A panel study of the relevance of financial constraints on inventory investment

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1. Literature Review

Empirical research has often produced results inconsistent with the "irrelevance" theory prospected by Modigliani and Miller, much of the literature ascribes, and reconciles, the existence and relevance of accounts as cash, inventory, accounts receivable and payable to market frictions, agency costs and asymmetric information (Hubbard 1990). But inventories have been studied by macro-economist for their role in the **business cycles** (Abramovitz 1950) and their relation with **corporate profits** (Mitchell 1951, Lucas 1977) and with the **volatility of cash flows** (Fazzari, Hubbard et al. 1988), both key leading indicators of the state of the economy (Carpenter, Fazzari et al. 1994); other evidence suggests their implications on the general level of the economy in case of **financial shocks** because of erroneous forecasts (Bernanke and Gertler 1989, Bernanke, Gertler et al. 1996) or their limited efficiency in collateralization (Berk 2014). Clearly, the level of inventory is connected to the level of cash, but its relevance derives from the fact that inventory is a **component of production**. Indeed, the level of inventory is also determined by the overall **strategy of operations**, in this context variability and uncertainty affect inventory because it is used to reduce their impact on the processes of the firm (Chase 2016).

The type of businesses holding inventories are known: manufacturing accounts for 60%, with roughly equal importance of finished products, work in progress and materials; trade represents a 20%, with the dominance of consumer goods. **Input materials and retail inventories** are the most volatile components of inventory investment (Blinder and Maccini 1991). At firm level, depending on its short-term financial planning, a policy is chosen and, among others strategic issues, the level of inventory is set; such policy considers the **peculiarities of the firm**, like its size or net worth (Bernanke and Gertler 1989, Gertler and Gilchrist 1994), and its **industry** (Pavitt 1984), as well as the **seasonality** of its sales (Hubbard 1990), the likely of a **sales shock** (Blinder and Maccini 1991, Carpenter, Fazzari et al. 1994) or the **volatility of its production**, often presenting more pronounced swings than sales (Blinder and Maccini 1991). Among other theories, the matching principle states that short- and long-term liabilities should be matched by same term financing; however, in the recent low rate environment, the opposite approach had increased its role for less constrained firms. Usually the production bunching models are considered better performers than the traditional smoothing frameworks, nonetheless most studies demonstrated the validity of such theoretical models when considering **carrying and stock-out costs** (Calomiris and Hubbard 1989, Hubbard 1990, Berk 2014). In summary, research evidenced a proportional relation with sales in the long-term but without significance in the short-term.

Firms' internal policy influences also the decision to rely more on equity (Carpenter, Fazzari et al. 1994) or on debt (Whited 1992) for inventory investment. Once constrained firms are excluded, investment is more variable for firms with lower payout ratios but less variable for more distressed firms. With the increasing evidence of the importance of the **liquidity variables**, the greatest difficulty has been constructing a suitable proxy for financial distress in order to classify firms as constrained: approaches included **access to bond markets**, **dividend policy** (Whited 1992) and **financial health**, the latter more focused on its impact in assessing government fiscal policy (Fazzari, Hubbard et al. 1988). Most of the studies have been questioned in the way the issue has been addressed on theoretical and technical grounds (Kaplan and Zingales 1997); a study of Japanese firms recognizes that even less constrained firms profiting from strong intra-Keiretsu bank relations broke such relation whenever it became possible (Hoshi, Kashyap et al. 1991, Hoshi, Kashyap et al. 1993): thus, mixed evidence characterizes the **firm's main bank relation**, imputing distortions to agency costs and asymmetric information (Myers and Majluf 1984, Sharpe 1990, Rajan 1992, Kaplan and Zingales 1997). Recent approaches proxied financial distress with financial ratios and reconciled previous results: firms limited in internal funds require more external capital that increases in costs as it is more needed, thus constrained firms invest more to generate more revenues (Cleary, Povel et al. 2007). Inventory investment seems to be financially constrained mostly before recessions when **cash accumulation** builds up (Kim and Choi 2001); similarly, **trade credit** increases when firms start to experience credit constraints (Egon 1997). However, some **type of businesses**, exporters and foreign-owned firms, enjoy better operating conditions and less financial constraints (Mateut and Guariglia , Guariglia 1999).

2. Empirical Model Specification

Depending on the type of policy we may be able to infer the strategies of firms with respect to long-term interest rates, banks ratios credibility and the general level of the economy. If we assume that firms are pursuing a flexible short-term financial policy, relevant fact in our sample may include:
- large balances of cash and marketable securities
- large investments in inventory, generally long-term driven
- trade credit, resulting in a high level of accounts receivable

Such policy can be determined by other facts characterizing the current economic environment: long term credit is equally or less expensive than the average one decade old short-term credit, enabling established and healthy firms to borrow the need for the entire cycle avoiding the costs to re-contract short-term borrowings; financial products are perceived as too risky and banks ratios are not credible, suggesting firms to increase reliance on internal funds and accumulation of cash because of future increasing transaction costs and reduced marketability; low rates for long may suggest a slow recovery of the economy, requiring lower sale prices and more reduction in costs and liquidation of assets. Moreover, a policy of this type accomplishes with most backlogged lot size models suggesting demand as Poisson distributed. Thus, inventory will be less constrained by financial factors and more affected by demand and production shocks. However, not all firms may be able to pursue such a strategy because assets or risk may act as a constraint in quantitative terms or in the ability to access capital markets: to understand the degree of relevance for financial constraints, the proxy for financial constraints is interacted with dimensional and risk dummies assuming a point of view similar to the one of the commercial lender (Sangalli 2013). Inventories are generally proportional to sales, but some adjustments may occur in the short run. The model used is a variant of Lovell's target adjustment model (Lovell 1959) in ARDL(1) form:

$$\Delta \log(inv)_{it} = \alpha + \beta_0 \Delta \log(inv)_{it-1} + \beta_1 \Delta \log(sales)_{it} + \beta_2 \Delta \log(sales)_{it-1} + \beta_4 FIN_{it-1} + \mu_i + \mu_j + \mu_t + u_{it}$$

