each firm has different characteristics. Some firms are large while some firms are small. The tendency of small and large firms to respond to the economic shocks differs substantially. Some firms are "too big to fail" due to their capacity to absorb the shocks. Thus, it is important to investigate that whether monetary policy has asymmetric effects on the firms or not.

The existence of broad credit channel is identified by analyzing the differential role of cash flow for the small and large firms. Monetary tightening leads to the fall in net worth of borrowers, leading to rise in external finance premium<sup>11</sup>. Since small firms face greater agency problems relative to large firms, small firms are expected to respond more strongly to the cash flow than large firms in order to finance their investment. So, if the small firms, usually financially constrained, are discovered to be more responsive to the cash flow in comparison with large firms, it is considered as an indicator of relevance of broad credit channel<sup>12</sup>.

This study follows the method of Karim (2010) and Bryson (2009) to divide the firms into small and large on the base of total assets. Out of total 498 firms, 248 firms are large while 250 firms are small. The results of large and small firms' analysis are presented in table 4 and table 5, respectively of **Annexure**.

The dynamics of small and large firms indicates that for both types of the firms, investment is not a smooth mechanism. Butzen *et al.* (2001) argue that positive sign of lagged dependent variable represents smoother investment pattern and postulated that large firms exhibit smoother investment process as compared with

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10 To find the explanation of negative cash flow-investment sensitivity, refer to the Butzen *et al.* (2001) and Bhagat *et al.* (2005).

11 See Bernanke and Gertler (1989) for further explanation.

12 See Chatelain *et al.* (2003) for reference.

small firms. The negative signs of the lagged dependent variables are indicative of the notion that for both small and large firms, investment is not a smooth process as far as results of this study are concerned.

The results confirm the existence of a strong sales accelerator mechanism in Pakistan operating for both the small and large firms. This study explores the effects of sales growth on investment spending more profound for small firms as compared to large firms. It is not surprising since the small firms face problem in getting external finance due to severe agency problem in comparison with large firms. These results are supported by the findings of Karim (2010) and Lunnemann and Matha (2001).

The effect of user cost of capital growth on investment spending is discovered to be comparatively higher for large firms as compared to small firms. Results imply that large firms base their investment decisions on external finance because of having easy access to borrowing from the banks and the capital market. Results also indicate that monetary policy exerts heterogeneous effects, different for different sized firms. These results are confirmed by the findings of Mojon *et al.* (2001) and Gaiotti and Generale (2001).

Primary purpose to divide the firms into large and small is to investigate the existence of a broad credit channel in Pakistan. Effect of cash flow on investment spending is comparatively higher for small firms as compared to large firms. Results imply that the small firms in Pakistan are financially constrained and resultantly are more affected by the monetary tightening than large firms. Small firms, due to higher external finance premium as compared to large firms, heavily rely on internal generated funds for their investment needs. Results confirm that the effects of monetary policy are heterogeneous and a strong broad credit channel is operative in Pakistan. These results are in line with the findings of Karim (2010), Valderrama (2001), Wesche (2000), Bryson (2009) and Gaiotti and Generale (2001).

To summarize, on the base of above findings a strong broad credit channel is explored in Pakistan. Small firms' investment is more responsive to the cash flow than large firms indicating that small firms are affected more strongly by the monetary contraction implying heterogeneous effects of monetary policy. Effects of sales growth explored to be greater for the small firms while large firms' investment explored to be more responsive to the user cost of capital growth than the small firms.

## 6 Conclusions

This study explores the significance of interest rate and broad credit channels in Pakistan using disaggregated firm level data of manufacturing sector for the period 1974-2010. Neo-classical investment model is adopted for this purpose. The analysis proceeds in two steps. Firstly, this study analyses the full sample. Secondly, sample is divided into small and large firms in order to figure out the heterogeneous effects of monetary policy.

The analysis of full sample suggests that the firms' investment is negatively affected by the user cost of capital growth while positively influenced by cash flow to capital stock ratio and sales growth. The results are indicative of the relevance of a significant interest rate channel and also imply that the sales accelerator mechanism is operative in Pakistan.

Analysis of small and large firms shows that remarked differences exists in small and large firms' investment behavior. The effects of sales growth are explored to be more profound for small firms as compared to large firms. It implies that small firms' investment decisions are strongly influenced by sales growth. On the other hand, large firms' investment is found to be more sensitive to user cost of capital growth in comparison with small firms due to the large firms' greater access to bank borrowing and other sources of external finance. Small firms' investment is discovered to be more sensitive to the cash flow than large firms. This finding supports the relevance of the broad credit channel in Pakistan. Results confirm that the monetary policy exerts heterogeneous effects.

