TESTING THE PARTIAL ADJUSTMENT MODEL OF OPTIMAL CASH HOLDING: EVIDENCE FROM AMMAN STOCK EXCHANGE

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Abstract

This study aims at testing the partial adjustment model of cash holdings to investigate whether Jordanian industrial firms have a target cash holdings and how fast they move toward that target when any target deviation exists. A sample of 57 industrial firms listed in the Amman Stock Exchange (ASE) over the period 2001-2013 is used. The study uses the estimated fitted values from the conventional cash equation as a proxy for the target cash holding. Using pooled and panel data analysis, the study provides evidence suggesting that cash flows, net working capital, leverage and firm size significantly affect the cash holdings of Jordanian firms. Moreover, it reveals that Jordanian industrial firms have a target cash level and make a target reversion whenever needed. However, Jordanian industrial firms adjust their actual cash holdings to its target level too slowly.

Keywords: Cash Holdings, Trade-off Theory, Pecking Order Theory, Agency Theory of Free Cash Flow, Partial Adjustment Model

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1 Introduction

The perfection assumption of capital market suggests that firms should not show any preferences of internal over external financing. Both internal and external financing are perfectly substitute for each other. Consequently, there is no need for holding cash to meet any shortage in external financing as long as external funds can be raised at any time needed. On the other hand, when frictions exist, capital markets are no longer perfect. This may restrict the firm's ability to generate funds externally. Hence, external and internal financing are not perfect substitutes for each other. Consequently the need for holding cash increases in order to avoid under investment problem that might arise because of the presence of agency and bankruptcy costs of using external financing (Jensen & Meckling 1976). Consistent with this argument, Acharya *et al.* (2005) argue that, in the presence of financing frictions, cash plays a separate role and should therefore be managed and studied in its own right. The main problem in developing countries in general is the lack of sources of funds and the reliance on internal financing to take the advantages of investment opportunities. In Jordan, the capital market has been described as imperfect, less developed and all frictions are relevant and may affect the firm's investment, financing and dividend policy decisions. This, along with the fact that banks credit policy is largely affected by the uncertainty condition in the world and the region. Such conditions make Jordanian firms show a preference of internal over external financing and increase the need for holding cash.

The most relevant theoretical models that can explain determinants of the cash holding level are the trade-off theory, the pecking order theory and the agency theory. According to the trade off theory, firms trade off the costs and benefits of cash holdings to maximize the value, implying that the presence of cash holding costs may outweigh its benefits.[1] This suggests that there is some threshold level of cash holdings under which the firm's value is maximized. This threshold of cash is generally called the optimal (target) level of cash holdings. Hence, the observed cash holding is not always the optimal level which increases the necessity of target adjustment when deviation from that target exists.

With respect of pecking order theory, issuing new equity is very costly for firms because of information asymmetries. Therefore, firms finance their new investment opportunities primarily with internal funds, then with debt and finally with equities as the last resort. Extending the pecking order theory of Myers & Majluf (1984) and Myers (1984) to explain what determine cash holdings leads to the conclusion that there is no optimal cash level but cash is used as a buffer between retained earnings and

[1] The benefits of holding cash are the reduction of transaction cost for precautionary needs and the cash allowance for speculation, while, the costs are the opportunity cost and liquidity premium.

investment needs, implying that cash level would just be the result of financing and investment decisions. Few studies provide evidence supporting the prediction of pecking order theory such as Kalcheva & Lins (2003) who conclude that cash is positively related to the growth opportunities of the company, its size and cash flow. Whilst, negatively related to the level of debt and capital expenditures.

The agency theory of Jensen & Meckling (1976) provides another explanation as to why firms hold cash. It states that managers hold cash and other liquid assets in order to minimize the cost of external finance. Dittmar *et al.* (2003) find evidence suggesting that firms hold more cash in countries with greater agency problems. Dittmar & Mahrt-Smith (2007) and Pinkowitz *et al.* (2006) find that cash is worth less, when agency problems between insiders and outside shareholders are greater.

