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The adjustment of plant-level investment to exchange rate fluctuations in Tunisia: do the size and the ownership structure matter?

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Abstract

The aim of this paper is to investigate the response of private investment to exchange rate fluctuations in Tunisia using a sample of 548 manufacturing firms. We use an accelerator-profit investment specification augmented by variables measuring the variation and volatility of exchange rates. Results of the system GMM technique show that the effects of effective and bilateral exchange rates depreciation on investment are negative. Regarding the effects of volatility, measured by the GARCH model, findings suggest that the exchange rate uncertainty explains the decline of the private investment in Tunisian firms. Once the whole sample disaggregated according to the size and the ownership structure, the analysis shows that the negative effects of exchange rate fluctuations on investment are more important for small and medium firms than for large ones. On the other hand, exchange rate fluctuations affect almost equally the local and foreign firms.

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1. Introduction

Since the adoption of financial liberalization and capital markets integration policies just after the collapse of the Bretton Woods system in 1971, most of developed and developing countries have been exposed to high exchange rate fluctuations. These stylized facts have spurred significant research efforts dealing with the effects of exchange rate movements on economic performance, particularly trade flows (Devadoss et al, 2014; Soleymani and Chua, 2014). Other studies have extended the analysis to investigate the impact of exchange rate fluctuations on other economic variables, such as the private investment (Campa and Goldberg, 1999; Nucci and Pozzolo, 2001; Kandilov and Leblebicioglu 2011). A recent trend in the research area is rather based on the idea that exchange rate fluctuations may also produce an uncertainty effect that incites investors to reschedule their investments (Dixit and Pindyck, 1994). Therefore, the relationship between exchange rate volatility and investment levels has attracted more and more attention (Servén, 2003; Harchaoui et al., 2005). Empirically, although there are a lot of empirical studies dealing with the impact of exchange rate fluctuations on investment, the majority of them have mainly focused on developed countries (Goldberg (1993) for the United States, Nucci and Pozzolo (2001) for Italy, Lafrance and Tessier (2001) and Harchoui et al. (2005) for Canada, Chowdhury and Wheeler (2015) for a sample of countries G7). On the other hand, few studies have been devoted to developing countries, such as Servén (2003) for a large sample of developing countries and Kandilov and Leblebicioglu (2011) for Colombia.

The purpose of this paper is to contribute to the debate by examining the impact of exchange rate fluctuations (both changes and volatility) on private investment using a micro-level dataset of Tunisian manufacturing firms for the period 1997-2002. The choice of Tunisia is important for many reasons. Since the adoption of the structural adjustment program in 1986, several economic liberalization measures have been undertaken. From the early 1990s, the country has made substantial progress in the trade liberalization process by joining the World Trade Organization and signing a free trade agreement with the European Union in 1995. Other measures have been put in place to liberalize the capital market. Indeed, the current account convertibility was established since 1993, and from 1995 foreign direct investment and portfolio investment flows have been gradually liberalized. With regard to the exchange rate policy, some measures have been adopted to strengthen the liberalization of bilateral exchange rates. The interbank foreign exchange market and the forward foreign exchange market have been created in 1994 and 1997, respectively. The creation of these markets aims to ensure a better flexibility of bilateral exchange rates. As a result, these measures have led to exchange rate volatility, especially compared to the euro and the US dollar.

To address the issue of potential effects of exchange rate fluctuations on investment, the paper is structured as follows. The second section reviews the theoretical and empirical literature on the relationship between exchange rate fluctuations (changes and volatility) and the dynamics of private investment. In the third section, we present the database, namely the Annual Survey of Enterprises and the sample of firms. In the fourth section, we present the dynamic accelerator-profit investment specification and the econometric method, namely the GMM system technique. The fifth section discusses the empirical results. The final section presents concluding remarks and recommendations.

2. Literature review

2.1. Exchange rate changes and private investment

Theoretically speaking, the impact of exchange rates on the dynamics of private investment may be transmitted via several channels. The depreciation of the exchange rate affects domestic investment in both directions. First, it increases the cost of imported inputs and lowers the investment level especially in industries that heavily depend on imported inputs and equipment goods. Second, it improves the competitiveness of exports and boosts sales, which encourages firms to invest more. Campa and Goldberg (1999) and Nucci and Pozzolo (2001) show that the depreciation of the national currency affects the profitability and hence the investment level via a change in the price of exported domestic products, the price of imported goods used as inputs in the production process and the price of imports that compete with domestic products. Harchaoui et al. (2005) focus on the effects of the exchange rate depreciation on investment taking into account other transmission channel, namely the cost of capital. The net effect of the depreciation depends on the degree of the exchange rate pass-through on the price of imported inputs and capital and the elasticity of the demand with respect to exchange rates. These findings have been confirmed by Lafrance and Schembri (2000) and Swift (2006) who conclude that the exchange rate can also impact the private investment through its effect on the production cost or on competitiveness.

On the empirical side, the exchange rate-investment relationship attracted the attention of economists, focusing in most cases on developed countries. Harchaoui et al. (2005) show that exchange rates affect the sectoral investment in Canada. Nucci and Pozzolo (2001) reach results according to which changes in the exchange rate are an important determinant of the level of investment in the case of Italian firms. Using a sectoral analysis for Canada, Japan, the US and UK, Campa and Goldberg (1999) highlight that the sensitivity of investment to exchange rate changes depends on the considered country and activity sector. Landon and Smith (2006) investigate the impact of exchange rate movements on the price of investment goods using data of 22 sectors in 12 OECD countries over the period 1971-1997. The authors conclude that the exchange rate depreciation induces a significant increase in the price of capital goods and therefore the level of investment, but the magnitude of this effect varies according to industries.

