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An Empirical Investigation of Informal Credit Channel (Trade Credit), Offsetting Conjecture with Traditional Credit Channel: Evidence from Corporate Inventory Financing

Madeeha Islam and Ali Murad Syed

Department of Management Sciences, University of Central Punjab, Lahore, Pakistan.

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ABSTRACT

This study investigates the existence of trade credit as a short term financing channel during tight credit conditions, offsetting conjecture of trade credit channel with traditional credit channel of transmission of monetary policy and subsequently relative adjustments in inventory dynamics covering a large panel of 145 Pakistani firms over the period of 2000-2011.The generalization of Lovell's target adjustment model using Arellano & Bond approach for dynamic panel data has been employed using first difference GMM estimator .The model has been augmented with the short term bank borrowing and trade credit ratios by differentiating the firms either more or less likely to face financing constraints with the hypothesis of making high or low use of trade credit. The findings suggest that there exist a strong evidence of trade credit channel in moderating the credit channel of transmission of monetary policy. Financially constrained firms are found to have less availability of short term bank borrowings and a high dependence on trade credit in tight monetary episodes.

Introduction

The credit channel theorizes the policy effects on real economy through bank lending and balance sheet channels. The bank lending channel centered on the view that banks play a vital role in controlling the asymmetric information and reducing the agency problems in the credit markets. The Balance sheet channel works align to the bank lending channel because it emphasis on controlling the asymmetric problems (moral hazard and adverse selection) in the credit markets. Through this transmission channel, monetary policy affects the financial position of the firms and their investment and spending decisions Bernanke & Gertler (1995). Banks sanctioned funds to different class of borrowers according to their respective credit worthiness. Firms that finance their activities through bank lending channels usually face more difficulties in conducting their business activities when the policy is tightened and stretched out their investment and spending decisions in response to the contractionary pressures Alessandra Guariglia (1999). If the credit channel is assumed to be operative, bank dependent firms will be constrained in contractionary trends since there will be high sensitivity of firm's investment level to financial indicators Alessandra Guariglia (2000). To overwhelm such liquidity constraints when external financing is rationed, firms pursue vendors to provide short term finance to fulfill required working capital requirements during contractionary trends. Vendor financing (Trade credit) as an alternative source of bank credit dilute credit constraints in the market and finance those firms that lost their capacity to get loans through banks or more precisely offsets the effects of credit channel of transmission of monetary policy. Meltzer (1960) was the first who investigated and confirms the offsetting hypothesis of mercantile credit with bank lending channel of transmission of monetary policy on the US manufacturing companies. He concluded that during tight money periods, large firms proportionally increase their average receivables and provide funds to the small firms. Nilsen (2002) tests the redistribution hypothesis and concluded that during monetary contractions not only the small firms raise finance through trade credit but also the large firms with low bond ratings extended their trade payables. Choi & Kim (2005) investigate the redistribution hypothesis and find no evidence that large firms supply funds or play a role of credit suppliers to small constrained firms during tight money periods. Blasio (2005) has also studied the Meltzer conjecture on Italian manufacturing firms and found weak evidence of substitution effect of bank and trade credit. Guariglia & Mateut (2006) found the operationalization of both channels in UK and the trade credit channel dampens the effect of contractionary policy trends by exhibits low sensitivity of investment to financial variables for the financially distressed firms. Atanasova (2007) found the strong evidence suggesting high use of trade credit by financially constrained firms as a substitute to institutional finance during tight monetary periods. Yang (2011) found a complementary trend during tight credit market conditions the substitution effect in loose conditions. Atanasova & Wilson (2003) found small and medium size firms are more dependent on trade credit finance when credit market conditions are supposed to be deteriorated.

This study contributes to the existing literature by investigating this informal inter-firm credit market, exploring the firms financing behavior when facing financial constraints to get finance through credit markets, empirically testing the existence of trade credit channel as a source of short term external financing and whether this channel offsets the bank credit channel or not. There exist an empirical evidence of Traditional credit channels (Bank credits and balance sheet channels) of transmission mechanism of monetary policy in Pakistan[1] but no study has been done regarding the offsetting

[1] See Shabbir (2012) and Asif et al., (2005) for the existence of credit channel in Pakistan

Tele: +923005785155
E-mail addresses: m_madeeha@ymail.com

mechanisms of transmitting channels of the monetary policy. Effective implication of this informal credit channel (Trade Credit) in Pakistan will have implications for the firms at the corporate level because the optimal trade credit policy directly affects the share-holders value and also have implications for the macroeconomic policy makers to account for this channel in designing the monetary policy due to its effect of moderating credit market frictions.

Based on the research contributions the following research question has been formulated.

Does trade credit channel have offsetting conjecture with traditional credit channel during tight credit conditions through its influence on inventory accumulation?

To investigate the existence of trade credit channel during tight credit conditions and its offsetting hypothesis with bank credit channel, below objectives have been formulated:

- To investigate the existence of trade credit channel during tight credit conditions and its offsetting hypothesis with bank credit channel
- To study the role of trade credit in inventory financing strategies during tight credit market conditions
- To explore the sensitivity of inventory investment to financial variables for financially constrained firms with the level of making high or low use of trade credit

The remainder of the paper is organized as follows. Section-2 describes the methodology and framework which includes hypothesis, dataset, variables and baseline model specification. Section-3 presents the empirical results and Section-4 concludes the study.