According to Alles *et al.* (2012), tradeoff model, pecking order theory and agency theory of free cash flow complement each other and work together to explain the existence of target cash level. Although a cash holding is considered as one of the most important topics of corporate finance, there are few studies that focus on the partial adjustment of corporate cash holding. Most of the studies focused on investigating the determinants of firms' cash level, mainly of large public and private firms in developed economies (i.e. Ozkan & Ozkan, 2004 and Alles *et al.*, 2012) with less attention is paid to this topic in less developed countries including Jordan.

In Jordan, where the capital market is imperfect, market frictions such as information asymmetry agency and bankruptcy costs are applicable and influence a firm's investment and financial decisions and thereby its value. Moreover, it is a thin and a small market, making the cost of raising external funds in primary market relatively high which increases the reliance on internally generated funds. However, information asymmetries and agency costs restrict the firms' ability not only to raise funds externally, but also to raise funds internally, supporting the information content of dividend payment (see, Baskin, 1989). This makes cash management decisions too important for Jordanian listed companies in Amman Stock Exchange(ASE).

Therefore, this study tries to investigate whether Jordanian industrial companies have target cash holdings and how fast do they move towards that target if any deviations exist by testing the partial adjustment model of cash holding using a sample of 57 Jordanian Industrial firms listed in the ASE over the period of (2001- 2013). For this purpose, the current study uses fitted values estimated by using the conventional cash equation as a proxy for target cash holdings level.

This paper is organized as follows. Section 2 presents theoretical framework and a related literature review. Section 3 discusses the research methodology. Section 4 presents the estimation results with some conclusions and recommendations.

2 Theoretical framework and literature review

The theoretical background of cash holdings refers to Modigliani & Miller (1958) who stated that, under the perfection assumption of capital market, holding large amounts of cash is irrelevant because all companies can borrow and lend at the same rate and can easily finance their profitable investment projects at negligible transaction costs. The absence of market frictions such as transaction, bankruptcy, agency and information costs makes firms show no preferences of internal financing over external financing. Hence, the firm's decision to hold cash is not related to, or affected by other financial decisions.

However, when transaction costs, agency costs and information asymmetries are considered, firms' investment decisions become highly sensitive to the cash holdings. This suggests that the firm's decision to hold cash is largely affected by capital market frictions. More precisely, it is largely affected by the costs and benefits of cash holding when firms are restricted to raise funds externally, implying that there is an optimal cash level that balances costs and benefits and thus maximizes the firm's value (Garcia-Teruel & Martinez-Solano, 2008). Moreover, empirical evidence shows that any deviations from the optimal level reduce firm value. This implies that firms can increase their market value merely by being around the optimal level of cash, which seems consistent according to the trade-off between benefits and cost of cash holdings.

In the absence of adjustment cost and the costs of liquidating assets, firms would always have and maintain their target cash ratio by changing its existing ratio to equal its target cash ratio. On the other word, each firm's observed cash ratio should be its optimal ratio. However, the presence of adjustment costs may restrict the firm's ability to back immediately to its target level. Thus, when the observed level of cash deviates from its optimal level, firms will gradually adjust that level to the optimal level in a process referred to as the partial adjustment process (Jalilvand & Harris, 1984; Taggart, 1977). The partial adjustment mechanism allows for firms' observed cash ratio not always to be equal to their optimal level. Hence, the dynamic trade-off theories, not the static trade-off theory, will be able to capture the dynamic change in firms cash holdings. Dynamic behavior exists because the presence of market frictions may limit the firm's ability to manage their cash level, causing them to deviate from optimal levels and consequently increasing the need for target reversion to maximize value (Kim *et al.*, 2011).