Turning to the effects of exchange rates on foreign direct investments, Froot and Stein (1991) advance that the exchange rate depreciation increases the value of the foreign investor's wealth denominated in the currency of the host country, and thus facilitates FDI operations in that country. Klein and Rosengren (1994) state that the depreciation of the exchange rate encourages FDI movements due to the decrease of production costs. Generally, many empirical studies support the hypothesis according to which the depreciation of the host country's currency increases the volume of FDI (Sharifi-Renani and Mirfatah, 2012; Takagi and Shi, 2011). Nonetheless, some authors, such as Dhakal et al. (2010) and MacDermott (2008), point out that a weak currency discourages the volume of FDI inflows in the host country. Finally, some researchers argue that the exchange rate depreciation has no significant impact on FDI (Goldberg and Kolstad, 1995; Dewenter, 1995).

2.2. Exchange rate volatility and private investment

McDonald and Siegel (1986) and Dixit and Pindyck (1994) make use of the real options theory to explain the negative impact of uncertainty on private investment. The most important result of the real options theory is that the uncertainty in the business environment increases the value of the option to invest in the future and pushes firms to delay their investment decision (Guerin and Lahrèche-Révil, 2001). Recently, the real options theory has been particularly used to analyze the dynamics of investment when the source of uncertainty is the exchange rate volatility. The uncertainty about the exchange rate dynamics caused for example by a permanent volatility promotes the *wait and see* behavior and obligate investors to delay their investment decisions. Servén (1997, 1998) shows that uncertainty in general, and particularly exchange rate uncertainty, justifies the waiting stage and induces threshold effects in the investment decision. Erdal (2001) models the negative effects of the exchange rate uncertainty by considering the investment decision of exporting firms and importing firms of intermediate inputs. Belke and Gros (2001) develop a model in which the exchange rate uncertainty favors the waiting strategy rather than the immediate investment strategy. Lee and Min (2011) suggest that the exchange rate volatility leads to uncertainty about future returns and therefore increases the likelihood of delay in foreign direct investments.

On the empirical side, an abundant literature focuses on the effects of the exchange rate volatility on private investment in developed countries. Byrne and Davis (2005) provide strong empirical evidence on the negative response of investment to nominal and real effective exchange rate uncertainty in G7 countries. Urata and Kawai (2000) conclude also that the high exchange rates volatility discouraged Japanese FDI over the period 1980-1994. Using a firm-level dataset of OECD economies between 1985 and 2007, Cavallari and D'Addona (2013) show the presence of negative effects of volatility on FDI inflows. Regarding developing countries, Kandilov and Leblebicioglu (2011) use data relative to Colombian firms and find a strong negative impact of exchange rate volatility on the investment level. Servén (2003) concludes that the negative impact of the real exchange rate uncertainty on investment depends on many country-specific characteristics. Finally, Sharifi-Renani and Mirfatah (2012) study the effects of the exchange rate volatility on FDI in Iran based on a cointegration analysis. Findings suggest that the gross domestic product, openness and the exchange rate positively affect foreign direct investment. On the contrary, the exchange rate volatility exerts negative effects on it.

3. The sample of firms and the dataset

The sample on which this paper is based consists of firms that belong to six Tunisian manufacturing industries. Data comes from the Annual Survey of Enterprises conducted by the National Institute of Statistics and covers the period 1997 to 2002.[1] The filtering and selection of firms are made according to many criteria. Regarding this point, we use some procedures inspired from Hall and Mairesse (1995). We first remove firms that do never present data on their value added or employment level. We also eliminate firms for which total assets are different from total liabilities. The final sample includes 548 firms belonging to the different manufacturing industries.

[1] The access to data covering the period following 2002 has not been possible. Recently, Zmami and Ben-Salha (2015) conduct a firm-level study on the response of employment to economic openness in Tunisia. The empirical investigation is based on the same dataset during the period 1997-2002.

Table 1 presents the sample of firms and their distribution according to the industry, size and ownership structure.[2]

Table 1. The distribution of firms

According to the industry			
		Number of firms	%
Textiles, clothing and leather industry		229	41.8
Mechanical, electrical and electronic industry		45	8.2
Chemical industry		53	9.7
Agro-food industry		68	12.4
Pottery, glass and other construction materials Industry		85	15.5
Other manufacturing industries		68	12.4
According to the size			
	Number of workers	Number of firms	%
Small and medium firms	[6-200[	432	78.8
Large firms	≥200	116	21.2
According to the ownership structure			
	Foreign ownership	Number of firms	%
Local firms	[0-10[	411	75
Foreign firms	[10-100]	137	25

Source: The authors, based on the Annual Survey on Firms.

4. The econometric methodology

The econometric investigation developed in the current paper is based on an accelerator-profit specification. While the accelerator emphasizes the effect of demand, the profit assesses the profitability of investments. In fact, higher rates of profits encourage firms to invest more, which highlight the importance of profits in firms' investment decisions. Some other studies confirm that profits also reflect the importance of self-financing as a determinant of private investment given the potential existence of imperfect capital markets (Fazzari et al. 1988). This type of modeling has been widely used in the economic literature. For instance, Ben Jelili (1998) used it to examine the evolution of investment in Tunisian manufacturing firms between 1984 and 1993. Kandilov and Leblebicioglu (2012) also used the same model to study the impact of trade liberalization on investment in Mexican firms between 1984 and 1990. The investment function may be written as follows:

$$INV_{it} = f(S_{it}, CF_{it}) + \varepsilon_{it} \quad (1)$$

where INV_{it}, S_{it} and CF_{it} stand for investment, total sales and cash flows in firm i at year t, respectively. ε_{it} is the error term.