Methodology

Arellano & Bond (1991) approach for dynamic panel data regression models using first difference GMM estimator has been employed to control the potential problems of unobservable heterogeneity across firms (Time invariant and firm's specific characteristics) and controlling for the possible endogeneity among the regressors. For the evaluation of model specification, Sargan Test for the over identifying restrictions and the m statistics derived by Arellano & Bond (1991) for the detection of serial correlation of residuals in orders has been reported.

Dataset and Sample

The data used consists of listed companies of manufacturing sector (16 industries) from Karachi Stock Exchange over the period of 12 years (2000-2011).[2] Yearly Financial Statements comprises of Annual audited Balance Sheets, Profit and Loss Accounts are used to collect data of concerned variables. An unbalanced panel structure of data with 1586 firm-year observations is used that will allow the entry and exit of any particular firm in a specific year. The number of years of observations is varying between 6 and 12 on each firm. To control the effect of potential outliers, each of the regression variables has been truncated by calculating the 1^{st} and 99^{th} percentile of each regression variable and then removing those observations that lies beyond the 1^{st} and 99^{th} percentile so the dataset contains a total of 1454 firm-year observations.

[2]The companies used in the study are broadly from the manufacturing sector covering cement sector, metal& mining, paper & board, chemicals, oil and gas, electricity, tobacco, household, automobile & parts, engineering, electronics and electrical goods, pharmaceuticals, beverages, transportation, food producers, textile and general industrials.

Variables

The dependent variable Inventories include investment in raw materials, work in progress and finished goods inventory. The dependent variable inventories are considered as a function of current and lagged output measured in terms of sales, lagged inventory demand and cost of holding inventories being far from target level, short term bank borrowing ratio and trade credit ratio. The difference between the logarithms of inventory and sales has been used to capture the cost associated with the inventories being held. The effects of short term bank borrowing ratio and trade credit ratio are further differentiated according to firms facing more or less financing constraints using five proxies, the ratio of short term bank borrowing to total short term debt, the tangibility ratio, real assets, short term debt to sales ratio and net leverage ratio whereas the effects of short term bank borrowing ratio for constrained firms are further generalized according to the dependence of trade credit using three proxies of high or low use of trade credit, the ratio of trade credit to total assets, the ratio of trade credit to total short term debt and trade credit and the ratio of trade credit to inventories. Interaction dummy variables of all financing constraint proxies have been derived by first determining these ratios, calculating the highest quartile of all the ratios of firms belonging to same industry in a particular time period and assigning dummy value of 1 if the ratio lies in the highest quartile of the distribution otherwise 0.

Hypothesis Testing

To test the hypothesis, two panels of firms have been made. In the first panel, firms transit into classes according to financial worthiness either as healthy or constrained firms. In the second panel, firms are divided into classes according to the level of trade credit usage. For the sample separation criteria, sample observations have been winsorized according to highest and lowest quartile distributions. Based on the objectives of the study, we hypothesized that:

H1-a: Short term bank borrowing ratio has positive impact on the inventory investment of financially unconstrained firms

H1-b: Short term bank borrowing ratio has negative impact on investment level of financially constrained firms

H2-a: Trade credit ratio has negative impact on the inventory investment of financially unconstrained firms

H2-b: Trade credit ratio has positive impact on investment level of financially constrained firms

H3-a: There is a high sensitivity of short term bank borrowing ratio to inventory accumulation for financially unconstrained firms

H3-b: There is a low sensitivity of short term bank borrowing ratio to inventory accumulation for financially constrained firms

H4-a: Low use of trade credit has positive impact on the sensitivity of inventory investment to financial variables of financially constrained firms

H4-b: High use of trade credit has negative impact on the sensitivity of inventory investment to financial variables of financially constrained firms

Model Specification

The modified version of Lovell's target adjustment model (Lovell, 1961) has been used to investigate the existence of trade credit channel and its impact on inventory investment along with financial variables and its offsetting conjecture with bank credit. Here the model generalization of Guariglia & Mateut (2006) has been used. The baseline model run on the full firm-year observations is as:

$$\Delta I_{it} = \beta_0+\beta_1\Delta S_{it}+\beta_2\Delta S_{i\,(t-1)}+\beta_3\Delta I_{i(t-1)}+\beta_4\,(I_{i\,(t-1)}-S_{i\,(t-1)})+\beta_5 STBB\_TA_{it}+v_i+v_t+v_j+e_{it} \quad \textbf{(1)}$$

The above model is estimated to determine the role of bank credit in financing of inventories. ΔI_{it} represents the inventory investment, $\Delta S_{it}$the sales growth, $\Delta S_{i\ (t-1)}$,$\Delta I_{i\ (t-1)}$ the impact of previous year sales growth and inventory demand, $I_{i\ (t-1)}$.$S_{i\ (t-1)}$ the target inventory level cost and $STBB\_TA_{it}$ the ratio of short term bank borrowing. The subscripts i denotes the index of firms, j the industries and t denotes the time period of 12 years (2000-2011). Here the error term is a combination of four components. v_i(A firm's specific component controlling for possible heterogeneity issues), v_t(A time specific component controlling for possible business cycles), v_j(Industry specific component controlling for industry shifts in inventory demand) and idiosyncratic component $e_{it.}$[3]. In the above model (1)β_1, β_2,β_3,β_5 are expected to be with positive coefficients and β4with a negative coefficient.