Moreover, it may not be appropriate for firms to immediately adjust their target deviations when the cost of moving toward target level is higher than that

of being away from the target (Alles *et al*., 2012). This suggests that firms will make target-reversion when the benefit of moving toward the target level is higher than the cost of being away from the target. In addition, Bruinshoofd (2009) found that firms increase their level of cash holdings from an insufficient level to a target level more rapidly than they decrease their level from an excessive level to a target level. Therefore, firms are very concerned about the speed by which they move toward their target cash levels because of high adjustment costs. Few studies recognize and incorporate the dynamic nature of cash holdings.

Therefore another trend of research appears to examine the existence of partial adjustment model of cash holding. Whether adjustment frictions, such as those that affect capital structure decisions, influence cash holding decisions is an important research question because of their consequences on the shareholder wealth which associated with deviating from optimal levels of liquid assets, especially for financially constrained firms (Denis & Sibilkov, 2010).

Bruinshoofd and Kool (2004**)** collect data from Dutch firms and investigate the existence of long-run liquidity targets. Depending on the empirical methodology, they document that the rates of annual target convergence range from 20 percent to over 60 percent which supports the dynamic nature of the cash-holding decision, which is characterized by a trade-off between the costs of deviation from the target and the costs of adjustment. Slow adjustment process is attributed to adjustment cost and therefore a firm's actual cash level is not necessarily identical to the desired cash holding level.

Ozkan and Ozkan (2004**)** estimate a partial adjustment model of cash holdings for a sample of U.K. firms and find that a dynamic model of cash holding behavior is better suited than the static models employed in the extant literature. They find that the estimated target-adjustment coefficient has a positive value of 0.54, implying that UK companies adjust their target deviation too quickly and supporting the view that firms always adjust towards a target cash ratio. Drobetz and Grüninger (2006) analyze Swiss firms' speed of adjustment towards an endogenous target cash ratio, using dynamic panel estimation. They find that the speed of target adjustment of Swiss firms is between 0.35 and 0.5, indicating that Swiss firms adjust their liquidity holdings more slowly towards an endogenous target cash ratio than firms in other countries. They suspect that the most reasonable explanations are based on the strong influence of banks in Switzerland and/or the unfavorable economic conditions during the sample period that entail low costs of deviation from the target.

Guney *et al.*(2006) investigate corporate cash holding behavior in Japan, France, Germany, and the UK using data for 3,989 companies over the period 1983-2000. Their findings reveal that the dynamic cash holding analysis indicates that firms tend to adjust their cash levels towards a target cash structure. The speed of adjustment of cash holdings for France, Germany and Japan is found to be similar (adjustment coefficient is approximately 0.5),while firms in the UK seem to adjust to the target cash level more quickly. This possibly, may suggest that when adjustment costs are higher, resulting in lower speeds of adjustment. According to their study, the lower speed of adjustment for Japan and Germany can be explained by the fact that German firms and Japanese firms have close ties with their banks and depend on them for external financing. It is feasible for them to adjust slowly towards their target level without incurring a high level of agency cost. Overall, the results lend strong support to the dynamic nature of the cash holding decision of firms. Firms tend to trade-off between costs of speedy adjustment and costs of delay in achieving the target cash structure.

Empirical studies also indicate that the speed of adjustment towards target levels varied among different samples with different firm characteristics and at different cash positions. For example, using a dynamic adjustment model to analyze the cash-holding behavior of small and medium-sized firms (SMEs) in Spain, Garcia-Teruel and Martinez-Solano (2008) find that SMEs aim to achieve a target level of cash holdings and that they adjust their actual level towards the target level more rapidly than large firms do in developed countries.

Another related study by Jiang and Lie (2010) estimates that firms close about 36% of the gap between actual and target cash ratios each year. They further document that across all sample firms, the adjustment speed is slower if the cash level is above the target than if it is below. They interpret this as evidence that self-interested managers are reluctant to disburse excess cash, and will allow cash levels to remain high unless they are subject to external pressure and this is consistent with the argument of Opler *et al*. (1999).