On the base of above conclusions, this paper suggests that the monetary authority can stabilize the investment by changing the interest rate. Since monetary policy produces heterogeneous effects, monetary authority is recommended to take into account the financial conditions of firms in formulation of monetary policy.

## References

- Abel, Andrew B., Ben S. Bernanke, and Dean Croushore (2011). *Macroeconomics*. 7<sup>th</sup> Edition, Pearson, Inc., pp. 120-129
- Agha, Asif Idrees, Noor Ahmed, Hastam Shah, and Yasir Ali Mubarak (2005). Transmission Mechanism of Monetary Policy in Pakistan. *SBP Research Bulletin*, Vol. 1(1): 1-23
- Agung, Juda (2000). Financial Constraints, Firms' Investments and the Channels of Monetary Policy in Indonesia. *Applied Economics*, Vol. 32: 1637-1646

- Alam, Tanseem and Muhammad Waheed (2006). Sectoral Effects of Monetary Policy: Evidence from Pakistan. *The Pakistan Development Review*, Vol. 9(4): 1103-1115
- Angelopoulou, Eleni and Heather D. Gibson (2007). *The Balance Sheet Channel of Monetary Policy Transmission: Evidence from the UK*. Bank of Greece, Working Paper 53 <<http://www.bankofgreece.gr/BogEkdoseis/Paper200753.pdf>>
- Ashcraft, Adam B. (2006). New Evidence on the Lending Channel. *Journal of Money, Credit and Banking*, Vol. 38(3): 751-775
- Audretsch, David B. and Julie Ann Elston (1994). *Does Firm Size Matter? Evidence on the Impact of Liquidity Constraint on Firm Investment Behavior in Germany*. CERP, Discussion Paper 1072 <<http://www.cepr.org/pubs/dps/DP1072.asp>>
- Badia, Marialuz Moreno and Veerle Slootmaekers (2009). *The Missing Link between Financial Constraints and Productivity*. International Monetary Fund, Working Paper 09/72 <<http://www.imf.org/external/pubs/cat/longres.aspx?sk=22823.0>>
- Baddeley, M.C. (2003). *Investment Theories and Analysis*. 1<sup>st</sup> Edition, Palgrave Macmillan, pp. 5-13
- Baltagi, Badi H. (2002). *Econometric Analysis of Panel Data*. 2nd Edition, John Wiley & Sons, Ltd., pp. 129-158
- Bernanke, M.S. and Mark Gertler (1989). Agency Costs, Net worth and Business Fluctuations. *American Economic Review*, Vol. 79(1): 14-31
- Bernanke, Ben S. and Mark Gertler (1995). Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspective*, Vol. 9: 27-48
- Bernanke, B., M. Gertler and S. Gilchrist (1996). The Financial Accelerator and Flight to Quality. *The Review of Economics and Statistics*, Vol. 78(1): 1-15
- Bernanke, Ben S., Mark Gertler and Simon Gilchrist (1999). The Financial Accelerator in a Quantitative Business Cycle Framework. In J.B. Taylor (Ed.), *Handbook of Macroeconomics* (pp. 1340-1393). Elsevier Science B.V
- Bernanke, Ben S. and Alan S. Blinder (1988). Credit, Money and Aggregate Demand. *The American Economic Review*, Vol. 78(2): 435-439
- Benito, Andrew (2005). Financial Pressure, Monetary Policy Effects and Inventories: Firm Level Evidence from a Market Based and a Bank Based Financial System. *Economica*, Vol. 72(286): 201-224
- Bhagat, Sanjai, Nathalie Moyen and Inchul Shah (2005). Investment and Internal Funds of Distressed Firms. *Journal of Corporate Finance*, Vol. 11 (3): 449-472
- Bond, Stephen and Costas Meghir (1994). Dynamic Investment Models and the Firm's Financial policy. *The Review of Economic Studies*, Vol. 61(2): 197-222
- Brigden, Andrew and Paul Mizen (1999). *Money, Credit and Investment in UK Corporate Sector*. Bank of England, Working Paper 100 <<http://www.bankofengland.co.uk/publications/Documents/workingpapers/wp100.pdf>>
- Bryson, Taffi (2009). *Firm Investment and Monetary Transmission in Jamaica: An*