Financial constraints are one of the determinants of the reduction in investments. Nonetheless, it has been noted that American economic history presented times of tight liquidity independently of recessionary periods (Sangalli 2013). Generally, firms start accumulating cash before the begin of slowdowns (Kim and Choi 2001). Since we suppose such behaviors are the result of various developments more than a predetermined strategy, a dynamic panel study could capture at least some of those aspects.

3. Data Description

The unbalanced panel consists of 20 periods from 1996 to 2015 for 7403 manufacturing and for 1701 trade US firms, obtained from Compustat. The means of the analyzed variables are all higher than the respective geometric means, thus evidencing the presence of outliers. Between the two industries we observe, as expected, a clear difference in terms of the absolute magnitude of cash, receivables, Ebit, Coverage ratio and Acid ratio, still persisting once how firms cluster by size has been taken in account. In fact, such difference depends mostly on the sector the firms belong.

Proportion of firms by industry

Manufacturing   Trade
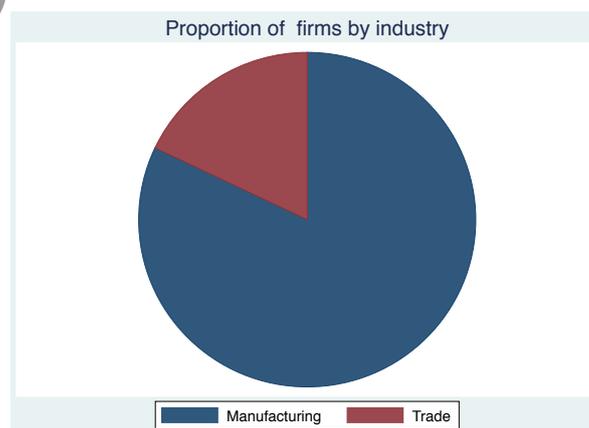
Businesses are partitioned in small, medium and large firms respectively representing 10%, 17% and 60% (the remaining are micro firms).

Manufacturing Firms

stats	dche	dinvt	drect	dsale	debit	covr	acid	ldc
mean	199.2	181.4	298.8	1654	353.8	−75.05	1059	2899
cv	5.335	4.558	7.93	5.336	5.52	−244.3	5.06	234.2
p25	1.252	.8682	1.216	7.861	−.8304	−.0005647	12.3	0
p50	9.81	9.228	10.99	68.51	7.718	.03115	66.51	.06495
p75	54.18	63.64	69.86	477.4	88.1	.14	327.9	.6811
sd	1063	826.7	2369	8824	1953	18334	5357	678823
variance	1129969	683412	5613640	7.79e+07	3814349	3.36e+08	2.87e+07	4.61e+11
min	−18.57	0	−.0007868	−15.91	−14245	−4473925	−24.74	−3363
max	35046	24018	141121	260729	66201	587	168368	1.70e+08
N	64485	64433	64185	64330	59595	59546	63878	63392

Trade Firms

stats	dche	dinvt	drect	dsale	debit	covr	acid	ldc
mean	75.35	196.9	120	1881	173.1	.01741	835.6	.8086
cv	4.228	3.752	4.974	4.036	4.123	552.5	3.571	26.54
p25	.9064	2.628	1.33	51.68	2.31	.01382	23.56	0
p50	6.2	23.94	9.214	257.7	21.99	.08824	124.7	.2976
p75	33.74	118.6	57.44	1008	99.85	.2218	496.2	1.089
sd	318.6	739	596.8	7593	713.5	9.619	2984	21.46
variance	101493	546049	356230	5.77e+07	509082	92.52	8904953	460.6
min	0	0	−.08841	−2.894	−616.8	−915.5	−106.2	−876.3
max	8031	19256	17578	204245	19528	242.7	63277	1148
N	14058	14024	13957	14009	13267	13257	13807	13739