[2] The classification of firms according to industries is based on the Nomenclature of Tunisian Activities of the Tunisian National Institute of Statistics, while the classification of firms according to the size is based on the definition used by the Tunisian National Institute of Statistics, which classifies firms according to the number of workers. Finally, the classification of firms according to the ownership structure is based on the definition of the International Monetary Fund. A foreign direct investment enterprise is an enterprise in which a foreign investor owns 10 % or more of the capital.

This static specification does not seem to reflect the real behavior of firms since it does not consider the dynamic aspect of capital accumulation. Indeed, when a firm makes an investment, it will not only support the cost of purchasing new equipments but also those related to the installation such as the costs of temporarily suspensions of production and staff training. Taking into account the presence of adjustment costs implies that firms will not immediately adjust their capital stock to the desired level. Accordingly, firms' investment should be modeled as a dynamic process (Epaulard, 2001). Some authors, such as Blundell and Smith (1991), illustrate the dynamics of the investment function. Making the assumption that there are no adjustment costs does not seem to be reasonable. Instead, the dynamic approach takes into account the persistence of investments and allows the evaluation of adjustment costs.

Taking into account the existence of adjustment mechanisms, the investment function is written in a dynamic framework as follows:

$$INV_{it} = g(INV_{it-1}, S_{it}, CF_{it}) + \varepsilon_{it} \tag{2}$$

Equation (2) has been augmented by two variables measuring the change and the volatility of effective and bilateral exchange rates. Following Fuentes (2006) and Kandilov and Leblebicioglu (2011), we use the following dynamic specification:

$$\frac{INV_{it}}{K_{it-1}} = \beta_0 + \beta_1 \frac{INV_{it-1}}{K_{it-2}} + \beta_2 \frac{S_{it}}{K_{it-1}} + \beta_3 \frac{CF_{it}}{K_{it-1}} + \beta_4 Z_t + j_i + \gamma_t + \varepsilon_{it} \tag{3}$$

where K is the capital stock and Z is the change or the volatility of exchange rates. First, we check the impact of the exchange rate change. To do so, the effective exchange rate and the bilateral exchange rate of the dinar against the euro and the dollar are used.[3] Then, we use the GARCH (1,1) model to calculate the different series of exchange rate volatility.[4] The study covers the period 1997-2002.[5] A detailed description of variables and their sources is presented in Table A1 reported in the Appendix.

Given that our dataset has both cross-sectional and time series elements, a panel data model has to be estimated. Since the right-hand side of Equation (3) includes the lagged dependent variable, i.e. investment, the appropriate econometric technique to be used is the generalized method of moments (GMM). This technique has been widely used to estimate dynamic specifications when the number of observations is greater than the number of periods (Arellano and Bond, 1991). Its first advantage is that it overcomes the problem of endogeneity of the lagged dependant variable. Then, it takes into account the correlation between the lagged dependant variable and the error term. In addition, it allows controlling the problem of potential endogeneity

[3] An increase in bilateral exchange rate reflects a depreciation of the Tunisian dinar while a fall is a sign of an appreciation. Contrary to bilateral exchange rates, an increase in effective exchange rates represents the appreciation of the local currency.

[4] Following Brzozowski (2006), the conditional variance based on the GARCH (1,1) model of monthly nominal and real exchange rates represents our proxy of monthly volatility. For each exchange rate, the annual volatility is calculated as the average of the 12 monthly volatilities.

[5] For the years 1997 and 1998, we follow Tarchi (2004) by using the ECU/TND parity instead of the EUR/TND parity. ECU refers to the European Currency Unit.

among variables. Finally, it remedies for the problem of using non-stationary data since it is based on first differentiated variables. The panel data econometrics offers two variants of GMM, namely the first difference GMM estimator developed by Arellano and Bond (1991) and the system GMM estimator developed by Blundell and Bond (1998). The method of Arellano and Bond (1991) uses a first difference equation to eliminate the firms' specific effects and takes lagged levels (dated t-2 and earlier) as appropriate instruments for all potentially endogenous variables. It has been shown that the first difference GMM provides more efficient estimators than standard techniques (OLS and GLS), but might be subject to a large downward finite-sample bias and suffers from the relatively small number of instruments. To overcome these shortcomings, Blundell and Bond (1998) proposed the system GMM method that provides more robust estimates than the first difference GMM. In addition to a first differenced equation, this technique is also based on an equation in levels, which raises the number of instruments and improves the quality of the estimators. Results of the GMM technique are econometrically interpretable under the assumptions of no second-order serial correlation of the error terms and the reliability of instruments. To check the validity of these assumptions, we report the AR (2) and Hansen tests.

5. Empirical findings

The purpose of this section is to provide the estimation results of the impacts of exchange rates change and volatility on investment for the full sample and different subsamples.

5.1. Exchange rate changes and investment

5.1.1. The full sample

Table 2 presents results of estimating Equation (3) for the full sample of firms. Both real and nominal effective and real and nominal bilateral exchange rates relative to the euro and the dollar are introduced in the model. One can note that the quality of the estimators are suitable since the Hansen and AR(2) tests validate the used specification. Coefficients of the lagged investment are not statistically significant for the overall sample, which may be partly explained by the heterogeneity of the sample. As mentioned previously, the sample on which the paper is based is composed of firms having different characteristics. Regarding the impact of total sales, it is shown that it is positive and statistically significant, which shows that the demand is a main determinant of investment decisions in private firms. The effect of cash flows is also positive in all specifications, reflecting the impact of financial constraints on investment.