Using a sample of U.S. manufacturing firms, Venkiteshwaran (2011**)** estimates a dynamic model that allows firms to adjust their cash holding levels over time and find evidence consistent with trade-off type behavior in cash holding levels. He finds a very strong mean reversion in cash holding levels to optimal levels and that any deviations from optimal cash levels are rapidly corrected, typically within two years for the average firm in the sample. He also finds that this adjustment rate is faster for small, financially constrained firms than for larger firm consistent with the expectation that constrained firms may find it more costly to operate at sub-optimal levels of cash. Further, he finds that firms with excess cash are slower to return to optimal levels than firms that have cash deficiencies. His findings are similar to those reported in Ozkan and Ozkan (2004) for a sample of U.K. firms, but inconsistent with the finding reported by Dittmar and Duchin(2011) for U.S. firms who

report a slower adjustment rates for a broader sample of firms; firms need three to six years to correct any deviations from optimal levels. They also find that, on average, cash deficient firms are slower to adjust to optimal levels compared to firms with surpluses and attribute this finding to asymmetric adjustment costs associated with building versus spending cash reserves.

3 Research methodology

The study uses pooled and panel data analysis which is usually estimated by either fixed effect or random effects technique.

As the current study aims at investigating the target adjustment path of Jordanian firms, the conventional cash equation is used to estimate the target cash holding. This is because the target cash holding itself is unobservable. Previous studies have analyzed determinants of cash holdings assuming implicitly the existence of optimal cash holding (Opler *et al*., 1999; Kim *et al.*, 1998).In addition, Opler *et al*.(1999) estimate the optimal cash holding as a moving average of past cash holding levels.

Consistent with the majority of previous studies (e.g. Opler *et al.*, 1999, Dittmar *et al.*, 2003, Kalcheva & Lins, 2003, Ferreira & Vilela, 2004 and Bates *et al.*, 2009) which have identified a set of firm specific characteristics that influence the target level of cash holdings of firms, the current study uses firm specific characteristics as predictors for target cash holdings of listed Jordanian firms.

It is worth noting that the selection of explanatory variables in the current study is based on alternative theories that might be responsible for the corporate cash holdings and can be found in the literature. However, the choice is sometimes limited, due to lack of relevant data. Following Opler *et al.*, (1999) and Bates *et al*., (2009) in the selection of independent variables, the following variables are selected; firm size, growth opportunity (the market to book ratio), cash flow, net working capital, capital expenditure, leverage ratio and profitability.

The current study employs the following static model to investigate the determinants of optimal cash holding of listed Jordanian industrial firms in the Amman Stock Exchange. In this model, the observed cash holding is modeled as a function of the various firm-specific factors has been discussed above.

$$Cash_{it} = \lambda_0 + \beta_1 Grth_{it-1} + \beta_2 FSiz_{it-1} + \beta_3 NWC_{it-1} + \beta_4 prof_{it-1} + \beta_5 Lev_{it-1} + \beta_6 Cflow_{it-1} + \beta_7 CExp_{it-1} + \varepsilon_{it} \quad (1)$$

Where Cash: is the dependent variable and measured by the ratio of cash and cash equivalent to total assets (e.g. Kim *et al*., 1998; Opler *et al*., 1999; Ozkan and Ozkan, 2004; Bruinshoofd and Kool, 2004).

Grth is the Growth opportunity and measured by market to book ratio.

FSiz is the Firm size, and measured by the natural logarithm of total assets.

NWC is Net working capital and measured by current assets minus current liabilities minus cash.

Prof is the firm's profitability *and* measured as the ratio of earnings before interest and tax (EBIT) divided by total assets.

Lev is the leverage ratio and measured by the ratio of total liabilities to total assets.

Cflow is the cash flows. Operating cash flows are calculated by EBIT+ Depreciation- Taxes.