*Investigation of the Balance Sheet Channel with Micro-Level Firm Data*. Bank of Jamaica, Working Paper <[http://boj.org.jm/uploads/pdf/papers\\_pamphlets/papers\\_pamphlets\\_Firm\\_investment\\_and\\_Monetary\\_Transmission\\_in\\_Jamaica\\_An\\_Investigation\\_of\\_the\\_Balance\\_Sheet\\_Channel\\_with\\_Micro-level\\_Firm\\_Data.pdf](http://boj.org.jm/uploads/pdf/papers_pamphlets/papers_pamphlets_Firm_investment_and_Monetary_Transmission_in_Jamaica_An_Investigation_of_the_Balance_Sheet_Channel_with_Micro-level_Firm_Data.pdf)>

Brissimis, Sophocles N., Nicos C. Kamberoglou and George T. Simigiannis (2001). *Is There a Bank Lending Channel of Monetary Policy in Greece? Evidence from Bank Level Data*. European Central Bank, Working Paper 104 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp104.pdf>>

Butzen, Paul, Catherine Fuss and Philip Vermeulen (2001). *The Interest Rate and Credit Channels in Belgium: An Investigation with Micro-Level Firm Data*. European Central Bank, Working Paper 107 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp107.pdf>>

Carpenter, Robert E. and Alessandra Guariglia (2008). Cash flow, Investment, and Investment Opportunities: New Tests using UK Panel Data. *Journal of Banking and Finance*, Vol. 32(9): 1894-1906

Chatelain, J.B., A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen (2001). *Firm Investment and Monetary Policy Transmission in the Euro Area*. European Central Bank, Working Paper 112 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp112.pdf>>

Chatelain, Jean Bernard, Michael Ehrmann, Andrea Generale, Jorge Martinez Pages, Philip Vermeulen and Andreas Worms (2003). Monetary Policy Transmission in the Euro Area: New Evidence from Micro Data on Firms and Banks. *Journal of European Economic Association*, Vol. 1(2-3): 731-742

Chatelain, Jean Bernard and Andre Tiomo (2001). *Investment, the Cost of Capital, and Monetary Policy in the Nineties in France: A Panel Data Investigation*. European Central Bank, Working Paper 106 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp106.pdf>>

Chatelain, Jean Bernard, Andrea Generale, Ignacio Hernando, Ulf von Kalckreuth and Philip Vermeulen (2003). New Findings on Firm Investment and Monetary Policy Transmission in the Euro Area. *Oxford Review of Economic Policy*, Vol. 19 (3): 1-11.

Choudhary, Ali, Saima Naeem, Abdul Faheem, Nadem Hanif and Farooq Pasha (2011). *Formal Sector Price Discovers: Preliminary Results from a Developing Country*. State Bank of Pakistan, Working Paper 42 <<http://www.sbp.org.pk/publications/wpapers/2011/wp42.pdf>>

Choudhary, Ali, Amjad Ali, Shah Hussain and Vasco J. Gabriel. *Bank Lending and Monetary Shocks: Evidence from a Developing Economy*. State Bank of Pakistan, Working Paper 45 <<http://www.sbp.org.pk/publications/wpapers/2012/wp45.pdf>>

Chirinko, Robert S., Steven M. Fazzari and Andrew P. Meyer (1999). How Responsive is Business Capital Formation to its User Cost? An Exploration with Micro Data. *Journal of Public Economics*, Vol. 74(1): 53-80.

Christiano, Lawrence J., Martin Eichenbaum and Charles Evans (1996). The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds. *The Review of Economics and Statistics*, Vol. 78(1):16-34