Turning to the impact of exchange rates, estimates show that the depreciation of effective exchange rates has a negative effect on firm-level investment. Moreover, coefficients of real and nominal exchange rates are almost close, which means that they affect in a similar way the investment level. It is important to note that the expected impact of the exchange rate depreciation on investment might be positive (in case where it improves the competitiveness of exports and boosts sales) or negative (in case where it raises the costs of imported intermediate inputs and capital goods). Consequently, two contradictory effects simultaneously coexist. Our findings clearly show that the negative effects of the exchange rate depreciation on private investment dominate the positive effects.

Table 2. Exchange rates and investment – The full sample

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged investment rate (INV_{it-1}/K_{it-2})	-0.046	-0.041	-0.039	-0.040	-0.050	-0.050
	(0.040)	(0.039)	(0.043)	(0.043)	(0.040)	(0.040)
Total sales (S_{it}/K_{it-1})	0.038***	0.037***	0.037***	0.037***	0.039***	0.039***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Cash flows (CF_{it}/K_{it-1})	0.038***	0.037***	0.036**	0.037***	0.039***	0.039***
	(0.013)	(0.013)	(0.014)	(0.014)	(0.012)	(0.012)
NEER	0.015**	–	–	–	–	–
	(0.007)					
REER	–	0.016**	–	–	–	–
		(0.006)				
Nominal $_{EUR/TND}$	–	–	-0.010*	–	–	–
			(0.004)			
Real $_{EUR/TND}$	–	–	–	-0.009*	–	–
				(0.005)		
Nominal $_{USD/TND}$	–	–	–	–	-0.002*	–
					(0.001)	
Real $_{USD/TND}$	–	–	–	–	–	-0.002*
						(0.001)
Constant	-1.778**	-1.928**	1.104*	0.991*	0.235*	0.254*
	(0.836)	(0.792)	(0.583)	(0.518)	(0.138)	(0.148)
Arellano-Bond test for AR(1)	0.010	0.008	0.009	0.009	0.013	0.013
Arellano-Bond test for AR(2)	0.133	0.148	0.185	0.176	0.111	0.111
Hansen test	0.457	0.506	0.554	0.537	0.291	0.303
Number of firms	548	548	548	548	548	548
Number of observations	3288	3288	3288	3288	3288	3288

Notes: Dependent variable: Investment rate. All estimates are performed using the xtabond2 command developed by Roodman (2009). Coefficients and robust standard errors in parentheses are obtained using the two-step system GMM and the Windmeijer finite-sample correction. Hansen, AR(1) and AR(2) are *p*-values of the Hansen over-identification test, the first-order serial correlation of residuals and the second-order serial correlation of residuals, respectively . ***, ** and * represent the statistical significance at 1%, 5% and 10%, respectively.

One issue that may arise from this analysis is whether the investment level reacts similarly to different bilateral exchange rates. As mentioned previously, the two main currencies used by Tunisian firms in international transactions, namely the euro and the US dollar, are introduced in the analysis. From Table 2, one can advance that coefficients of exchange rates relative to the euro and the US dollar are statistically significant at 10% level. Furthermore, results reveal that coefficients of the euro/TND exchange rate are five times more important than the one associated with the USD/TND exchange rate. This result means that the firm-level investment is more sensitive to a change in the exchange rate relative to the euro than to a change in the exchange rate relative to the US dollar. This is explained by the importance of the European countries as the main trade partner of the Tunisian economy. Boughzala (2010) highlights that about 20% of Tunisian total imports from the European Union are electrical and mechanical equipments, used especially to launch new investments or to extend existing ones.

5.1.2. The subsamples

Estimates of the previous section were performed under the assumption that the reaction of investment to exchange rates is the same in all firms. This assumption may not be true. One advantage of using a firm-level dataset is that it allows checking such an impact for firms with different characteristics. Tables 3 and 4 explore the role of firm heterogeneity in terms of two dimensions, namely the size and the ownership structure.

Table 3 shows the impact of exchange rate changes on investment by taking into account the importance of the size. The original sample is decomposed to two subsamples. The first is composed of 116 large firms for which the number of employees is equal or greater than 200. The second sample is reserved to small and medium firms that contain less than 200 employees. 432 firms belong to this category. The disaggregation of the sample according to the size shows that coefficients of the lagged dependent variable are statistically significant only for large firms, which confirms the existence of adjustment costs. These findings support out previous intuition according to which the insignificance of the lagged dependent variable for the full sample is due to the heterogeneity of firms. The existence of adjustment costs for large firms may be explained by the fact that they employ heavy and relatively sophisticated production techniques. Launching a new investment requires in fact important additional expenses such as startup and technical training costs. On the contrary, the adjustment costs associated with small and medium firms are not significant given that they usually exploit traditional investment techniques and do not require additional costs. Consequently, there are no adjustment costs for these firms, which explain the insignificance of the lagged dependent variable. The impacts of the two control variables (total sales and cash flows) in the two subsamples are similar to those associated with the full sample. The coefficients of these variables are statistically significant in most cases. Empirical findings show that the impact of exchange rates is more pronounced in small and medium firms than in large firms. While all coefficients associated with effective and bilateral exchange rates are statistically significant for small and medium firms, only the nominal effective exchange rate and the bilateral exchange rate relative to the euro affect investment in large firms. The table shows also that the exchange rate depreciation lowers investment in the groups of firms. Nevertheless, the reaction of investment to exchange rate changes in small and medium firms is about twice higher than the one of large firms. This may be explained by the nature of large firms that have generally big stocks of imported intermediate inputs, which explains the weak (and sometimes insignificant) negative effect of the exchange rate depreciation. By cons, small and medium firms do not have important financial capacities to store intermediate inputs. These firms are largely dependent on the rest of the world in terms of raw materials and capital goods. The exchange rate depreciation makes imports more expensive and is therefore negatively related to the investment level. These considerations make the reaction of investment to the exchange rate depreciation in these firms more important compared the one of large firms.