CExp is the firm's capital expenditure is measured as the yearly change in fixed assets added to depreciation.

ε is the error term which represents all random variables that are not included in the model.

3.1 Target adjustment model of cash holding

To investigate whether Jordanian listed industrial firms have targeted cash ratio and move gradually toward their target ratio when any deviations exist, the static-partial adjustment models are adopted. Prior studies have used several methods to estimate the adjustment speed for cash levels. This study will follow the theoretical framework developed by Opler *et al*. (1999), who argue that firms' optimal cash holdings are determined by the tradeoff between the marginal costs and benefits of holding liquid assets. They emphasize the persistence of cash holdings and the existence of implicit target cash levels. They test the validity of the static trade-off theory, using a partial adjustment model to provide evidence for the presence of target level of cash holdings. The underlying assumption of this model is that, firms optimally balance the costs and benefits of cash holdings to maintain their target level of cash reserves. Moreover, firms may not be always in equilibrium at their target level of cash holdings. A delay in target adjustment exists because of its adjustment costs (Nicolusc, 2005). The presence of adjustment costs may restrict the firms' ability to make target reversion immediately, suggesting the occurrence of partial adjustment toward the target level (Opler *et al.*, 1999; Kim *et al*., 1998).

Hence, the firms' observed cash ratio will be at their target level only if no adjustment costs exist. The speed of target adjustment, when target reversion exists, depends on the adjustment cost as well as on the cost of being away from the target level (the

benefits of moving back towards the target level). In reality firms may not completely close the gap between their actual and target levels of cash holdings because it may not be effective to do due to the existence of market friction (Alles *et al.*, 2012). More precisely, firms may keep the gap between their observed cash holding and target level if the cost of being away from the target is lower than that of moving toward the target and vice versa (Dittmar & Duchin, 2011).

Following Ozkan & Ozkan (2004) and Garcia-Teruel & Martinez-Solano (2008), the partial adjustment model of cash holding can be formalized as follows:

$$CB_{it} - CB_{it-1} = \lambda\left(CB_{it}^{*} - CB_{it-1}\right) \quad (2)$$

Where, $CB_{it} and CB_{it}^{*}$ denote the actual cash holding and the target cash holdings for firm i at time t. $CB_{it} - CB_{it-1}$ is the difference between a firm's actual or observed cash holdings between year t and year t-1. The expression $CB_{it}^{*} - CB_{it-1}$ is the deviation of a firm's cash holdings from its target level of cash holdings indicating that the target adjustment is required to reach the optimal level.

Finally, estimating dynamic panel data model of cash holdings taking into account the dynamic nature of cash level, will help to analyze the speed of adjustment of Jordanian firms towards an endogenous target cash ratio. Unlike the static model that implicitly assumes that firms can instantaneously adjust their cash holdings toward the target levels, the dynamic model recognizes that an adjustment process may take place and there are some lags for firms to adjust their cash holdings to their target levels (Gao *et al.*, 2012). By extending the static model, the study estimates the speed of adjustment towards an endogenous target cash ratio in a dynamic panel model.

For the purpose of target adjustment estimation, model 2 will be re-formalized as follows:

$$\Delta CB_{it} = \lambda_0 + \lambda_1 TRDCB_{it} + \varepsilon_{it} \quad (3)$$

Where ΔCB_{it} is $CB_{it} - CB_{it-1}$, $TRDCB_{it}$ is $CB_{it}^{*} - CB_{it-1}$ and used to measure how far the actual cash ratio deviates from the target cash ratio. ε_{it} is the error term and assumed to be independently distributed with zero mean.