- Dedola, Luca and Francesco Lippi (2000). *The Monetary Transmission Mechanism: Evidence from the Industries of Five OECD Countries*. Banca d'Italia, Discussion Paper 389 <[http://www.bancaditalia.it/pubblicazioni/econo/temidi/td00/td389\\_00;internal&action=\\_setlanguage.action?LANGUAGE=en](http://www.bancaditalia.it/pubblicazioni/econo/temidi/td00/td389_00;internal&action=_setlanguage.action?LANGUAGE=en)>
- Ehrmann, Michael (2004). *Firm Size and Monetary Policy Transmission- Evidence from German Business Survey Data*. CESifo, Working Paper 1201 <<http://ssrn.com/abstract=355581>>
- Eisner, R. and M. Nadari (1968). Investment Behavior and Neo-classical Theory. *The Review of Economics and Statistics*, Vol. 50: 369-382
- Engel, Dirk and Torge Middendorf (2009). Investment, Internal Funds and Public Banking in Germany. *Journal of Banking and Finance*, Vol. 33(11): 2132-2139
- Fazzari, Steven M., R. Glenn Hubbard and Bruce C. Petersen (1988). Financing Constraints and Corporate Investment. *Brookings Papers on Economic Activity*, Vol. 1: 141-195
- Fisher, Irving (1933). The Debt-Deflation Theory of Great Depression. *Econometrica*, Vol. 1: 337-357
- Gaiotti, Eugenio and Andrea Generale (2001). *Does Monetary Policy have Asymmetric Effects? A Look at the Investment Decisions of Italian Firms*, Banca D'Italia, Working Paper 429 <[http://www.bancaditalia.it/pubblicazioni/econo/temidi/td01/td429\\_01/td429/tema\\_429\\_01.pdf](http://www.bancaditalia.it/pubblicazioni/econo/temidi/td01/td429_01/td429/tema_429_01.pdf)>
- Gertler, Mark and Simon Gilchrist (1994). Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms. *The Quarterly Journal of Economics*, Vol. 109: 309-340
- Ghosh, Saibal and Saurabh Ghosh. (2006). Impact of Liquidity Constraints on Firms' Investment Decisions. *Economia Internazionale*. Retrieved June 18, 2013, from <http://ideas.repec.org/p/pramprapa/17181.html>
- Gonzalez, Jose E. Gomez and Paola Morales Acevedo (2009). *Bank Lending Channel of Monetary Policy: Evidence for Colombia, Using a Firms' Panel Data*. Banco De La Republica Colombia, Working Paper 545 <<http://www.banrep.gov.co/docum/ftp/borra545.pdf>>
- Guariglia, Alessandra and Simona Mateut (2006). Credit Channel, Trade Credit Channel and Inventory Investment: Evidence from a Panel of UK Firms. *Journal of Banking and Finance*, Vol. 30(10): 2835-2856
- Hassan, Rubina (2011). The Reserve Equation and the Analytics of Pakistan's Monetary Policy. *The Lahore Journal of Economics*, Vol. 16 (1): 111-142
- Hussein, Shah, Amna Saeed and Amer Hassan (2011). *The Financial Accelerator: An Emerging Market Story*. State Bank of Pakistan, Working Paper 41 <<http://www.sbp.org.pk/publications/wpapers/2011/wp41.pdf>>
- Husain, S. Aijaz (1994). *History of the State Bank of Pakistan (1961-1977)*. Karachi, State Bank of Pakistan, pp. 57-102
- Hussain, Karar (2009). *Monetary Transmission Channels of Pakistan and Their Impact on Real GDP and Inflation*. Centre for International Development, Working Paper 41

- <[http://www.hks.harvard.edu/var/ezp\\_site/storage/fckeditor/file/pdfs/centers-programs/centers/cid/publications/student-fellows/wp/041.pdf](http://www.hks.harvard.edu/var/ezp_site/storage/fckeditor/file/pdfs/centers-programs/centers/cid/publications/student-fellows/wp/041.pdf)>
- Hu, Charles. X. (1999). Leverage, Monetary Policy and Firm Investment. *FRBSF Economic Review*, Vol. 2: 32-39
- Jimenez, Gabriel, Steven Ongene, Jose Luis Peydro and Jesus Saurina (2008). *Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?* Banco De Espana, Working Paper 0833 <<http://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSerias/D ocumentosTrabajo/08/Fic/dt0833e.pdf>>
- Jorgenson, Dale W. (1963). Capital Theory and Investment Behavior. *The American Economic Review*, Vol. 53 (2): 247-259
- Jorgenson, Dale W. (1967). *The Theory of Investment Behavior*. Proceedings of Universities-National Bureau Conference Series 18, New York, 129-155
- Janjua, M. Ashraf (2003). *History of the State Bank of Pakistan (1977-2008)*. Karachi, State Bank of Pakistan, pp. 145-223
- Karim, Zulkefly Abdul. (2010). Monetary Policy and Firms' Investment in Malaysia: A Panel Evidence. *IJUM Journal of Economics and Management*, Vol. 18 (2): 221-253
- Karim, Zulkefly Abdul. (2012). Monetary Policy Effects on Investment Spending: A Firm-Level Study of Malaysia. *Studies in Economics and Finance*, Vol. 29(4): 268-286
- Kalckreuth, Ulf Von (2001). *Monetary Transmission in Germany: New Perspectives on Financial Constraints and Investment Spending*. Economic Research Centre, Deutsche Bundesbank, Discussion Paper 19/01 <[http://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Discussion\\_Paper\\_1/2001/2001\\_12\\_29\\_dkp\\_19.pdf?\\_\\_blob=publicationFile](http://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Discussion_Paper_1/2001/2001_12_29_dkp_19.pdf?__blob=publicationFile)>
- Kashyap, Anil. K., Jermy C. Stein and David W. Wilcox (1993). Monetary Policy and Credit Conditions: Evidence from Composition of External Finance. *The American Economic Review*, Vol. 83(1): 78-98
- Kashyap, Anil. K., Jermy C. Stein and David W. Wilcox (1996). Monetary Policy and Credit Conditions: Evidence from Composition of External Finance: Reply. *The American Economic Review*, Vol. 86(1): 310-314
- Kashyap, Anil K. and Jeremy C. Stein (2000). What Do a Million Observations on Banks Say About the Transmission of Monetary Policy? *The American Economic Review*, Vol. 90(3): 407-428
- Kennedy, Peter (2008). *A Guide to Econometrics*. 6<sup>th</sup> Edition, BlackWell Publishing, pp.122-123
- Khan, Sajawal and Abdul Qayyum (2007). *Measure of Monetary Policy Stance: The Case of Pakistan*. Pakistan Institute of Development Economics, Working Paper 39 <<http://www.pide.org.pk/pdf/Working%20Paper/WorkingPaper-39.pdf>>