Table 4 summarizes results of estimation Equation (3) taking into account the ownership structure of firms. Decomposing firms based on the share of the foreign ownership in the firm's capital gives two subsamples. The first sample is composed of firms for which the foreign participation in the capital is equal or greater than 10% (foreign firms). The second sample is composed of firms with a foreign participation below 10% (local firms).

Table 3. Exchange rates and investment – Small and medium firms vs large firms

	SMALL AND MEDIUM FIRMS						**LARGE FIRMS**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged investment rate (INV_{it-1}/K_{it-2})	0.045 (0.065)	0.043 (0.061)	0.054 (0.062)	0.053 (0.063)	0.044 (0.071)	0.044 (0.071)	0.082** (0.038)	0.083* (0.044)	0.084** (0.038)	0.085** (0.037)	0.080 (0.049)	0.080* (0.048)
Total sales (S_{it}/K_{it-1})	0.018 (0.011)	0 .018* (0.011)	0 .018* (0.011)	0 .018 (0.011)	0 .020* (0.012)	0 .020* (0.012)	0.051*** (0.0003)	0 .051*** (0.0003)	0 .051*** (0.0003)	0 .051*** (0.0003)	0 .051*** (0.0003)	0 .051*** (0.0003)
Cash flows (CF_{it}/K_{it-1})	0.033*** (0.010)	0.033*** (0.010)	0.033*** (0.010)	0.033*** (0.010)	0.033*** (0.010)	0.033*** (0.010)	-0.094** (0.047)	-0.094* (0.054)	-0.096** (0.048)	-0.097** (0.046)	-0.092 (0.058)	-0.091 (0.056)
NEER	0.021*** (0.008)	–	–	–	–	–	0.010** (0.005)	–	–	–	–	–
REER	–	0.024*** (0.007)	–	–	–	–	–	0.002 (0.005)	–	–	–	–
Nominal $_{EUR/TND}$	–	–	-0.012** (0.005)	–	–	–	–	–	-0.006* (0.003)	–	–	–
Real $_{EUR/TND}$	–	–	–	-0.011** (0.004)	–	–	–	–	–	-0.007** (0.003)	–	–
Nominal $_{USD/TND}$	–	–	–	–	-0.003** (0.001)	–	–	–	–	–	-0.0001 (0.001)	–
Real $_{USD/TND}$	–	–	–	–	–	-0.004** (0.001)	–	–	–	–	–	-0.0005 (0.001)
Constant	-2.484** (0.966)	-2.762*** (0.890)	1.395** (0.567)	1.272** (0.508)	0.461** (0.192)	0.490** (0.206)	-1.270** (0.638)	-0.256 (0.602)	0.684* (0.370)	0.738** (0.354)	0.027 (0.120)	0.065 (0.119)
Arellano-Bond test for AR(1)	0.010	0.009	0.007	0.008	0.015	0.014	0.111	0.110	0.110	0.110	0.112	0.112
Arellano-Bond test for AR(2)	0.951	0.909	0.938	0.947	0.834	0.843	0.577	0.632	0.609	0.598	0.633	0.620
Hansen test	0.115	0.147	0.165	0.156	0.056	0.060	0.203	0.087	0.200	0.243	0.090	0.097
Number of firms	432	432	432	432	432	432	116	116	116	116	116	116
Number of observations	2592	2592	2592	2592	2592	2592	696	696	696	696	696	696

Notes: See Table 2.