In this study, $\lambda 1$ is used to capture a firm's ability to adjust to its target cash holdings, $\lambda 1$ should be statistically significant and between zero and one, not zero nor one ($0 < \lambda < 1$) implying that the movement toward the target is not a costless process. At one extreme, when $\lambda 1 = 1$, the model implies that firms can immediately adjust to their target levels. Such immediate adjustment is possible only in frictionless perfect capital markets that impose no adjustment costs. At the other extreme, when $\lambda 1 = 0$, the model implies that adjustment costs are so large that firms cannot adjust their actual level of cash reserves (Alles *et al.*,2012).

In general, this class of model is used to describe the adjustment process toward target levels of corporate cash holdings taking in to account that the deviations from target cash ratio are not necessarily offset quickly. This implies that value-maximizing firms will gradually adjust their actual cash holding toward their target level (Garcia-Teruel & Martinez-Solano, 2008). The reason for this is that cash holding decisions may be affected by the existence of market imperfections such as information asymmetry, agency conflicts or the existence of transaction costs incurred by accessing the capital markets (Garcia-Teruel & Martinez-Solano, 2008).

It worth's noting that the conventional cash equation will be used to estimate the target cash holdings level that will be used to calculate the target deviation and then estimating the target adjustment rate. The following section presents the estimation results of partial adjustment model.

4 Regression results

This section consists of two sub-sections. The first one presents the estimation results of conventional cash holding equation; the equation that has been used in the current study to estimate the fitted values of cash holdings as a proxy for the target cash level. The second one presents the estimation results of partial adjustment model.

4.1 Estimation results of conventional cash equation

The result presented in table (4-1) suggests that the fixed effect model is found to be the best specification of the study's data set. The significant Lagrange Multiplier (LM) test implies that the panel data analysis is better than pooled OLS analysis, suggesting the presence of firm and time specific effect, and hence, OLS regression will not be efficient to estimate study empirical model. The Ch2 value of LM test is estimated to be 138.09 with p-value of 0.000. However, Hausman test suggests that the fixed effects regressors will be better than random effect regressors to greater efficient estimation results. This finding is confirmed by the insignificant value of Hausman CH2. It is found to be 18.5 with a p-value of 0.000. Moreover, the results of diagnostic tests for Multicolinearity and Heteroskedasticity indicate that the empirical models have no Multicolinearity and Heteroskedasticity problems. The results of VIF show that the mean value of VIF for all variables included

in the model is 1.20, since the VIF for all variables are ranged between (1.07 – 1.25) which indicates that the model may not suffer from Multicolinearity problem. With respect to the Heteroskedasticity problem, Breusch-Pagan test is found to be statistically insignificant, implying that the variance of residuals is homogeneous, and hence no Heteroskedasticity problem exists for the sample of the study.

The results presented in Table 1 show the determinants of optimal cash holdings in Jordan. They are generally similar to those documented in the empirical studies in both developed countries and other developing countries. Table 1 reveals the estimation results of model (1). Discussion will be restricted to the model which has been found the best specification for the current data set.

- There is a significant positive relationship at 1% between a firm's cash holdings and cash flow (Cflow). This result is in line with the findings of Ferreira and Vilela (2004), Afza and Adnan (2007) and Alam et al. (2011) who found a positive relationship between cash flow and cash holdings. This supports the idea that, in the presence of information asymmetries, firms prefer to finance their new investment opportunities with internally generated resources (Garcia & Solano, 2008).

Table 1. The estimation results of study's models

Variable	FEM	REM
Cflow	0.0251 (0.002)	0.0276 (0.000)
CExp	0.0249 (0.438)	0.02443 (0.439)
Lev	-0.0529 (0.000)	-0.0426 (0.000)
NWC	-0.2661 (0.000)	-0.1667 (0.006)
Fsize	-0.03766 (0.086)	0.0012 (0.917)
Grth	0.01754 (0.288)	0.0200 (0.194)
PRO	0.0071 (0.114)	0.00902 (0.035)
Cons	1.259 (0.001)	0.5709 (0.004)
F test	10.29 (0.000)	72.91 (0.000)
R*2	22.17%	20.41%
Hausman test/Chi2	Chi^2 statistic =18.5 Prob(Chi^2) = 0.000	
LM test	$chi^2(1)$ =138.09 Prob > chi^2 0.000	
Hottest	2.51 0.1128	