To know the role of trade credit, the above model (1) is estimated by incorporating the variable $(Trade\text{-}Credit/Total\text{-}Assets)_{it}$ The model estimated is:

$$\Delta I_{it}= \beta_0+\beta_1\Delta S_{it}+\beta_2\Delta S_{i\ (t-1)} +\beta_3\Delta I_{i\ (t-1)} + \beta_4\ (I_{i\ (t-1)}.S_{i\ (t-1)}) +\beta_5 STBB\_TA_{it}+ \beta_5 TC\_TA_{it} +v_i+v_t+v_j+e_{it} \quad \textbf{(2)}$$

To test the hypothesis of existence of trade credit channel and its offsetting hypothesis with bank credit channel, the further two generalizations of the above target models has been used by incorporating short term bank borrowing to total assets ratio and the trade credit to total assets ratio interacted with the five proxies of financing constraints and three proxies of high trade credit usage. In the first generalization the first regression model is estimated with the short term bank borrowing to total assets ratio interacted with five proxies of financing constraints and with trade credit to total assets ratio interacted with five proxies of financing constraints in the second regression model.

The regression models[4] estimated are:

$$\Delta I_{it}=\beta_0+\beta_1\Delta S_{it}+\beta_2\Delta S_{i(t-1)}+\beta_3\Delta I_{i(t-1)+}\beta_4(I_{i(t-1)}.S_{i(t-1)})+\beta_5*(FinancialVariable*ProxFinancingConsts_{it})+\beta_6*(FinancialVariable*(1ProxFinancingConsts_{it}))+v_i+v_t+v_j+e_{it} \quad \textbf{(3)}$$

$$\Delta I_{it}=\beta_0+\beta_1\Delta S_{it}+\beta_2\Delta S_{i(t-1)}+\beta_3\Delta I_{i(t-1)+}\beta_4(I_{i(t-1)}.S_{i(t-1)})+\beta_5*(FinancialVariable*ProxFinancingConsts_{it})+\beta_6*(FinancialVariable)*(1ProxFinancingConsts_{it})+\beta_7*(TradeCreditVariable_{it})*ProxFinancingConsts_{it}+\beta_8*(TradeCreditVariable_{it})*(1-ProxFinancingConsts_{it})+v_i+v_t+v_j+e_{it} \quad \textbf{(3) `}$$

In the second generalization of the above model, the financially constrained firm-years are sub-categorized as: Firm-years making a low use of trade credit, a high use of trade credit and healthy firms.[5] The model estimated is:

$$\Delta I_{it}=\beta_0+\beta_1\Delta S_{it}+\beta_2\Delta S_{i(t-1)}+\beta_3\Delta I_{i(t-1)+}\beta_4(I_{i(t-1)}.S_{i(t-1)})+\beta_5*(FinancialVariable*ProxFinancingConsts_{it})*(1-HT\text{-}Credit\text{-}i)+ \beta_6*(FinancialVariable*ProxFinancingConsts_{it})*(HT\text{-}Credit\text{-}i)+\beta_7*(FinancialVariable)*(1-ProxFinancingConsts_{it})+\beta_8*(TradeCreditVariable_{it})*ProxFinancingConsts_{it}+\beta_9*(TradeCreditVariable_{it})*(1-ProxFinancingConsts_{it})+v_i+v_t+v_j+e_{it} \quad \textbf{(4)}$$

From the above model It is expected that the financial variable (Ratio of short term bank borrowing to total assets) have positive effect on the inventory investment of those constrained firms only that are making a low use of trade credit because those constrained firms making a high use of inter firm credit can easily overcome financing constraints in tight credit conditions.

Empirical Results

To test the stated hypothesis H1-a, H1-b, H2-a, H2-b, H3-a andH3-b the generalized inventory accumulation equations (3), (3)`have been used while the model (4) has been used for the hypothesis H4-a andH4-b. This section presents the results of the aforesaid models.

Model Estimations

Table-1 reports the regression results of the model equations (1) and (2) on full sample firm-years, equations (3) and (3) ` by partitioning the firm-years into healthy or constrained firm-years including and excluding the trade credit to total assets ratio interacted with five proxies of financing constraints, Column (1) presents the significant results of equation (1) and column (2) presents the results of equation (2) augmented with the trade credit ratio. Column (3) to Column (11) presents the estimates of model equation (3) and (3)` using five proxy of financing constraints. The reported m-statistics and Sargan test generally improves the specification of the model with no problem of the choice of instruments used in the model.

Our first test of hypothesis H1-a focusing on the significant positive impact of short term bank borrowings on the inventory investments of financially unconstrained firms has been accepted in all Columns (3-12) and proposing that the unconstrained firms can easily access funds through banks due to the availability of high collateral, high net worth and more liquidity as compared to the constrained firms. The hypothesis of H1-b expecting a negative relation of short term bank borrowings on inventory investments of financially constrained firms has been rejected using all proxies of financing constraints in all specifications. These estimate shows that small constrained firms are not curtailing their investments in inventories with the low availability of bank credits rather intending to use trade credit for the financing of inventories confirming the existence of trade credit channel and the offsetting hypothesis of bank credit channel of transmission of monetary policy with trade credit. The estimates of trade credit ratio shows a positive statistically significant impact on inventory accumulations of financially unconstrained firms in the Columns (4),(6),(8),(10) and (12) causes the rejection of the hypothesis H2-a of a negative impact of trade credit ratio on the inventory investment of financially unconstrained firms. The result suggests that the large firms are also delaying payments to the suppliers and using trade credit as a source of financing in their credit portfolios. The H2-b hypothesis of positive impact of trade credit ratio on inventory accumulation of financially constrained firms has been accepted in Column (4), (6), (8), (10) and (12). The favorably acceptance of H2-b proposing that bank credits and trade credit are substitutes to each other's especially for small firms having problems in obtaining funds from banks. The significant positive coefficients of trade credit ratio for financially constrained firms 0.8660, 0.8268 in column (4) and (6), 0.6375 in Column (8) and 0.6769 in column (12) shows that small constrained firms overcome their liquidity problems by the use of trade credits.