The graph below plots over time averages of the variables Sales, Ebit, Coverage Ratio and Acid Ratio and highlight the peaks before the recessions of 2001, 2007 and 2012. Such variables are not directly involved in the regression, but give some information about the trend in the economy and in each industry. We note:
• the slowing turnover for manufacturing firms
• the sharp drop in Ebit for trade firms in correspondence of each recession
• the increase in availability of funds to pay for interest between the first two downturns
• an increasing Acid Ratio, evidencing short-term funds accumulation
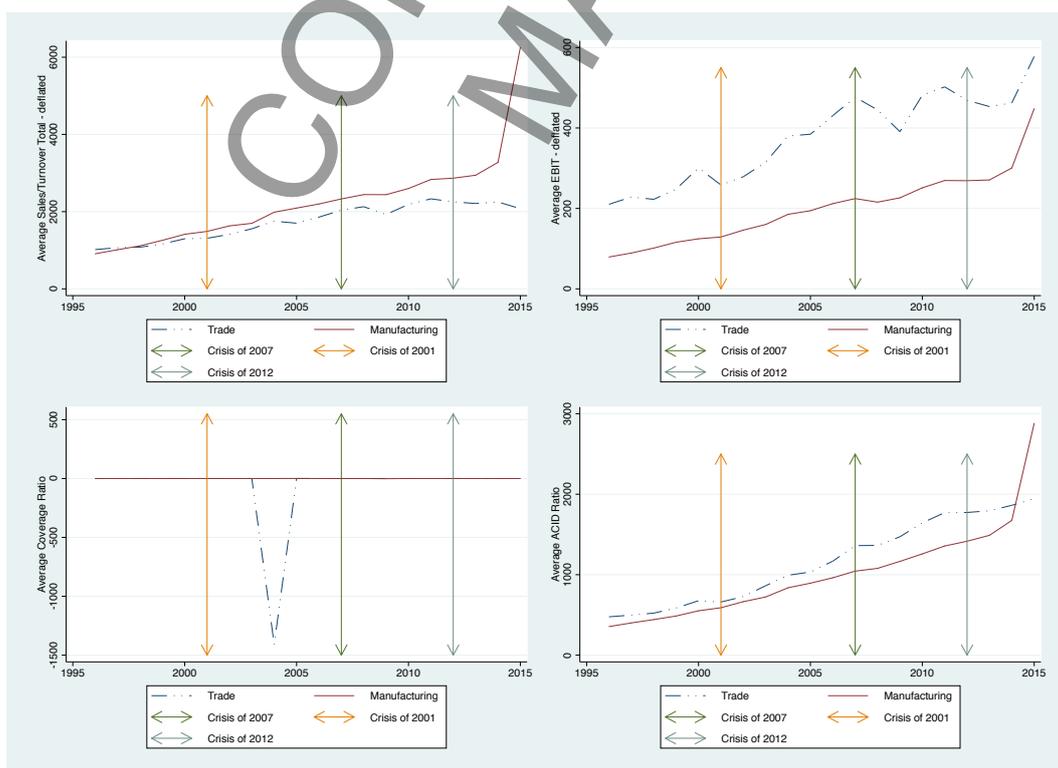
Below we observe how regression variables are distributed, suggesting a log transformation:

Histograms of Cash, Inventories and Receivables with normal density (MANUFACTURING)

Histograms of Cash, Inventories and Receivables with normal density (TRADE)
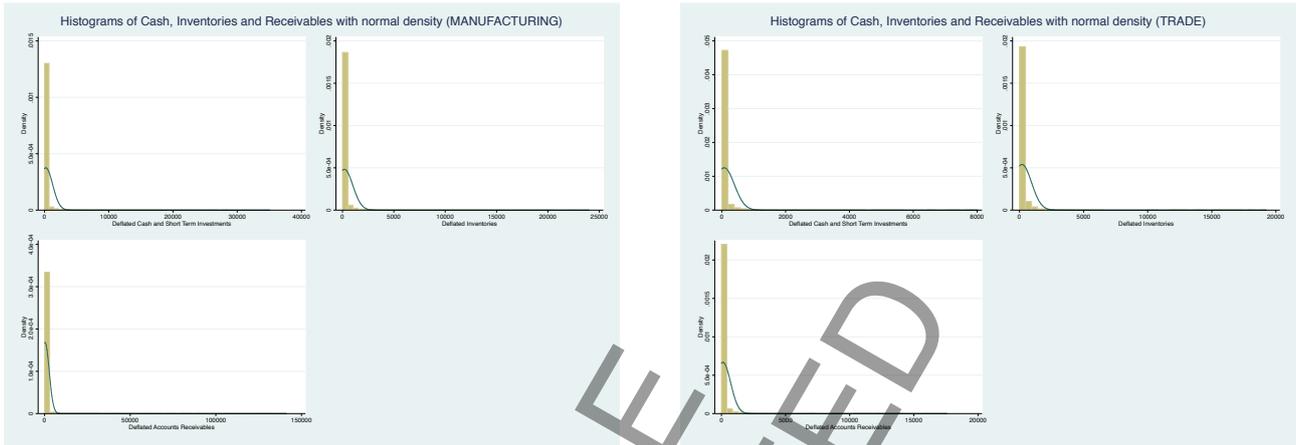
We turn our attention to the relevant fact mentioned above, namely:
- large balances of cash and marketable securities
- large investments in inventory, generally long term driven
- trade credit, resulting in a high level of accounts receivable
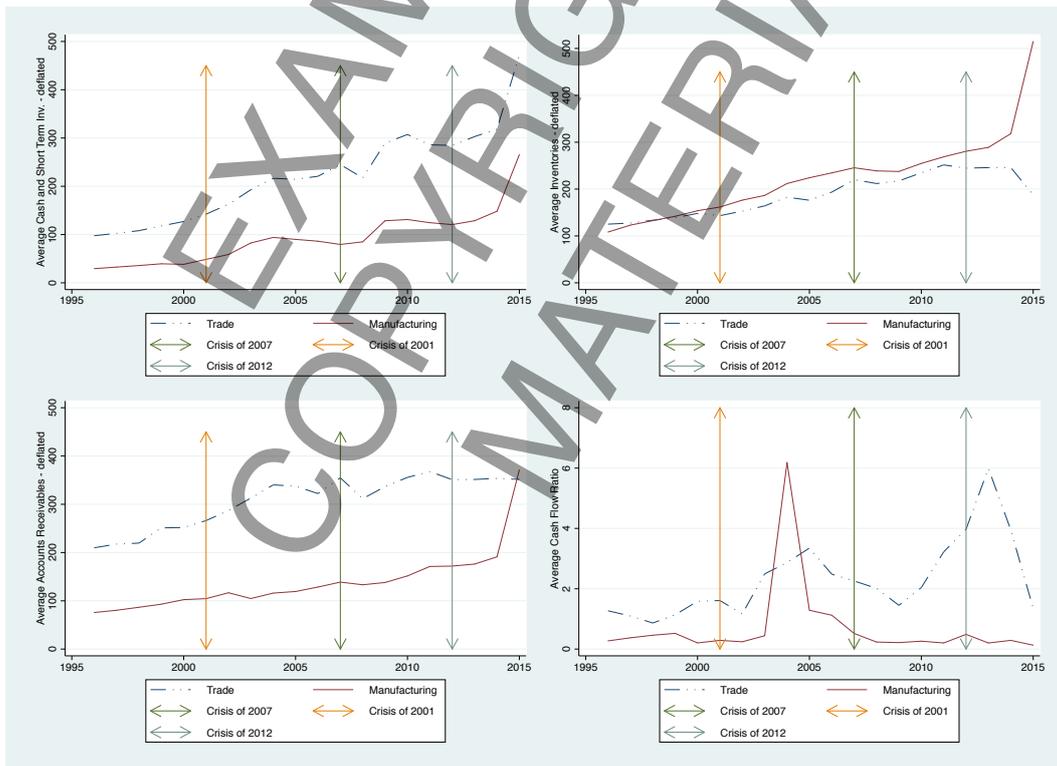
For Cash and short-term securities we observe a similar pattern after each recession, consisting in large balances to sustain the expected demand and in progressive reductions as the business cycle develops. Inventories show more variability for trade firms, as expected. Trade credit, proxied by receivables, do not show a clear pattern; however, a small drop occurs in proximity of every recession suggesting a reduction in liquidity (traditionally because of tightening monetary policy) and increasing importance of financial variables. Finally, the level of cash to net of cash total assets show pronounced spikes after 2001 and 2012 in the trade industry; manufacturing seems affected only after 2001.