- Kohler, Marion, Erik Britton and Tony Yates (2000). *Trade Credit and the Monetary Transmission Mechanism*. Bank of England, Working Paper 115 <<http://www.bankofengland.co.uk/publications/Documents/workingpapers/wp115.pdf>>
- Lunnemann, Patrick and Thomas Matha (2001). *Monetary Transmission: Empirical Evidence from Luxembourg Firm Level Data*. European Central Bank, Working Paper 111 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp111.pdf>>
- Mahmood, Asif (2010). *Monetary and Fiscal Policy Coordination in Pakistan: Current Practices and Potential Reforms*. Monetary Policy Department, State Bank of Pakistan, Policy Note
- Mairesse, Jacques, Bronwyn H. Hall and Benoit Mulkey (1999). Firm-Level Investment in France and the United States: An Exploration of What We have Learned in Twenty Years. *Annals of Economics and Statistics/ Annales d'Economie et de Statistique*, Vol. 55/56: 27-67
- Malik, Wasim Shahid and Musleh-ud Din (2008). *Monetary Policy Transparency in Pakistan: An Independent Analysis*. Pakistan Institute of Development Economics, Working Paper 44 <<http://www.pide.org.pk/pdf/Working%20Paper/WorkingPaper-44.pdf>>
- Mateut, Simona, Spiros Bougheas and Paul Mizen (2002). *Trade Credit, Bank Lending and Monetary Policy Transmission*. European University Institute, Working Paper 2003/2 <<http://cadmus.eui.eu/handle/1814/802?show=full>>
- Meltzer, Allan H. (1960). Mercantile Credit, Monetary Policy and Size of Firms. *The Review of Economics and Statistics*, Vol. 42(4): 429-437
- Mishkin, Frederic S. (1996). The Channels of Monetary Transmission: Lessons for Monetary Policy. NBER, Working Paper 5464 <<http://www.nber.org/papers/w5464.pdf>>
- Mojon, Benoit, Frank Smets and Philip Vermeulen (2001). *Investment and Monetary Policy in the Euro Area*. European Central Bank, Working Paper 78 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp078.pdf>>
- Morgan, Donald P. (1998). The Credit Effects of Monetary Policy: Evidence Using Loan Commitments. *Journal of Money, Credit and Banking*, Vol. 30(1):102-118
- Munir, Kashif and Abdul Qayyum (2012). *Measuring the Effects of Monetary Policy in Pakistan: A Factor Augmented Vector Autoregressive Approach*. Retrieved March 13, 2013, from <http://www.ideas.repec.org/p/pramprapa/35976.html>
- Oliner, Stephen, D. and Glenn D. Rudebusch (1996). Monetary Policy and Credit Conditions: Evidence from Composition of External Finance: Comment. *The American Economic Review*, Vol. 86(1): 300-309
- Nagahata, T., and T. Sekine (2005). Firm Investment, Monetary Transmission and Balance Sheet Problems in Japan: An Investigation Using Micro Data. *Japan and World Economy*, Vol. 17(3): 345-369
- Nilsen, Jeffrey H. (2002). Trade Credit and the Bank Lending Channel. *Journal of Money, Credit and Banking*, Vol. 34(1): 226-253