Table 4. Exchange rates and investment – Foreign firms vs local firms

	FOREIGN FIRMS						**LOCAL FIRMS**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged investment rate (INV_{it-1}/K_{it-2})	-0.010 (0.033)	-0.007 (0.030)	-0.005 (0.034)	-0.006 (0.034)	-0.010 (0.029)	-0.010 (0.030)	0.174*** (0.048)	0.173*** (0.048)	0.169*** (0.046)	0.170*** (0.046)	0.199*** (0.054)	0.196*** (0.054)
Total sales (S_{it}/K_{it-1})	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .005 (0.004)	0 .005 (0.004)	0 .005 (0.003)	0 .005 (0.003)	0 .005 (0.005)	0 .005 (0.004)
Cash flows (CF_{it}/K_{it-1})	0.004 (0.018)	0.003 (0.018)	0.002 (0.018)	0.002 (0.019)	0.005 (0.016)	0.005 (0.017)	0.040*** (0.007)	0.041*** (0.007)	0.041*** (0.006)	0.041*** (0.006)	0.041*** (0.008)	0.041*** (0.007)
NEER	0.025*** (0.007)	–	–	–	–	–	0.020*** (0.005)	–	–	–	–	–
REER	–	0.024*** (0.007)	–	–	–	–	–	0.019*** (0.005)	–	–	–	–
Nominal $_{EUR/TND}$	–	–	-0.009** (0.004)	–	–	–	–	–	-0.011*** (0.003)	–	–	–
Real $_{EUR/TND}$	–	–	–	-0.010** (0.003)	–	–	–	–	–	-0.010*** (0.002)	–	–
Nominal $_{USD/TND}$	–	–	–	–	-0.005*** (0.001)	–	–	–	–	–	-0.003** (0.001)	–
Real $_{USD/TND}$	–	–	–	–	–	-0.005*** (0.002)	–	–	–	–	–	-0.003** (0.001)
Constant	-3.047*** (0.907)	-2.873*** (0.920)	0.980** (0.489)	0.997** (0.413)	0.470** (0.208)	0.506** (0.219)	-2.284*** (0.639)	-2.188*** (0.611)	1.309*** (0.377)	1.199*** (0.503)	0.433*** (0.146)	0.468*** (0.154)
Arellano-Bond test for AR(1)	0.052	0.047	0.046	0.047	0.051	0.051	0.017	0.015	0.013	0.014	0.014	0.015
Arellano-Bond test for AR(2)	0.440	0.419	0.402	0.414	0.455	0.457	0.968	0.939	0.924	0.936	0.911	0.928
Hansen test	0.602	0.708	0.645	0.625	0.644	0.638	0.155	0.115	0.253	0.258	0.028	0.033
Number of firms	137	137	137	137	137	137	411	411	411	411	411	411
Number of observations	822	822	822	822	822	822	2466	2466	2466	2466	2466	2466

Notes: See Table 2.

Estimating the dynamic specification of the investment equation using the system GMM technique for the two subsamples shows that Hansen and second-order serial autocorrelation tests validate the dynamic specification. Regarding coefficients of the lagged dependent variable, it is clear that they are statistically significant only for the case of local firms, which confirms the existence of adjustment costs. The explanation of these results is that the banking system is considered as the main source of financing of new investments for the majority of these firms. Costs related to banking financing are considered as additional costs supported by these firms which certainly raise the total cost of the investment. In addition, there are other related costs such as training and equipments installing, which may be sometimes high. With regards to foreign firms, the coefficients are not statistically significant. The absence of adjustment costs for these firms can be explained by the nature of foreign outsourced investments which are always foreign subsidiaries. As a consequence, they have important financial capacities and generally finance their investments based on their parent companies. All these considerations make the adjustment costs related to investment financing in these firms relatively low. Furthermore, the majority of foreign firms are concentrated in the textiles and leather industry. Employers in this industry generally execute the same tasks and often personal training expenses are negligible. Turning to control variables, we find that in all regressions, a change in total sales is significant for foreign firms while investment in local firms is largely dependent on financing conditions. With regard to exchange rates, our results reveal that they negatively and significantly affect the investment level in local and foreign firms. The existence of a negative effect of the exchange rate depreciation shows the dependence of local firms on imports of inputs and capital goods. For foreign firms, the depreciation of the exchange rate also impacts negatively the investment level. These findings may be explained by the fact that the negative effect of the depreciation (repatriation of profits) dominates its positive effect (decline of the cost of the initial investment) in foreign firms.

5.2. Exchange rate volatility and investment

5.2.1. The full sample

The different estimates of the investment equation for the full sample of firms are provided in Table 5. Comments regarding the lagged dependent variable are as made previously. While coefficients of the lagged investment are not statistically significant for the full sample, the disaggregation shows that they are significant for local firms. These results suggest the existence of adjustment costs for this category of firms. Table 5 suggests that coefficients associated with control variables shows that the dynamics of capital accumulation is partially explained by the demand prospects and the funding constraints since coefficients of total sales and cash flows are both statistically significant.

Turning to the effects of volatility, results are as expected since coefficients associated with the different bilateral exchange rates volatility negatively affect the investment level. The exchange rate volatility creates uncertainty about the export revenue and the cost of imported intermediate inputs and makes profits unpredictable. Hence, Firms prefer to delay their investment decisions and choose a wait strategy. We also note the absence of any effect of the effective exchange rates volatility on investment. This may be explained by the fact that effective exchange

rates are usually not too volatile since the exchange rate policy in Tunisia aimed the stabilization of the effective exchange rate during the period under study.

Table 5. Exchange rate volatility and investment – The full sample

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged investment rate (INV_{it-1}/K_{it-2})	-0.043	-0.046	-0.038	-0.038	-0.036	-0.041
	(0.045)	(0.044)	(0.039)	(0.039)	(0.040)	(0.039)
Total sales (S_{it}/K_{it-1})	0.039***	0.039***	0.037***	0.037***	0.037***	0.038***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Cash flows (CF_{it}/K_{it-1})	0.038***	0.038***	0.036***	0.036***	0.035***	0.037***
	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
VOL *NEER*	0.003	–	–	–	–	–
	(0.008)					
VOL *REER*	–	0.003	–	–	–	–
		(0.010)				
VOL *Nominal* $_{EUR/TND}$	–	–	-0.013**	–	–	–
			(0.006)			
VOL *Real* $_{EUR/TND}$	–	–	–	-0.010**	–	–
				(0.004)		
VOL *Nominal* $_{USD/TND}$	–	–	–	–	-0.00006*	–
					(0.00003)	
VOL *Real* $_{USD/TND}$	–	–	–	–	–	-0.0008**
						(0.0003)
Constant	0.012	0.012	0.063	0.063	0.049	0.060
	(0.027)	(0.024)	(0.041)	(0.041)	(0.036)	(0.039)
Arellano-Bond test for AR(1)	0.019	0.014	0.008	0.008	0.008	0.008
Arellano-Bond test for AR(2)	0.151	0.149	0.168	0.167	0.183	0.148
Hansen test	0.294	0.289	0.431	0.429	0.442	0.402
Number of firms	548	548	548	548	548	548
Number of observations	3288	3288	3288	3288	3288	3288

Notes: See Table 2.