The plot below represents the ratios of debt, receivable and cash to total assets: such variables are scaled to enter the regression without introducing collinearity. We note that manufacturing firms hold a stable position in each of the three ratios. Our sample can be found to be suitable to understand our hypothesis about the firm's short-term financial policy and determine its relevance for inventories.
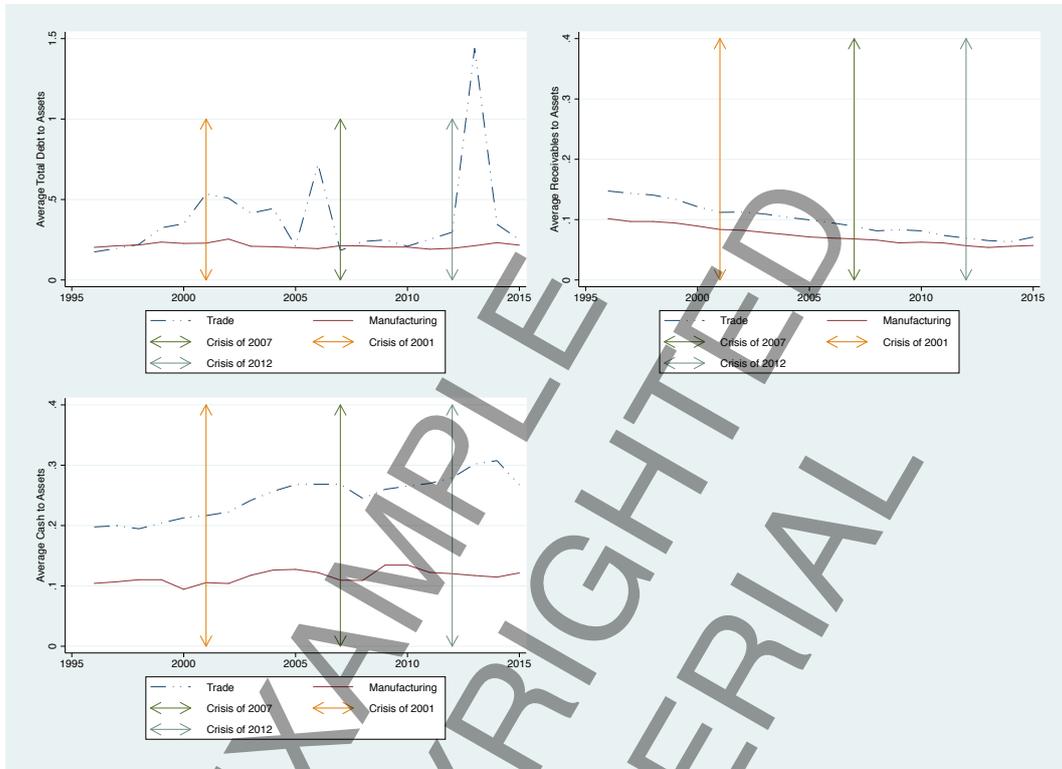
4. Regression Results

The data is further subdivided in three panels: 1996-2003, 2004-2009 and 2010-2015.

The base first differenced model has been estimated in FE, Arellano-Bond and Population Averaged methods (AB is always successfully tested for autocorrelation, but in the first two panels the over-identifying hypothesis is mostly rejected whereas instruments are considered valid in the third panel).

The financial constraint is defined by the acid test; leverage, trade debt and internal funds are proxied by the ratios of long term debt, accounts receivable and cash/short-term investments to total assets, respectively.

In the first panel correlation of right-hand regressors with the error component is the highest (less than 0.25 with exception of lagged sales at 0.65), thus we decide to consider it as slightly affecting the model without qualitative consequences. The estimations substantially agree assigning significance to financial variables and internal resources with expected signs, but leverage do not appear to be relevant (in some way expected, accordingly to the increase in availability of funds to pay for interest noted in section 3) and the coefficient for the reduction in inventories determined by financial constraints is very small. Similar results are obtained in the other panels.