- Pakistan, Government of (2012). Economic Survey 2012-2013. Economic Adviser's Wing, Finance Division Islamabad.
- Pakistan, State Bank of (2005). *Implication of liberalizing Trade and investment with India*. Research and Economic policy Department, State Bank of Pakistan <<http://www.sbp.org.pk/publications/pak-india-trade>>
- Qamar, Abid, Fida Hussain and Amin Lodhi (2009). *Monetary Policy Frameworks and Practices*. Monetary Policy Department, State Bank of Pakistan, Policy Note
- Qamar, Abid (2010). *Communication of Monetary Policy*. Monetary Policy Department, State Bank of Pakistan, Policy Note
- Romer, Christina D. and David H. Romer (1990). New Evidence on the Monetary Transmission Mechanism. *Brookings Paper on Economic Activity*. Vol. 21(1): 149-214
- Rungsomboon, Suvadee (2005). Deterioration of Firm Balance Sheet and Investment Behavior: Evidence from Panel Data on Thai Firms. *Asian Economic Journal*, Vol. 19(3): 335-356
- Shabbir, Safia (2012). *Monetary Transmission in Pakistan: The Balance Sheet Channel*. State Bank of Pakistan, Working Paper 49 <<http://www.sbp.org.pk/publications/wpapers/2012/wp49.pdf>>
- Shabbir, Safia (2013). *Implications of Monetary Policy for Corporate Sector and Economic Growth in Pakistan*. State Bank of Pakistan, Working Paper 61 <<http://www.sbp.org.pk/publications/wpapers/2013/wp61.pdf>>
- Valderrama, Maria (2001). *Credit Channel and Investment Behavior in Austria: A Micro Econometric Approach*. European Central Bank, Working Paper 108 <<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp108.pdf>>
- Wesche, Katrin (2000). Is there a Credit Channel in Austria? The Impact of Monetary Policy on Firms' Investment Decisions. Oesterreichische Nationalbank, Working Paper 41. <[http://www.oenb.at/de/img/wp41\\_tcm14-6119.pdf](http://www.oenb.at/de/img/wp41_tcm14-6119.pdf)>
- Zaidi, S. Akbar (1999). *Issues in Pakistan's Economy*. 1<sup>st</sup> Edition, Oxford University Press, pp.283-309
- Zhang, Ning (2012). Research on the Effects of Monetary Policy Shocks: An Empirical Analysis based on VAR Model. *Journal of Comparative Literature and Culture*, Vol.1 (3): 59-66

## Annexure

Table 1

## Panel Unit Root Tests

Variables	LLC Test Stat	p – value	IPS Test Stat	p - value	Conclusion
$I_{it}/K_{it-1}$	-483.809	0.0000	-91.2917	0.0000	Stationary
$CF_{it}/K_{it-1}$	-39.7299	0.0000	-37.3072	0.0000	Stationary
$\Delta \log UC_{it}$	-74.1911	0.0000	-82.7688	0.0000	Stationary
$\Delta \log Sale_{it}$	-97.8950	0.0000	-88.0733	0.0000	Stationary

Notes:

- LLC denotes the Levin, Lin and Chu panel unit root test while IPS is the Im, Pesaran and Shin panel unit root test.
- Investment ratio, cash flow to capital stock ratio, user cost of capital growth and sales growth are denoted by the  $I_{it}/K_{it-1}$ ,  $CF_{it}/K_{it-1}$ ,  $\Delta \log UC_{it}$  and  $\Delta \log Sale_{it}$ , respectively.

Table 2

## Correlation Matrix

Variables	$I_{it}/K_{it-1}$	$CF_{it}/K_{it-1}$	$\Delta \log Sale_{it}$	$\Delta \log UC_{it}$
$I_{it}/K_{it-1}$	1	0.003214	0.072016	-0.063297
$CF_{it}/K_{it-1}$	0.003214	1	0.085235	-0.018728
$\Delta \log Sale_{it}$	0.072016	0.085235	1	0.109451
$\Delta \log UC_{it}$	-0.063297	-0.018728	0.109451	1