[3] To control for the possible firm specific characteristics, we estimated all equations using first difference GMM estimator. To control the time and industry effects, time dummies accounted for business cycle phases (Expansion and Contractions) and dummies for industries have been included in all specifications.

[4]In models 3 and 3`, FinancialVariable represents the ratio of short term bank borrowing to total assets ratio and TradeCreditVariable is the ratio of trade credit to total assets. ProxFinancingConsts are in terms of five proxies of financing constraints.

[5]In the model 4, HT-Credit-i has been estimated in terms of HT-Credit1 (Trade credit to Total Assets ratio), HT-Credit2 (Trade credit to Short term debt and Trade credit ratio) and HT-Credit3 (Trade Credit to Inventory Investment ratio).

Table-1

	Based on Full Sample		Based on Proxy of Financing Constraint-1 (Ratio of Short term bank borrowing / Short term debt)		Based on Proxy of Financing Constraint-2 (Ratio of Tangible Assets / Total Assets)		Based on Proxy of Financing Constraint-3 (Based on Proxy of Real Assets)		Based on Proxy of Financing Constraint-4 (Ratio of Short term debt / Sales)		Based on Proxy of Financing Constraint-5 (Ratio of Net Leverage)	
	Based on All Firm-Years											
Dependent Variable (I_Inventory)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
G_Sales	0 .8014***	0.7331***	0.7782***	0.7334***	0.7990***	0.7325***	0.7913***	0.7427***	0.7986***	0.7487***	0.7782***	0.7308***
	(0 .1332)	(0 .1232)	(0.1234)	(0.1268)	(0.1329)	(0.1237)	(0.1221)	(0.1242)	(0.1189)	(0.1177)	(0.1208)	(0.1247)
LG_Sales	-0.1638**	-0.1710**	-0.1691**	-0.1785**	-0.1604**	-0.1632**	-0.1542**	-0.1595**	-0.1608**	-0.1702**	-0.1705**	-0.1767**
	(0.0714)	(0.0705)	(0.0719)	(0.0726)	(0.0729)	(0.0710)	(0.0665)	(0.0679)	(0.0725)	(0.0705)	(0.0693)	(0.0708)
LI_Inventory	0 .0654*	0.0678**	0 .0756**	0.0737**	0 .0655*	0.0663*	0.0659**	0.0660*	0.0677**	0.0687**	0.0719**	0.0717**
	(0.0351)	(0 .0345)	(0.0330)	(0 .0336)	(0.0358)	(0.0344)	(0.0336)	(0.0348)	(0.0341)	(0.0346)	(0.0338)	(0.0346)
TILC	- 3.8911***	- 3.7603***	- 3.8576***	-3.7893***	- 3.8766***	- 3.7455***	- 3.8457***	- 3.7735***	- 3.8680***	- 3.7793***	- 3.8532***	- 3.7720***
	(0 .1979)	(0 .2563)	(0.2181)	(0.2568)	(0.2223)	(0.2661)	(0.2121)	(0.2600)	(0.2025)	(0.2523)	(0.2018)	(0.2590)
STBB_TA	1.3275***	1.1766***										
	(0 .3604)	(0.2912)										
STBB/TA*(FinancingConst- i)			0.9587***	0.8958***	1.2107***	0.9891***	1.0172***	0.9989***	1.3421***	1.2412***	1.3270***	1.3025***
			(0.2618)	(0.3040)	(0.3679)	(0.2915)	(0.3807)	(0.3790)	(0.3204)	(0.3678)	(0.2409)	(0.2974)
STBB/TA*(1-FinancingConst- i)			1.4205***	1.4070***	1.3473***	1.2283***	1.3437***	1.3094***	1.1567***	1.0882***	1.0103***	1.0079***
			(0.2807)	(0.3390)	(0.4107)	(0.3538)	(0.2569)	(0.3110)	(0.2556)	(0.2571)	(0.3308)	(0.3453)
TC_TA		0 .6628**										
		(0 .2637)										
TC/TA*(FinancingConst- i)				0.8660**		0.8268***		0.6375*		0.5938		0.6769*
				(0.4166)		(0.3170)		(0.3432)		(0.4594)		(0.3927)
TC/TA*(1-FinancingConst- i)				0.5947**		0.5989**		0.7026**		0.6796***		0.6855***
				(0.2965)		(0.3015)		(0.2752)		(0.2590)		(0.2512)
Sargan (P-Value)	0.3396	0.4459	0.4012	0.4449	0.3325	0.4421	0.3623	0.3575	0.4115	0.4566	0.4732	0.4726
m1	-3.2046 (0.0014)	-3.5894 (0.0003)	-3.4461 (0.0006)	-3.599 (0.0003)	-3.2704 (0.0011)	-3.6078 (0.0003)	-3.3251 (0.0009)	-3.5251 (0.0004)	-3.3513 (0.0008)	-3.5792 (0.0003)	-3.4348 (0.0006)	-3.6455 (0.0003)
m2	-1.9178 (0.0551)	-1.6674 (0.0954)	-1.8566 (0.0634)	-1.747 (0.0806)	-1.9577 (0.0503)	-1.7389 (0.0820)	-2.0028 (0.0452)	-1.8532 (0.0639)	-1.8561 (0.0634)	-1.661 (0.0967)	-1.835 (0.0665)	-1.6773 (0.0935)
m3	0.5941 (0.5525)	0.6627 (0.5075)	0.62846 (0.5297)	0.6790 (0.4971)	0.6222 (0.5338)	0.6801 (0.4964)	0.6146 (0.5388)	0.6728 (0.5011)	0.6170 (0.5373)	0.6645 (0.5064)	0.6642 (0.5066)	0.7204 (0.4713)
Sample Observations	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002	1002