However, insights should be more interesting once the equations are augmented with dummy variables accounting for size and riskiness of firms and interacting with the financial variable group. Years dummies are included as well to control for time effects and determine whether results are sensitive to recessionary periods.

1996-2003

Variable	fe	ab	pa
ldinvt			
LD.	-0.2663***	-0.1384***	-0.1673***
ldsales			
D1.	0.5220***	0.5902***	0.5584***
LD.	0.1858***	0.1459***	0.1617***
alev			
L1.	0.0738*	0.0366	0.0349
atdebt			
L1.	1.7320***	0.3676***	0.3259***
acash			
L1.	0.9579***	0.1860***	0.2047***
acid			
L1.	-0.0000***	0.0000	-0.0000
_cons	-0.3936***	-0.0971***	-0.0909***
N	17226	17226	17226
r2	0.2891		
r2_o	0.1769		
r2_b	0.0922		
r2_w	0.2891		
sigma_u	0.3833		
sigma_o			
rho	0.4759		

legend: * p<.05; ** p<.01; *** p<.001

2004-2009

Variable	fe	ab	pa
ldinvt			
LD.	-0.3042***	-0.1677***	-0.1299***
ldsales			
D1.	0.5170***	0.6140***	0.5502***
LD.	0.1557***	0.1166***	0.1050***
alev			
L1.	0.0182	0.0024	0.0074
atdebt			
L1.	1.0722***	0.2908***	0.2564***
acash			
L1.	0.7711***	0.1099***	0.1041***
acid			
L1.	-0.0000***	0.0000**	0.0000**
_cons	-0.2441***	-0.0449***	-0.0418***
N	14295	14295	14295
r2	0.2613		
r2_o	0.1531		
r2_b	0.0573		
r2_w	0.2613		
sigma_u	0.3782		
sigma_o			
rho	0.4775		

legend: * p<.05; ** p<.01; *** p<.001

2010-2015

Variable	fe	ab	pa
ldinvt			
LD.	-0.3821***	-0.1997***	-0.1989***
ldsales			
D1.	0.4643***	0.5384***	0.5105***
LD.	0.1497***	0.1404***	0.1421***
alev			
L1.	0.0324	0.0037	0.0022
atdebt			
L1.	1.9339***	0.2866**	0.2674*
acash			
L1.	0.7653***	0.1616***	0.1683***
acid			
L1.	-0.0000**	-0.0000	-0.0000
_cons	-0.2835***	-0.0409***	-0.0371**
N	10351	10351	10351
r2	0.2538		
r2_o	0.1321		
r2_b	0.0548		
r2_w	0.2538		
sigma_u	0.4037		
sigma_o			
rho	0.5403		

legend: * p<.05; ** p<.01; *** p<.001

1996-2003

Variable	fe	ab	pa
ldinvt			
LD.	−0.2719***	−0.0743**	−0.1718***
ldsales			
D1.	0.5057***	0.4811***	0.5410***
LD.	0.1791***	0.0783**	0.1606***
alev			
L1.	−0.1384***	0.6595	−0.0464***
atdebt			
L1.	1.3401***	1.9538	0.1566**
acash			
L1.	0.8529***	1.5050	0.1628***
acid			
L1.	−0.0000**	−0.0001	−0.0000**
size			
0	−0.0231	(empty)	−0.2470**
1	−0.2371**	0.6683	−0.2209***
2	−0.0269	−0.0014	−0.0568*
3	(omitted)	1.0425	(omitted)
size#cL.alev			
0	0.3845***	−1.0051	0.2180***
1	0.2410***	−1.1080	0.1072***
2	0.0888	0.6427	0.0113
3	(omitted)	0.0000	(omitted)
size#cL.atdebt			
0	−0.1530	4.5414	0.4112
1	0.5522	0.0000	0.4121*
2	−0.0303	2.5908	0.0459
3	(omitted)	−4.5763	(omitted)
size#cL.acash			
0	0.1001	−1.4527	0.1905
1	0.2531	0.0000	0.2619**
2	0.0181	−0.2348	0.1039
3	(omitted)	−1.0977	(omitted)
size#cL.acid			
0	0.0013	0.0039	0.0075*
1	−0.0030	−0.0147	−0.0013
2	−0.0010	−0.0045	−0.0005
3	(omitted)	0.0001	(omitted)
fyr1	(omitted)	0.0000	(omitted)
fyr2	(omitted)	0.0000	(omitted)
fyr3	0.0951***	0.1275***	0.0725***
fyr4	0.0644***	0.0702*	0.0442***
fyr5	0.0838***	0.0937**	0.0806***
fyr6	0.0019	−0.0099	−0.0145
fyr7	0.0064	−0.0089	0.0042
fyr8	(omitted)	0.0000	(omitted)
_cons	−0.3124***	−0.9645	−0.0534***
N	17226	17226	17226
r2	0.3029		
r2_o	0.1949		
r2_b	0.0960		
r2_w	0.3029		
sigma_u	0.3762		
sigma_o			
rho	0.4710		

legend: * p<.05; ** p<.01; *** p<.001

Small firms are progressively more affected by the financial constraint, generally in a disadvantaged position compared to the larger counterparts; as expected, the relation loses significance in recessionary years. However, small but less risky firms are not affected by the financial constraint, but rather helped by the level of long term debt to assets. Thus, the corresponding flexible financial policy should be differently characterized depending on the size of the firm: small firms rely more on debt, whereas larger firms rely more on retained earnings.