Table 3

## Full Sample Results

Dependent Variable:  $I_{i,t}/K_{i,t-1}$ 

Explanatory Variables	Coefficients	Explanatory Variables	Coefficients
$I_{i,t-1}/K_{i,t-2}$	-0.251 (0.007)***	$\Delta \log UC_{i,t}$	-1.741 (0.096)***
$I_{i,t-2}/K_{i,t-3}$	-0.333 (0.006)***	$\Delta \log UC_{i,t-1}$	-0.748 (0.119)***
$I_{i,t-3}/K_{i,t-4}$	-0.269 (0.005)***	$\Delta \log UC_{i,t-2}$	-1.727 (0.115)***
$\Sigma I_{i,t-n}/K_{i,t-n-1}$	<b>-0.853***</b>	$\Delta \log UC_{i,t-3}$	-1.243 (0.107)***
$\Delta \log S_{i,t}$	1.649 (0.061)***	$\Sigma \Delta \log UC_{i,t-n}$	<b>-5.459***</b>
$\Delta \log S_{i,t-1}$	0.479 (0.055)***	$CF_{i,t}/K_{i,t-1}$	3.075 (0.118)***
$\Delta \log S_{i,t-2}$	0.949 (0.060)***	$CF_{i,t-1}/K_{i,t-2}$	-0.476 (0.059)***
$\Delta \log S_{i,t-3}$	0.534 (0.061)***	$CF_{i,t-2}/K_{i,t-3}$	0.705 (0.056)***
$\Sigma \Delta \log S_{i,t-n}$	<b>3.611***</b>	$CF_{i,t-3}/K_{i,t-4}$	0.198 (0.043)***
<i>Wald 1 (p value)</i>	0.0000	$\Sigma CF_{i,t-n}/K_{i,t-n-1}$	<b>3.502***</b>
<i>Wald 2 (p value)</i>	0.0000	<i>Long Term Sales Elasticity</i>	1.949 (0.116)***
<i>m2 (Statistics Value)</i>	0.505	<i>Long Term User Cost of Capital Elasticity</i>	-2.946 (0.200)***
<i>Sargan (p value)</i>	0.2888	<i>Long Term Cash Flow Elasticity</i>	1.890 (0.110)***

Notes:

- GMM two step estimates.
- Constant and time dummies are included (not reported here).
- Standard errors are in parenthesis.
- $I/K$  is the investment to capital ratio,  $\Delta \log S$  represents the sales growth,  $\Delta \log UC$  denotes the user cost of capital growth while  $CF/K$  is the cash flow to capital stock ratio.
- Instruments used are lags 2 to 5 of investment to capital ratio, lags 2 to 4 of sales growth, lags 1 to 5 of user cost of capital growth and lags 2 to 5 of cash flow to capital stock ratio.
- P-value for the total effects and long term elasticity is computed using Wald Statistic.
- Wald 1 and Wald 2 are the tests for the joint significance of explanatory variables and time dummies, respectively.
- m2 is the second order serial correlation test based on residuals asymptotically distributed as  $N(0,1)$  under the null of no serial correlation.
- Sargan is the test of instruments' validity asymptotically distributed as  $\chi^2$  under the null that instrument is valid.
- Statistics significant at 1%, 5% and 10% is denoted by \*\*\*, \*\* and \*, respectively.

Table 4

## Large Firms' Analysis

Dependent variable:  $I_{i,t}/K_{i,t-1}$ 

Explanatory Variables	Coefficients	Explanatory Variables	Coefficients
$I_{i,t-1}/K_{i,t-2}$	-0.967 (0.002)***	$\Delta \log UC_{i,t}$	-0.697 (0.056)***
$I_{i,t-2}/K_{i,t-3}$	-0.990 (0.002)***	$\Delta \log UC_{i,t-1}$	-0.644 (0.051)***
$I_{i,t-3}/K_{i,t-4}$	-0.955 (0.003)***	$\Delta \log UC_{i,t-2}$	-0.672 (0.065)***
$\Sigma I_{i,t-n}/K_{i,t-n-1}$	<b>-2.912***</b>	$\Delta \log UC_{i,t-3}$	-0.170 (0.049)***
$\Delta \log S_{i,t}$	0.093 (0.015)***	$\Sigma \Delta \log UC_{i,t-n}$	<b>-2.183***</b>
$\Delta \log S_{i,t-1}$	0.074 (0.020)***	$CF_{i,t}/K_{i,t-1}$	0.388 (0.028)***
$\Delta \log S_{i,t-2}$	0.324 (0.019)***	$CF_{i,t-1}/K_{i,t-2}$	0.232 (0.023)***
$\Delta \log S_{i,t-3}$	0.313 (0.019)***	$CF_{i,t-2}/K_{i,t-3}$	0.514 (0.037)***
$\Sigma \Delta \log S_{i,t-n}$	<b>0.804***</b>	$CF_{i,t-3}/K_{i,t-4}$	0.233 (0.039)***
<i>Wald 1 (p value)</i>	0.0000	$\Sigma CF_{i,t-n}/K_{i,t-n-1}$	<b>1.367***</b>
<i>Wald 2 (p value)</i>	0.0000	<i>Long Term Sales Elasticity</i>	0.205 (0.015)***
<i>m2 (Statistics Value)</i>	0.000	<i>Long Term User Cost of Capital Elasticity</i>	-0.558 (0.047)***
<i>Sargan (p value)</i>	0.2899	<i>Long Term Cash Flow Elasticity</i>	0.349 (0.029)***