Notes:The above table reports the results of model (1), (2) based on full sample observations and model (3) and (3)` based on five proxies of financing constraints estimated using Arellano & Bond approach to dynamic panel with first difference gmm estimator. I_Inventory denotes the inventory accumulation, G_Sales represents the growth of sales, and LG_Sales and LI_Inventory are the lagged variables of sales and inventory accumulation, TILC is the target inventory level cost,STBB_TA is the ratio of short term bank borrowing to total assets and TC_TA is the trade credit to total assets ratio,STBB/TA*(FinancingConst - i) is the interaction term variable showing the short term bank borrowings of financially constrained firms. STBB/TA*(1-FinancingConst - i) is the interaction term variable showing the short term bank borrowings of financially unconstrained firms. TC/TA*(FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially constrained firms. TC/TA*(1-FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially unconstrained firms. The figures reported are the coefficients and in parentheses the robust standard errors. The standard errors are asymptotically robust to heteroskedasticity. The Sargan (P-Value) test of over identifying restrictions has the null hypothesis of instrumental validity and asymptotically distributed as $\chi 2$ whereas the m-statistics for the detection of serial correlation of first difference residuals has the null hypothesis of no serial correlation and asymptotically distributed as standard normal distribution. Second and third lags of the variables LG_Sales, I_Inventory, LI_Inventory are used as gmm-type while the others including time dummies and industry dummies as standard instruments in difference equations keeping constant as standard instrument of level equation. The * shows significance at 10% level, ** at 5% and *** at 1% level of significance.

Table 2

	Based on Proxy of Financing Constraint-1 With HTCredit-1	Based on Proxy of Financing Constraint-2 With HTCredit-1	Based on Proxy of Financing Constraint-3 With HTCredit-1	Based on Proxy of Financing Constraint-4 With HTCredit-1	Based on Proxy of Financing Constraint-5 With HTCredit-1
	Based on All Firm-Years				
Dependent Variable (I_Inventory)	(1)	(2)	(3)	(4)	(5)
G_Sales	0.7343***	0.7269***	0.7441***	0.7529***	0.7307***
	(0.1278)	(0.1267)	(0.1224)	(0.1157)	(0.1245)
LG_Sales	-0.1805**	-0.1680**	-0.1652**	-0.1725**	-0.1761**
	(0.0738)	(0.0726)	(0.0687)	(0.0722)	(0.0721)
LI_Inventory	0.0750**	0.0668*	0.0668*	0.0703**	0.0722**
	(0.0336)	(0.0346)	(0.0346)	(0.0356)	(0.0347)
TILC	-3.7923***	-3.7472***	-3.784***	-3.7895***	-3.7698***
	(0.2592)	(0.2682)	(0.2601)	(0.2534)	(0.2607)
STBB/TA*FinancingConst– i *(1-HTCredit- i)	1.0019***	1.0102***	1.1733***	1.3890***	1.3148***
	(0.2659)	(0.3434)	(0.3527)	(0.3550)	(0.3146)
STBB/TA*FinancingConst– i *(HTCredit- i)	0.5524	0.9359***	0.6954	0.6314	1.1989***
	(0.4703)	(0.3067)	(0.4664)	(0.4556)	(0.2693)
STBB/TA*(1-FinancingConst- i)	1.4090***	1.2116***	1.3227***	1.1158***	1.0050***
	(0.3362)	(0.3605)	(0.3089)	(0.2632)	(0.3525)
TC/TA*(FinancingConst- i)	1.0341**	0.8110**	0.7417**	0.9411*	0.7202*
	(0.4337)	(0.3402)	(0.3457)	(0.5568)	(0.4196)
TC/TA*(1-FinancingConst- i)	0.6018**	0.5691*	0.7324***	0.7409***	0.6950***
	(0.3009)	(0.2908)	(0.2782)	(0.2582)	(0.2631)
Sargan (P-Value)	0.4078	0.4250	0.3800	0.3547	0.4586
m1	-3.5712 (0.0004)	-3.6045 (0.0003)	-3.5177 (0.0004)	-3.5619 (0.0004)	-3.6693 (0.0002)
m2	-1.7332 (0.0831)	-1.7152 (0.0863)	-1.8346 (0.0666)	-1.7736 (0.0761)	-1.6674 (0.0954)
m3	0.6672 (0.5046)	0.6585 (0.5102)	0.65623 (0.5117)	0.7111 (0.4770)	0.7189 (0.4722)
Sample Observations	1002	1002	1002	1002	1002