- With respect to the effect of leverage (LEV) on cash holdings, there is a significant negative relationship at 1% between cash holding and the leverage. The results may indicate that the leveraged firms have lower cash holdings. This is in accordance with the findings of Ferreira &Vilela (2004) that cash and leverage are negatively related. The negative coefficient supports the pecking order theory according to Drobets & Gruninger (2006).

- There is significant negative relationship at 1% between cash holding and net working capital. This result is in line with Alam et al. (2011) who found a negative relationship between net working capital and cash holdings. Afza & Adnan (2007) and Megginson & Wei (2010) also support that cash holdings are negatively related to net working capital.

- There is significant negative relationship at 10% between cash holding and firm size. This is consistent with Nguyen (2005), Saddour (2006), and Drobetz and Grininger (2007) who found a negative relationship between firm size and cash holdings

- Capital expenditure and profitability are also positively correlated with cash level but not significant. This result is in contrast to previous empirical studies (e.g; Ferreira and Vilela, 2004; Ozkan & Ozkan, 2004; Opler et al., 1999; Kim et al., 1998). Also, growth opportunities (as measured by market to book ratio) are found to be insignificant as cash holding determinants in Jordan in both panel regression models.

It worth's noting that the conventional cash equation will be used to estimate the target cash holdings level that will be used to calculate the target

deviation and then estimating the target adjustment rate. The following section presents the estimation results of partial adjustment model.

4.2 The estimation results of partial adjustment model

To investigate whether Jordanian industrial firms have target cash holdings and how fast they move toward that target, the study extends the static cash holding model and formulates a partial (dynamic) adjustment model. In a frictionless world, firms would always maintain their target cash level. However, market imperfections such as transaction costs may prevent firms from immediate adjustment to their target level of cash holding. Hence, the partial adjustment model will be better than the static cash holding model to capture the dynamic pattern of firms' cash holdings behavior.

The estimation results of this model are presented in table 2. As signified by the significant Lagrange Multiplier (LM) and insignificant Hausman tests, the model with fixed effects is the preferred specification. Hence, discussion will be restricted to results obtained by fixed effects regressors.

Table 2. The estimation results of partial adjustment model

Variables	ΔCB_{it}		
	Pooled data	FEM	REM
Intercept	-6.58 (-17.62) (0.000)	-6.95 (-18.95) (0.000)	-6.913 (-16.98) (0.000)
$TRDCB_{it}$	0.239 (3.48) (0.001)	0.172 (2.53) (0.012)	0.189 (2.88) (0.004)
R^2	0. 259	0. 159	0. 159
F-statistic	12.13 (0.0005)	6.39 (0.012)	8.27 (0.004)
Observations(n)	458	458	458
Hausman test	Chi^2 statistic = 0.81	$Prob(Chi^2) = 0.3675$	
LM test	$chi^2(1)= 87.62$	$Prob > chi^2 = 0.000$	

As can be seen, the estimation results of model (3) suggest that industrial Jordanian firms are dynamically adjusting their cash holdings towards target levels. More precisely, they have a target cash ratio and move gradually toward that target if any deviation exists. This finding is confirmed by the statistically significant of the $TRDCB_{it}$ variable. However, the results indicate that Jordanian firms adjust their actual cash level slower than do firms in other countries. The estimated coefficient on the $TRDCB_{it}$ variable is found to be, on average, 0.172, implying that Jordanian industrial firms need 3.7 years to adjust half of the deviation of their actual cash ratios, and 7.2 years to correct totally target deviation.