1996-2003

Variable	fe	ab	pa
ldinvt			
LD.	−0.2742***	−0.1231**	−0.1733***
ldsales			
D1.	0.5041***	0.4868***	0.5384***
LD.	0.1764***	0.1148*	0.1596***
alev			
L1.	−0.0915	2.2779	−0.0097
atdebt			
L1.	3.0059**	24.0955	2.4157*
acash			
L1.	1.2042*	−4.5361	0.5282
acid			
L1.	−0.0000	0.0004	0.0130
size			
0	0.1163	−1.7198	−0.0638
1	−0.1969*	(empty)	−0.1593***
2	−0.0207	−0.2863	−0.0439
3	(omitted)	0.0170	(omitted)
risk			
0	0.4560*	−1.7581	0.4214
1	0.2327	−4.1122	0.2229
2	0.0281	(empty)	0.1636
3	(omitted)	−2.2688	(omitted)
size#cL.alev			
0	0.6308***	−0.2316	0.3567**
1	0.2632***	−2.1671	0.1269***
2	0.0886	−0.4256	0.0191
3	(omitted)	0.0000	(omitted)
risk#cL.alev			
0	−0.0562	−1.2253	−0.0417
1	−0.0413	0.0000	−0.0613
2	−0.3467	−2.6191	−0.2134
3	(omitted)	−0.7561	(omitted)
size#cL.atdebt			
0	−0.5624	0.0000	−0.2640
1	0.4385	−10.6732	0.2362
2	−0.0555	−6.5569	0.0104
3	(omitted)	−12.9108	(omitted)
risk#cL.atdebt			
0	−1.7468	−12.9463	−2.2817
1	−1.1087	−11.0561	−1.8144
2	−0.7425	−23.7378	−1.4256
3	(omitted)	0.0000	(omitted)
size#cL.acash			
0	−0.1063	0.0000	−0.0236
1	0.2032	2.7249	0.1817*
2	0.0053	0.3859	0.0747
3	(omitted)	1.1021	(omitted)
risk#cL.acash			
0	−0.4092	3.8369	−0.3755
1	−0.0382	8.2104	−0.0654
2	0.3003	4.3253	−0.0690
3	(omitted)	0.0000	(omitted)
size#cL.acid			
0	0.0015	0.0448	0.0067
1	−0.0031	−0.0147	−0.0016
2	−0.0010	−0.0025	−0.0005
3	(omitted)	−0.0004	(omitted)
risk#cL.acid			
0	0.0000	0.0000	−0.0130
1	0.0000	0.0006	−0.0130
2	−0.0361	−0.0857	−0.0510
3	−0.0266	1.3962	0.0000
fyr1	(omitted)	0.0000	(omitted)
fyr2	(omitted)	0.0000	(omitted)
fyr3	0.0964***	0.0000	0.0742***
fyr4	0.0648***	−0.0534	0.0459***
fyr5	0.0836***	−0.0318	0.0815***
fyr6	0.0043	−0.1274*	−0.0118
fyr7	0.0074	−0.1227	0.0060
fyr8	(omitted)	−0.1073	(omitted)
_cons	−0.7397**	1.7565	−0.4660
N	17226	17226	17226
r2	0.3114		
r2_o	0.2055		
r2_b	0.1079		
r2_w	0.3114		
sigma_u	0.3732		
sigma_o			
rho	0.4698		

legend: * p<.05; ** p<.01; *** p<.001

2004-2009

Variable	fe	ab	pa
ldinvt			
LD.	−0.3043***	−0.1770***	−0.1301***
ldsales			
D1.	0.5236***	0.6220***	0.5466***
LD.	0.1605***	0.1194***	0.1021***
alev			
L1.	−0.0613	0.0267	−0.0030
atdebt			
L1.	0.8925***	2.4509	0.0063
acash			
L1.	0.6586***	−0.1996	0.1395***
acid			
L1.	−0.0000***	−0.0000	0.0000
size			
0	0.1360	0.7254	−0.1805**
1	−0.0335	(empty)	−0.1364**
2	−0.1087	−0.3364	−0.0411
3	(omitted)	0.6814	(omitted)
size#cL.alev			
0	0.0801	−0.0878	0.0164
1	0.1088	0.2398	0.0460
2	0.0766	−0.6357	−0.0221
3	(omitted)	0.0000	(omitted)
size#			
cL.atdebt			
0	−0.3060	−1.8269	0.7880*
1	0.0340	−2.0850	0.5929*
2	0.8758**	0.0000	0.3219*
3	(omitted)	−1.5768	(omitted)
size#			
cL.acash			
0	0.2604	0.0000	0.1079
1	0.3133	0.2559	0.1156
2	0.1013	1.3429	−0.0329
3	(omitted)	0.3741	(omitted)
size#cL.acid			
0	−0.0024	0.0195	−0.0004
1	−0.0023	0.0103	−0.0024
2	−0.0001	0.0010	−0.0003
3	(omitted)	−0.0000	(omitted)
fyr1	(omitted)	0.0000	(omitted)
fyr2	(omitted)	0.0000	(omitted)
fyr3	(omitted)	0.0000	(omitted)
fyr4	(omitted)	0.0000	(omitted)
fyr5	(omitted)	0.0000	(omitted)
fyr6	(omitted)	0.0000	(omitted)
fyr7	(omitted)	0.0000	(omitted)
fyr8	(omitted)	−0.0239*	(omitted)
_cons	−0.2112***	−0.6233	−0.0049
N	14295	14295	14295
r2	0.2649		
r2_o	0.1419		
r2_b	0.0439		
r2_w	0.2649		
sigma_u	0.3891		
sigma_o			
rho	0.4926		

legend: * p<.05; ** p<.01; *** p<.001

Medium firms show increasing balances of receivables; small and medium businesses at risk of not generating enough cash to pay interest on long term debt appear to reduce more their inventories to accumulate cash (PA did not converge). When accounting for risk, the impact of internal funds doubles.