Notes: The above table reports the results of model (4) based on five proxies of financing constraints with the 1st proxy of high trade credit usage HT-Credit-1, the ratio of trade credit to total assets. I_Inventory denotes the inventory accumulation, G_Sales represents the growth of sales, and LG_Sales and LI_Inventory are the lagged variables of sales and inventory accumulation, TILC is the target inventory level cost, STBB/TA*FinancingConst – i *(1-HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a low use of trade credit, STBB/TA*Financing Const – i *(HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a high use of trade credit, STBB/TA*(1-FinancingConst - i) is the interaction term variable showing the short term bank borrowings of financially unconstrained firms. TC/TA*(FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially constrained firms. TC/TA*(1-FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially unconstrained firms. The figures reported are the coefficients and in parentheses the robust standard errors. The standard errors are asymptotically robust to heteroskedasticity. The Sargan (P-Value) and the m-statistics shows no problem of model specification. Second and third lags of the variables LG_Sales, I_Inventory, LI_Inventory are used as gmm-type while the others including time dummies and industry dummies as standard instruments in difference equations keeping constant as standard instrument of level equation. The * shows significance at 10% level, ** at 5% and *** at 1% level of significance.

Table 3

	Based on Proxy of Financing Constraint-1 With HTCredit-2	Based on Proxy of Financing Constraint-2 With HTCredit-2	Based on Proxy of Financing Constraint-3 With HTCredit-2	Based on Proxy of Financing Constraint-4 With HTCredit-2	Based on Proxy of Financing Constraint-5 With HTCredit-2
	Based on All Firm-Years				
Dependent Variable (I_Inventory)	(1)	(2)	(3)	(4)	(5)
G_Sales	0.7439***	0.7567***	0.7517***	0.7531***	0.7522***
	(0.1255)	(0.1344)	(0.1219)	(0.1147)	(0.1286)
LG_Sales	-0.1865**	-0.1507*	-0.1695**	-0.1742**	-0.1641**
	(0.0728)	(0.0799)	(0.0695)	(0.0738)	(0.0771)
LI_Inventory	0.0791**	0.0682**	0.0693**	0.0715**	0.0715**
	(0.0331)	(0.0344)	(0.0331)	(0.0350)	(0.0353)
TILC	-3.8393***	-3.8158***	-3.8312***	-3.8201***	-3.8195***
	(0.2552)	(0.2812)	(0.2472)	(0.2431)	(0.2616)
STBB/TA*FinancingConst– i *(1-HTCredit- i)	0.8608***	0.8366***	0.9533***	1.1750***	0.9495***
	(0.2150)	(0.3032)	(0.3208)	(0.2938)	(0.2681)
STBB/TA*FinancingConst– i *(HTCredit- i)	0.0259	-0.3990	-0.1437	-0.0515	0.5599
	(0.7210)	(0.7548)	(0.5769)	(0.4441)	(0.5022)
STBB/TA*(1-FinancingConst- i)	1.2799***	1.0921***	1.2263***	0.9449***	0.8216**
	(0.2920)	(0.3769)	(0.2973)	(0.2477)	(0.3679)
TC/TA*(FinancingConst- i)	1.3046***	1.1515***	0.9652**	1.4684**	1.2267**
	(0.4399)	(0.3903)	(0.3926)	(0.6217)	(0.5268)
TC/TA*(1-FinancingConst- i)	0.5392*	0.6223***	0.7436***	0.7594***	0.7596***
	(0.3026)	(0.2138)	(0.2812)	(0.2581)	(0.2801)
Sargan (P-Value)	0.4308	0.2959	0.4326	0.3642	0.3784
m1	-3.4292 (0.0006)	-3.353 (0.0008)	-3.3534 (0.0008)	-3.4383 (0.0006)	-3.4964 (0.0005)
m2	-1.7609 (0.0783)	-1.8495 (0.0644)	-1.9845 (0.0472)	-1.8599 (0.0629)	-1.7637 (0.0778)
m3	0.6346 (0.5257)	0.5919 (0.5539)	0.6127 (0.5400)	0.6948 (0.4872)	0.6070 (0.5438)
Sample Observations	1002	1002	1002	1002	1002

Notes: The above table reports the results of model (4) based on five proxies of financing constraints (1), the ratio of short term bank borrowing to total short term debt, (2) the ratio of tangibility, (3) the real assets, (4) the ratio of short term debt to sales ratio and (5) the ratio of net leverage ratio with the 2nd proxy of high trade credit usage HT-Credit-2, the ratio of trade credit to short term debt and trade credit. I_Inventory denotes the inventory accumulation, G_Sales represents the growth of sales, and LG_Sales and LI_Inventory are the lagged variables of sales and inventory accumulation, TILC is the target inventory level cost, STBB/TA*FinancingConst – i *(1-HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a low use of trade credit, STBB/TA*FinancingConst – i *(HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a high use of trade credit, STBB/TA*(1-FinancingConst - i) is the interaction term variable showing the short term bank borrowings of financially unconstrained firms. TC/TA*(FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially constrained firms. TC/TA*(1-FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially unconstrained firms. The figures reported are the coefficients and in parentheses the robust standard errors. The standard errors are asymptotically robust to heteroskedasticity. The Sargan (P-Value) test of over identifying restrictions has the null hypothesis of instrumental validity and asymptotically distributed as $\chi 2$ whereas the m-statistics for the detection of serial correlation of first difference residuals has the null hypothesis of no serial correlation and asymptotically distributed as standard normal distribution. Second and third lags of the variables LG_Sales, I_Inventory, LI_Inventory are used as gmm-type while the others including time dummies and industry dummies as standard instruments in difference equations keeping constant as standard instrument of level equation. The * shows significance at 10% level, ** at 5% and *** at 1% level of significance.