5.2.2. The subsamples

In what follows, we present the different estimates of the two subsamples taking into account the size (large firms/small and medium firms) and the ownership structure (local firms/foreign firms). Estimates are presented in Tables 6 and 7. The estimation results of the investment function for firms with different sizes (Table 6) show that the overall econometric quality of the dynamic specification is good given the output of the Hansen and AR(2) tests. Regarding the exchange rate volatility, we find that the associated coefficients are negative and statistically significant for small and medium firms. These results are explained by the negative impact of the exchange rate risk for this category of firms. Ben Marzouka and Belkheria (1994) point out that the exchange rate risk supported by firms is relatively important and that hedging strategies are often misused and sometimes unknown by Tunisian firms. For large firms containing more than 200 employees, the effect of the exchange rate volatility on investment appears to be low or even insignificant.

Table 6. Exchange rate volatility and investment – Small and medium firms vs large firms

	SMALL AND MEDIUM FIRMS						**LARGE FIRMS**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged investment rate (INV_{it-1}/K_{it-2})	0.058 (0.071)	0.058 (0.074)	0.046 (0.060)	0.045 (0.060)	0.048 (0.059)	0.043 (0.062)	0.071 (0.050)	0.080 (0.049)	0.081 (0.051)	0.081 (0.051)	0.079 (0.052)	0.082 (0.050)
Total sales (S_{it}/K_{it-1})	0 .020* (0.011)	0 .020* (0.011)	0 .019* (0.010)	0 .019* (0.010)	0 .019* (0.010)	0 .019* (0.011)	0 .051***	0 .051*** (0.0004)	0 .051*** (0.0004)	0 .051*** (0.0004)	0 .051*** (0.0004)	0 .051*** (0.0004)
Cash flows (CF_{it}/K_{it-1})	0.034*** (0.010)	0.033*** (0.010)	0.032*** (0.009)	0.032*** (0.009)	0.032*** (0.009)	0.032*** (0.009)	-0.084 (0.059)	-0.094 (0.058)	-0.092 (0.061)	-0.092 (0.061)	-0.091 (0.062)	-0.093 (0.059)
VOL *NEER*	0.006 (0.011)	–	–	–	–	–	-0.011 (0.007)	–	–	–	–	–
VOL *REER*	–	-0.002 (0.010)	–	–	–	–	–	0.015 (0.010)	–	–	–	–
VOL $Nominal_{\text{EUR/TND}}$	–	–	-0.021*** (0.007)	–	–	–	–	–	0.004 (0.007)	–	–	–
VOL $Real_{\text{EUR/TND}}$	–	–	–	-0.016*** (0.005)	–	–	–	–	–	0.003 (0.005)	–	–
VOL $Nominal_{\text{USD/TND}}$	–	–	–	–	-0.0001** (0.00004)	–	–	–	–	–	0.00002 (0.00003)	–
VOL $Real_{\text{USD/TND}}$	–	–	–	–		-0.001*** (0.0004)	–	–	–	–		0.0001 (0.0004)
Constant	0.068* (0.041)	0.083** (0.038)	0.152*** (0.054)	0.151*** (0.053)	0.129*** (0.047)	0.149*** (0.054)	0.027 (0.026)	-0.009 (0.023)	-0.008 (0.032)	-0.007 (0.032)	-0.005 (0.027)	-0.003 (0.030)
Arellano-Bond test for AR(1)	0.013	0.014	0.008	0.008	0.008	0.009	0.113	0.113	0.110	0.110	0.111	0.110
Arellano-Bond test for AR(2)	0.951	0.987	0.896	0.892	0.935	0.852	0.529	0.640	0.646	0.647	0.637	0.653
Hansen test	0.065	0.045	0.135	0.133	0.147	0.113	0.121	0.158	0.057	0.057	0.057	0.061
Number of firms	432	432	432	432	432	432	116	116	116	116	116	116
Number of observations	2592	2592	2592	2592	2592	2592	696	696	696	696	696	696

Notes: See Table 2.