2004-2009

Variable	fe	ab
ldinvt		
LD.	−0.3020***	−0.1598***
ldsales		
D1.	0.5165***	0.6075***
LD.	0.1591***	0.1235***
alev		
L1.	−0.0034	−0.5965
atdebt		
L1.	2.1542	−4.4989
acash		
L1.	2.4467**	−0.7583
acid		
L1.	0.0000	−0.0782
size		
0	0.2148	0.9152
1	−0.0038	(empty)
2	−0.1112	−0.1492
3	(omitted)	1.1444*
risk		
0	0.6819*	−1.1693
1	0.7458**	0.1583
2	0.4097	0.1166
3	(omitted)	(empty)
size#cL.alev		
0	0.2141***	−0.5638
1	0.1822	0.0000
2	0.1040	−1.4784
3	(omitted)	−0.6437
risk#cL.alev		
0	−0.0480	1.2866
1	−0.2371	1.0607
2	−0.1456	1.0598
3	(omitted)	0.0000
size#		
cL.atdebt		
0	−0.7034	−0.0276
1	−0.1191	0.0000
2	0.8557**	2.6399
3	(omitted)	−0.3447
risk#		
cL.atdebt		
0	−1.2476	6.0223
1	−1.4148	0.0000
2	−0.3349	5.8982
3	(omitted)	5.7830
size#		
cL.acash		
0	0.1685	−1.1501
1	0.2529	−0.1914
2	0.1038	0.0000
3	(omitted)	−0.5761
risk#		
cL.acash		
0	−1.7815*	1.9307*
1	−1.8300*	0.0000
2	−1.5570	−0.1119
3	(omitted)	11.6190*
size#cL.acid		
0	−0.0024	0.0032
1	−0.0018	0.0000
2	−0.0001	−0.0089
3	(omitted)	−0.0113
risk#cL.acid		
0	−0.0000	0.0895
1	−0.0000	0.0894
2	−0.0648	0.0000
3	−0.2700	−2.3056*
fyr1	(omitted)	0.0000
fyr2	(omitted)	0.0000
fyr3	(omitted)	0.0000
fyr4	(omitted)	0.0000
fyr5	(omitted)	0.0000
fyr6	(omitted)	0.0000
fyr7	(omitted)	0.0000
fyr8	(omitted)	−0.0170
_cons	−0.8941**	−0.0110
N	14295	14295
r2	0.2743	
r2_o	0.1516	
r2_b	0.0544	
r2_w	0.2743	
sigma_u	0.3864	
sigma_o		
rho	0.4919	

legend: * p<.05; ** p<.01; *** p<.001

2010-2015

Variable	fe	ab	pa
ldinvt			
LD.	−0.3762***	−0.1938***	−0.2039***
ldsales			
D1.	0.4566***	0.5128***	0.4964***
LD.	0.1483***	0.1245***	0.1409***
alev			
L1.	−0.2051***	0.2301	−0.0284
atdebt			
L1.	2.0211***	−2.3401	0.1717*
acash			
L1.	0.6606***	−0.3344	0.1717***
acid			
L1.	−0.0000**	0.0001	−0.0000**
size			
0	0.2313	0.0340	−0.2090**
1	0.0585	−0.6365	−0.1320**
2	0.2314	(empty)	0.0002
3	(omitted)	−0.1157	(omitted)
size#cL.alev			
0	0.2489***	−0.2114	0.0413*
1	0.2202***	−0.4130	−0.0011
2	0.2173	−0.9674	0.0585
3	(omitted)	0.0000	(omitted)
size#cL.atdebt			
0	0.6032	2.7268	1.0219
1	0.6496	7.0829	0.4485
2	−1.2332	0.0000	−0.2967
3	(omitted)	3.9141	(omitted)
size#cL.acash			
0	0.2138	0.0000	0.1294
1	0.5540*	0.8694	0.1032
2	0.2396	1.1571	0.1104
3	(omitted)	0.6911	(omitted)
size#cL.acid			
0	−0.0051	−0.0067	−0.0029
1	−0.0048	−0.0020	0.0002
2	−0.0031	−0.0017	−0.0009
3	(omitted)	−0.0001	(omitted)
fyr1	(omitted)	0.0000	(omitted)
fyr2	(omitted)	0.0000	(omitted)
fyr3	(omitted)	0.0000	(omitted)
fyr4	(omitted)	0.0000	(omitted)
fyr5	(omitted)	0.0000	(omitted)
fyr6	(omitted)	0.0000	(omitted)
fyr7	(omitted)	0.0000	(omitted)
fyr8	(omitted)	0.0000	(omitted)
_cons	−0.2830***	−0.0203	−0.0058
N	10351	10351	10351
r2	0.2651		
r2_o	0.0964		
r2_b	0.0247		
r2_w	0.2651		
sigma_u	0.4440		
sigma_o			
rho	0.5904		

legend: * p<.05; ** p<.01; *** p<.001

In this panel AB showed the greatest level of validity of instruments (thus reducing endogeneity), but the only significant factors are inventories and sales. Fe yields small firms levels of inventories are positively affected by cash and debt, pointing to the same conclusions of the previous panel.

The financial constraint loses significance once firms are characterized by risk, suggesting that the global recession did not restrict access to financial markets (as expected, given the amount of liquidity advanced by central banks). Omitted variables (and thus time invariant) confirm the generality of the relationship.