Table 4

	Based on Proxy of Financing Constraint-1 With HTCredit-3	Based on Proxy of Financing Constraint-2 With HTCredit-3	Based on Proxy of Financing Constraint-3 With HTCredit-3	Based on Proxy of Financing Constraint-4 With HTCredit-3	Based on Proxy of Financing Constraint-5 With HTCredit-3
	Based on All Firm-Years				
Dependent Variable (I_Inventory)	(1)	(2)	(3)	(4)	(5)
G_Sales	0.7444***	0.7609***	0.7599***	0.7572***	0.7521***
	(0.1272)	(0.1302)	(0.1194)	(0.1123)	(0.1283)
LG_Sales	-0.1827**	-0.1517**	-0.1611**	-0.1609**	-0.1592**
	(0.0743)	(0.0771)	(0.0699)	(0.0738)	(0.0758)
LI_Inventory	0.0796**	0.0679**	0.0683**	0.0694**	0.0734**
	(0.0333)	(0.0334)	(0.0326)	(0.0344)	(0 .0354)
TILC	-3.8317***	-3.8211***	-3.8381***	-3.8144***	-3.8115***
	(0.2533)	(0.2733)	(0.2424)	(0.2441)	(0.2575)
STBB/TA*FinancingConst– I *(1-HTCredit- i)	0.8502***	0.8149***	0.9434***	1.1313***	0.9277***
	(0.2120)	(0.2988)	(0.3136)	(0.3007)	(0.2752)
STBB/TA*FinancingConst– I *(HTCredit- i)	-0.2226	-0.5538	-1.2152*	-0.4859	-0.2146
	(0.4792)	(0.5072)	(0.6910)	(0.4594)	(0.4148)
STBB/TA*(1-FinancingConst- i)	1.2621***	1.0500***	1.1631***	0.8905***	0.7871**
	(0.2951)	(0.3734)	(0.3010)	(0.2523)	(0.3632)
TC/TA*(FinancingConst- i)	1.3677***	1.0910***	0.9693**	1.6110**	1.2926**
	(0.4400)	(0.4041)	(0.4274)	(0.6487)	(0.5446)
TC/TA*(1-FinancingConst- i)	0.5563*	0.6038***	0.6837**	0.7450***	0.7510***
	(0.3102)	(0.2151)	(0.2844)	(0.2582)	(0.2763)
Sargan (P-Value)	0.4286	0.3929	0.5178	0.3977	0.4108
m1	-3.4768 (0.0005)	-3.3741 (0.0007)	-3.3856 (0.0007)	-3.4133 (0.0006)	-3.541 (0.0004)
m2	-1.7754 (0.0758)	-1.8826 (0.0598)	-1.9913 (0.0464)	-1.9095 (0.0562)	-1.707 (0.0878)
m3	0.6594 (0.5096)	0.6158 (0.5380)	0.6039 (0.5459)	0.7390 (0.4599)	0.6578 (0.5107)
Sample Observations	1002	1002	1002	1002	1002

Notes: The above table reports the results of model (4) based on five proxies of financing constraints (1), the ratio of short term bank borrowing to total short term debt, (2) the ratio of tangibility, (3) the real assets, (4) the ratio of short term debt to sales ratio and (5) the ratio of net leverage ratio with the 3rd proxy of high trade credit usage HT-Credit-3, the ratio of trade credit to inventory investment. I_Inventory denotes the inventory accumulation, G_Sales represents the growth of sales, and LG_Sales and LI_Inventory are the lagged variables of sales and inventory accumulation, TILC is the target inventory level cost, STBB/TA*Financing Const – i *(1-HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a low use of trade credit, STBB/TA*Financing Const – i *(HTCredit- i) is the interaction term variable showing the impact of short term bank borrowing for constrained firms having a high use of trade credit, STBB/TA*(1-FinancingConst - i) is the interaction term variable showing the short term bank borrowings of financially unconstrained firms. TC/TA*(Financing Const - i) is the interaction term variable showing the trade credit usage by the financially constrained firms. TC/TA*(1-FinancingConst - i) is the interaction term variable showing the trade credit usage by the financially unconstrained firms. The figures reported are the coefficients and in parentheses the robust standard errors. The standard errors are asymptotically robust to heteroskedasticity. The Sargan (P-Value) test of over identifying restrictions has the null hypothesis of instrumental validity and asymptotically distributed as $\chi 2$ whereas the m-statistics for the detection of serial correlation of first difference residuals has the null hypothesis of no serial correlation and asymptotically distributed as standard normal distribution. Second and third lags of the variables LG_Sales, I_Inventory, LI_Inventory are used as gmm-type while the others including time dummies and industry dummies as standard instruments in difference equations keeping constant as standard instrument of level equation. The * shows significance at 10% level, ** at 5% and *** at 1% level of significance.