## Notes:

- GMM two step estimates.
- Constant and time dummies are included (not reported here).
- Standard errors are in parenthesis.
- $I/K$  is the investment to capital ratio,  $\Delta \log S$  represents the sales growth,  $\Delta \log UC$  denotes the user cost of capital growth while  $CF/K$  is the cash flow to capital stock ratio.
- Instruments used are lags 2 to 3 of investment to capital stock ratio, lags 1 to 3 of sales growth, lags 1 to 3 of user cost of capital growth and lags 2 to 3 of cash flow to capital stock ratio.
- $P$ -value for the total effects and long term elasticity is computed using Wald Statistic.
- Wald 1 and Wald 2 are the tests for the joint significance of explanatory variables and time dummies, respectively.
- $m2$  is the second order serial correlation test based on residuals asymptotically distributed as  $N(0,1)$  under the null of no serial correlation.
- Sargan is the test of instruments' validity asymptotically distributed as  $\chi^2$  under the null that instrument is valid.
- Statistics significant at 1%, 5% and 10% is denoted by \*\*\*, \*\* and \*, respectively.

Table 5

## Small Firms' Analysis

Dependent variable:  $I_{i,t}/K_{i,t-1}$ 

Explanatory Variables	Coefficients	Explanatory Variables	Coefficients
$I_{i,t-1}/K_{i,t-2}$	-0.508 (0.007)***	$\Delta \log UC_{i,t}$	-0.619 (0.073)***
$I_{i,t-2}/K_{i,t-3}$	-0.533 (0.008)***	$\Delta \log UC_{i,t-1}$	0.924 (0.112)***
$I_{i,t-3}/K_{i,t-4}$	-0.476 (0.009)***	$\Delta \log UC_{i,t-2}$	-0.590 (0.102)***
$\Sigma I_{i,t-n}/K_{i,t-n-1}$	<b>-1.517***</b>	$\Delta \log UC_{i,t-3}$	-0.063 (0.078)
$\Delta \log S_{i,t}$	1.622 (0.050)***	$\Sigma \Delta \log UC_{i,t-n}$	<b>-0.348***</b>
$\Delta \log S_{i,t-1}$	1.254 (0.074)***	$CF_{i,t}/K_{i,t-1}$	0.847 (0.078)***
$\Delta \log S_{i,t-2}$	1.342 (0.063)***	$CF_{i,t-1}/K_{i,t-2}$	-0.370 (0.041)***
$\Delta \log S_{i,t-3}$	1.033 (0.055)***	$CF_{i,t-2}/K_{i,t-3}$	0.860 (0.042)***
$\Sigma \Delta \log S_{i,t-n}$	<b>5.251***</b>	$CF_{i,t-3}/K_{i,t-4}$	0.147 (0.043)***
<i>Wald 1 (p value)</i>	0.0000	$\Sigma CF_{i,t-n}/K_{i,t-n-1}$	<b>1.484***</b>
<i>Wald 2 (p value)</i>	0.0000	<i>Long Term Sales Elasticity</i>	2.086 (0.084)***
<i>m2 (Statistics Value)</i>	1.365	<i>Long Term User Cost of Capital Elasticity</i>	-0.138 (0.120)
<i>Sargan (p value)</i>	0.4607	<i>Long Term Cash Flow Elasticity</i>	0.589 (0.043)***



## Notes:

- GMM two step estimates.
- Constant and time dummies are included (not reported here).
- Standard errors are in parenthesis.
- $I/K$  is the investment to capital ratio,  $\Delta \log S$  represents the sales growth,  $\Delta \log UC$  denotes the user cost of capital growth while  $CF/K$  is the cash flow to capital stock ratio.
- Instruments used are lags 2 to 4 of investment to capital stock ratio, lags 2 to 3 of sales growth, lags 1 to 4 of user cost of capital growth and lags 2 to 3 of cash flow to capital stock ratio.
- $P$ -value for the total effects and long term elasticity is computed using Wald Statistic.
- Wald 1 and Wald 2 are the tests for the joint significance of explanatory variables and time dummies, respectively.
- $m2$  is the second order serial correlation test based on residuals asymptotically distributed as  $N(0,1)$  under the null of no serial correlation.
- Sargan is the test of instruments' validity asymptotically distributed as  $\chi^2$  under the null that instrument is valid.
- Statistics significant at 1%, 5% and 10% is denoted by \*\*\*, \*\* and \*, respectively.