2010-2015

Variable	fe	ab	pa
ldinvt			
LD.	−0.3761***	−0.1854***	−0.2030***
ldsales			
D1.	0.4558***	0.5039***	0.4965***
LD.	0.1461***	0.1333***	0.1421***
alev			
L1.	−0.1476	0.2297	0.0126
atdebt			
L1.	6.3404	−5.4287	5.8037
acash			
L1.	−0.9309	−0.5929	−1.2145
acid			
L1.	0.0164	−0.0109	0.0021
size			
0	0.2176	−0.2086	−0.1698
1	0.0472	−1.0490	−0.1254**
2	0.2128	(empty)	−0.0028
3	(omitted)	−0.2589	(omitted)
risk			
0	0.2176	1.8550	0.2494
1	0.2837	1.7418	0.2338
2	0.2546	1.7697	0.2345
3	(omitted)	(empty)	(omitted)
size#cL.alev			
0	0.2038	−0.4967	−0.0142
1	0.1894	−0.3434	−0.0109
2	0.2227	−1.2021	0.0533
3	(omitted)	0.0000	(omitted)
risk#cL.alev			
0	−0.0648	0.0746	−0.0475
1	0.0265	0.0000	0.0074
2	−0.0068	0.3109	0.0182
3	(omitted)	0.3009	(omitted)
size#cL.atdebt			
0	0.6908	3.9042	1.1565
1	0.7611	9.7581	0.5421
2	−1.0560	0.0000	−0.2097
3	(omitted)	4.7156	(omitted)
risk#cL.atdebt			
0	−4.2219	2.3345	−5.5974
1	−5.6465	0.0000	−6.4290
2	−4.3389	1.3151	−6.2324*
3	(omitted)	13.0656	(omitted)
size#cL.acash			
0	0.2504	0.0000	0.0372
1	0.5601*	1.2386	0.0924
2	0.2492	0.8675	0.1097
3	(omitted)	0.7715	(omitted)
risk#cL.acash			
0	1.5841	0.1323	1.3879
1	1.5832	1.1003	1.4746
2	1.6603	0.6908	1.6168
3	(omitted)	0.0000	(omitted)
size#cL.acid			
0	−0.0051	−0.0657	−0.0022
1	−0.0047	−0.0648	0.0000
2	−0.0032	−0.0652	−0.0009
3	(omitted)	−0.0643	(omitted)
risk#cL.acid			
0	−0.0164	0.0752	−0.0021
1	−0.0164	0.0751	−0.0021
2	−0.0934	0.0000	−0.0595
3	(omitted)	0.6005	(omitted)
fyr1	(omitted)	0.0000	(omitted)
fyr2	(omitted)	0.0000	(omitted)
fyr3	(omitted)	0.0000	(omitted)
fyr4	(omitted)	0.0000	(omitted)
fyr5	(omitted)	0.0000	(omitted)
fyr6	(omitted)	0.0000	(omitted)
fyr7	(omitted)	0.0000	(omitted)
fyr8	(omitted)	0.0000	(omitted)
_cons	−0.5024	−1.7264	−0.2545
N	10351	10351	10351
r2	0.2697		
r2_o	0.1014		
r2_b	0.0311		
r2_w	0.2697		
sigma_u	0.4406		
sigma_o			
rho	0.5877		

legend: * p<.05; ** p<.01; *** p<.001

5. Conclusions

Manufacturing firms show a more dynamic relation of inventories to the examined variables, whereas only small trade firms share a similar behavior probably because of the easier liquidation of finished consumer goods. Cash has been significant in all panels, therefore characterizing the short-term financial policy: small (medium) firms rely more on long term debt, whereas larger firms rely more on retained earnings. Generally, financial constraints effects are less evident once risk is accounted for but this component is more irrelevant for firms characterized by a dimensional advantage.

Some correlation of inventories and sales with the error component exists: fixed effects are mean differenced away; time dummies are used to address time effects; industry effects are not investigated. The two-step Arellano-Bond method is employed to provide a reference for the biased Within estimator, although in the two first panel the validity for the set of instruments is low; data is also population averaged to evidence discrepancies and to test whether pooling subtracts information. Predominantly, significant regressors agree in sign and magnitude across estimators but year dummies progressively lose importance in the last two panels, suggesting that relevant aspects of the short-term financial policy assume a time invariant behavior: we advance the hypothesis that short-term needs are absorbed in long term working capital financed with long term debt, thus insensitive to recessionary years unless such liabilities are in coincidence re-negotiated. Regressions are performed twice using size dummies with two different measures: in both cases, firms classified as small and medium show the same characteristics compared to larger counterparts notwithstanding sales are 100 times greater, thus suggesting it is the relationship between small/medium and large businesses to be stable across different parametrization of the dimensional measure.

However, the data does not include relevant information to draw a final conclusion (for instance the use by small firms of cheap, collateralized long term debt to provide funds for investments and continuing operations; the number of markets of presence; the degree of industry integration specific to the firm; other forms of definition of risk, etc.). Moreover, small firms could be better characterized by using the information about their age of operations. Essentially, risk is not precisely defined and the approach shares the same difficulties of previous studies. Finally, we suggest how the decreasing relevance of financial constraints could be interpreted:
- in terms of higher integration in the national political and economic system, rather than higher profitability or lower riskiness of operations
- in terms of higher diversification in different geographical and political markets, thus reducing the impact of downturn independently of its nature

Similarly, the higher sensitivity of smaller firms can be justified on the ground of a reduced impact on the national economy, as well as a reduced access to global financial markets and an increased exposure to the direct and indirect effects of local, national and international downturns. Further attention should be given to the role of trade debt, for instance investigating the relationship of small firms with industrial districts, the industry-wide vertical integration and the firm-specific upward/downward supply chain counterparts.

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