The hypothesis H3-a and H3-b has been accepted using first three proxies of financing constraints in Column (4), (6) and (8) but rejected using the proxy of short term debt to sales ratio and net leverage ratio in column (10) and (12). The acceptance of hypothesis H3-a and H3-b using first three proxies of financing constraints describes the theory that financial factors does matter for the firm's investment decisions and have high sensitivity to the inventory accumulations.

Since the coefficients associated with the short term bank borrowing ratio for financially constrained firms are lower in size 0.8958, 0.9891 and 0.9989 in columns (4), (6) and (8) than the coefficients of unconstrained firms showing the low sensitivity of financial factors with inventory accumulations of financially constrained firms evidently supporting the existence of trade credit channel. The reason for the low sensitivity of short term bank borrowings to inventory investments is the heavy use of trade credit by the constrained firms. This factor is shown by the coefficients as 0.8660, 0.8268 and 0.6375 which are statistically significant. The rejection of the hypothesis H3-a and H3-b in column (10) and (12) elucidated the high volatility of inventory investments to financial factors for the smaller constrained firms due to the low usage of trade credit.

Table-2 to Table-4 report the results of equation-4 to test the hypothesis H4- a and H4- b by further partitioning the constrained firm-years in terms of five proxies of financing constraints with the high or low use of trade credit. In table-2, the ratio of trade credit to total assets is used to distinguish firm's relative dependence on trade credit. The hypothesis H4- a that the low use of trade credit has significantly positive impact on the sensitivity of inventory investment to financial variables of financially constrained firms is accepted in all columns of Table-2 whereas the impact of short term bank borrowings on the sensitivity of inventory investments of those firm-years making a high use of trade credit is either poorly determined in columns (1), (3) and (4) with the coefficients as 0.5524, 0.6954 and 0.6314 confirming the offsetting hypothesis of trade credit with bank credit and significantly positively determined in column (2) and (5) showing the moderating role of trade credit in mitigating the liquidity constraints. The hypothesis H4-b is rejected in all specifications using trade credit to total assets as a proxy for high or low use of trade credit. The impact of sales growth, target inventory level cost and inventory demand of preceding year are as expected on current year inventory accumulation whereas the impact of lagged sales negatively determined. The impact of short term bank borrowings on the inventory investments of financially healthy firms are as expected with the positive and statistically significant coefficients 1.4090, 1.2116, 1.3227, 1.1158 and 1.0050 whereas the impact of trade credit on inventory investments of either financially constrained or unconstrained firms are positive and statistically determined.

Table-3 presents the results using the ratio of trade credit to total short term debt and trade credit as a proxy for high or low use of trade credit. Here the similar findings have been found characterizing the positive impact of short term bank borrowings on inventory accumulation of those firm-years making a low use of trade credit leading to the acceptance of our hypothesis H4-a in all columns of Table-3.

The hypothesis of H4-b is accepted in column (2), (3) and (4) describing the strong evidence of offsetting hypothesis of trade credit with the traditional credit channel whereas it is rejected using short term bank borrowing to total short term debt ratio and net leverage ratio indicating the moderating effect of trade credit in alleviating credit constraints as the effect of short term bank borrowing ratio is positively and poorly determined. The similar results are found when I use the ratio of trade credit to inventory investment as a sorting device to classify firms are either high or low users of trade credit. The both hypothesis H4-a and H4-b are accepted using all five proxies of financing constraints with the positive and statistically significant coefficients for H4-a and insignificant negative coefficients for H4-b strongly evidence of offsetting conjecture of trade credit with bank credit channel. The variables for trade credit are significantly determined for constrained firms and for unconstrained firms, precisely and less significantly determined. In both Table-3 and Table-4, only the lagged sales growth has unexpected negative impact on current year inventory demand whereas the coefficients associated with the current year sales growth, target inventory level cost and lagged inventory demand have expected significant results.

Conclusion

In this study, we have employed a panel of 145 non-financial firms broadly from the manufacturing sector of Pakistan over the period of 12 years (2000-2011) to investigate the existence of trade credit channel as a source of short term financing during tight credit conditions faced by the firms and its offsetting conjecture with traditional credit channel. To test our hypothesis we have used a generalized model of inventory accumulation augmented with the short term bank borrowing to total assets ratio for the existence of bank credit channel and trade credit to total assets ratio for the trade credit channel differentiated the effects of these two variables on financially unconstrained and healthy firms segregated according to the five proxies of financing constraints, the ratio of short term bank borrowing to total short term debt, tangibility ratio, real assets, short term debt to sales ratio and net leverage ratio and the three proxies for the firms dependence on trade credits as the ratio of trade credit to total assets, ratio of trade credit to total short term debt and trade credit and trade credit to inventory ratio.

Our results based on all firm-year observations suggest that the existence of trade credit as a source of short term finances in credit portfolios of firms and a complementary trend of both bank credit and trade credit channel in inventory financing strategies of firms. The trend of trade credit becomes substitute to bank credit when the firm-years are partitioned into financially constrained and healthy firms proposed the role of trade credit in offsetting the effects of credit channel during tight periods of policy. In the light of our results, we can conclude that those firms facing problems in raising credits through banks in short run exhibits a low sensitivity of inventory accumulations to financial variables due to the dependence on trade credit as a source of short term financing by delaying payments due on creditors leading to the offsetting role of trade credit with traditional bank credit channel and an effective role played by trade credits in financing of inventories. Financially constrained firms are not required to cut back their investment plans because they can use trade credits to improve their balance sheet liquidity position.

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