As the estimated coefficient on the $TRDCB_{it}$ variable measures the speed rate of target adjustment, the speed of target adjustment of Jordanian industrial firms is lower than that of other developed countries. For Swiss non-financial firms, Drobetz& Grüninger(2006) report an adjustment speed rate ranged between 0.35 and 0.50. Ozkan and Ozkan (2004) report 0.6 adjustment rates for U.K firms. Using sample data from U.K., Japan, France, and Germany markets, Guney *et al.* (2003) reports adjustment speed rates of 0.59, 0.57, 0.60, and 0.56 for French, German, UK, and Japanese firms, respectively. Couderc (2005) provides evidence suggesting that adjustment rates differ across countries. The estimated adjustment rates are higher for the U.S. and Canada (over 0.6) than for Germany and France (roughly 0.5) (Drobetz & Grüninger, 2006).

One explanation to the low adjustment speed of Jordanian firms is the presence of adjustment cost. As transaction costs are inversely proportional to the adjustment coefficient, the lower the value of this coefficient, the higher the transaction costs and then the slower the movement toward the target level. For some firms under certain circumstances, the adjustment costs may be so high, that it is not cost effective for them to make any further adjustments, especially when the deviation is close to the target levels (Alles *et al.*, 2012) .The presence of market frictions in Jordan creates many financial constraints to which the Jordanian firms could generally respond. As Jordanian firms have relatively large transaction costs indicating that these costs are much higher than those of staying away from the target which may prevent firms or even make them reluctant from making quick adjustments due to the higher transaction costs involved, which may affect the overall average adjustment speed. The role of adjustment costs has been emphasized in the context of other financial policies, such as capital structure

and investment but has not received attention in the cash literature (Dittmer & Duhin, 2011).

Another explanation for the delay in adjustment process is the access to bank credit. According to Zeitun *et al.* (2007), Jordan is a bank-based system and the cost of borrowing is quite high, which makes retained earnings an important source of funds. Thus, a limited source of funding that is available for Jordanian firms would have an impact on their cash adjustment ability, and this means that the mechanisms for Jordanian firms to make their cash adjustments are limited. These findings are consistent with the finding of Dittmer and Duhin (2011) that firms with access to bank credit have significantly higher speed of adjustment of cash. These results are supportive of the "trade-off theory" of cash holdings, under which firms have an optimal cash level, as opposed to the "financial hierarchy hypothesis" of cash holdings.

5 Conclusion and recommendations

The aim of this study is to investigate the speed by which a sample of Jordanian industrial firms adjust cash ratios toward their target levels, using a dynamic adjustment model. A panel data for a sample of 57 Jordanian firms over the 2001-2010 is used and estimated using fixed and random effects model. The findings of this study suggest that Jordanian industrial companies retain an average 6.5% of their assets in the form of cash. This implies that Jordanian firms keep their cash holdings low for the purpose of reducing the agency costs of holding cash. Furthermore, Cash flow, net working capital, leverage and firm size significantly influence the cash holdings of Jordanian firms with no impact of growth opportunities, profitability and capital expenditures. The negative impact of leverage on cash holdings suggests that Industrial Jordanian firms can use borrowing as a substitute for holding high levels of cash and marketable securities. This explains how severe the agency problem in Jordanian industrial firms is as listed in ASE.

The study also reveals that Jordanian industrial firms identify a target level for their cash holdings and their decisions are taken in the aim of achieving this objective. However, target adjustment occurs too slowly, indicating that Jordanian firms have a large transaction, asymmetric information and agency costs, increasing the cost of moving toward the target ratio and consequently, reducing the impetus of these firms to back quickly to their target.

In the light of above conclusions, the study recommends that Jordanian firms should increase their cash holdings in an attempt to lower the probability of financial distress and bankruptcy because the insufficient balance of cash holdings may force firms to give up some of the profitable investment opportunities. Moreover, it recommends that the policy makers in Jordan should develop the capital market, increase its efficiency, competition and transparency to increase the firm's ability to generate funds externally.

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