Table 7. Exchange rate volatility and investment – Foreign firms vs local firms

	FOREIGN FIRMS						**LOCAL FIRMS**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged investment rate (INV_{it-1}/K_{it-2})	-0.003 (0.033)	-0.006 (0.030)	-0.003 (0.028)	-0.003 (0.028)	-0.001 (0.029)	-0.005 (0.028)	0.209*** (0.057)	0.214*** (0.057)	0.185*** (0.052)	0.185*** (0.052)	0.186*** (0.053)	0.185*** (0.052)
Total sales (S_{it}/K_{it-1})	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .047*** (0.002)	0 .006 (0.004)	0 .006 (0.004)	0 .005 (0.004)	0 .005 (0.004)	0 .006 (0.004)	0 .005 (0.004)
Cash flows (CF_{it}/K_{it-1})	0.001 (0.017)	0.003 (0.016)	0.002 (0.017)	0.003 (0.017)	0.002 (0.017)	0.003 (0.017)	0.042*** (0.007)	0.042*** (0.008)	0.042*** (0.007)	0.042*** (0.007)	0.042*** (0.007)	0.041*** (0.007)
VOL *NEER*	-0.009 (0.014)	–	–	–	–	–	0.0001 (0.005)	–	–	–	–	–
VOL *REER*	–	-0.014 (0.012)	–	–	–	–	–	0.004 (0.010)	–	–	–	–
VOL $Nominal_{\text{EUR/TND}}$	–	–	-0.017* (0.009)	–	–	–	–	–	-0.014** (0.006)	–	–	–
VOL $Real_{\text{EUR/TND}}$	–	–	–	-0.013* (0.007)	–	–	–	–	–	-0.011** (0.005)	–	–
VOL $Nominal_{\text{USD/TND}}$	–	–	–	–	-0.00007 (0.00005)	–	–	–	–	–	-0.00006* (0.00003)	–
VOL $Real_{\text{USD/TND}}$	–	–	–	–	–	-0.001** (0.0005)	–	–	–	–	–	-0.0009**
Constant	-0.032 (0.039)	-0.025 (0.036)	0.011 (0.044)	0.011 (0.044)	-0.011 (0.037)	0.017 (0.043)	0.100*** (0.024)	0.095*** (0.022)	0.149*** (0.033)	0.149*** (0.033)	0.132*** (0.028)	0.151*** (0.031)
Arellano-Bond test for AR(1)	0.051	0.047	0.042	0.042	0.041	0.044	0.012	0.011	0.012	0.012	0.011	0.013
Arellano-Bond test for AR(2)	0.384	0.385	0.373	0.375	0.356	0.399	0.776	0.739	0.953	0.955	0.932	0.970
Hansen test	0.536	0.611	0.768	0.767	0.767	0.750	0.028	0.024	0.050	0.050	0.050	0.047
Number of firms	137	137	137	137	137	137	411	411	411	411	411	411
Number of observations	822	822	822	822	822	822	2466	2466	2466	2466	2466	2466

Notes: See Table 2.

This result is explained by the fact that these firms have huge financial capacities and the needed expertise in the management of the exchange rate risk. This result appears to be robust since it is obtained using the volatility of different exchange rates. Table 7 presents estimates of the exchange rate volatility on investment in both local and foreign firms. Findings highlight the existence of negative relationships between volatility and investment and confirm previous results since firms are more sensitive to the bilateral exchange rate volatility. This is explained by the fact that firms are often using one or more bilateral exchange rates and not effective exchange rates. These results show the importance of taking into account the exchange rate uncertainty in explaining the sluggish of investment by local and foreign firms in Tunisia.

6. Concluding remarks and policy implications

The objective of this paper is to empirically check the potential effects of exchange rate fluctuations on the private investment. Unlike most previous works on developing countries, the effects of exchange rate fluctuations on private investment are analyzed based on a sample of 548 firms belonging to the manufacturing industry during the period 1997-2002. In addition, we examine the response of different categories of firms to exchange rate changes and volatility, taking into account the size and the share of foreign ownership in the capital structure of firms.

The empirical investigation suggests the existence of negative and statistically significant impacts of the depreciation and the volatility of exchange rates on private investment. The main results can be summarized in the following points. First, the depreciation of the effective and bilateral exchange rates against the euro and the US dollar has negative effects on investment. This is mainly explained by the fact that the depreciation makes the cost of imported intermediate goods and equipments more expensive, which discourage firms to invest more. Second, findings show that the response of investment in small and medium firms is higher than the one associated with large firms, while local and foreign firms react almost similarly to the exchange rate depreciation. The analysis of the impact of volatility on investment shows that firms are sensitive to bilateral and not to effective exchange rates volatility. The negative impact of bilateral exchange rates volatility is statistically significant for small and medium firms but not significant for large firms. These firms generally have the financial and managerial resources needed to exercise hedging strategies in the case of exchange rate risk. Similarly, they have strong loyalty relationships with their customers and suppliers, which enable them to adopt flexible payment methods. Our analysis also shows that bilateral exchange rates volatility affects the investment level regardless of the foreign ownership since the negative impact is observed among local and foreign firms

These results have important implications for the development of the exchange rate policy in Tunisia. Given the importance of small and medium enterprises in the Tunisian economy, monetary authorities should try to set up a foreign exchange policy that seeks to stabilize the bilateral exchange rate against the major currencies. Stable and predictable exchange rates are fundamental for domestic and foreign operators to invest more. At the same time, implementing and making adequate exchange rate risk management strategies available for small and medium enterprises may encourage them to invest more.

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Appendix

Table A1. Data description and sources

Variable	Definition	Source
$\frac{INV_{it}}{K_{it-1}}$	Investment is the total investment excluding construction and land. The investment volume is obtained using the sectoral prices indices of the gross fixed capital formation extracted from the national accounts. The capital stock is calculated using the accounting capital stock deflated by the price index of the gross fixed capital formation, taking into account the age of the capital. The normalization by capital stock allows controlling for the size of the firm.	Annual Survey of Enterprises
$\frac{S_{it}}{K_{it-1}}$	The ratio between the total turnover and the capital stock. The nominal turnover is considered to total revenues. The transition to the real turnover is achieved by using industrial sales price indices.	Annual Survey of Enterprises
$\frac{CF_{it}}{K_{it-1}}$	The ratio of cash flows over the capital stock.	Annual Survey of Enterprises
$NEER$	Index of the nominal effective exchange rate.	International Financial Statistics, IMF
$REER$	Index of the real effective exchange rate.	International Financial Statistics, IMF
$Nominal_{A/B}$	Index of the nominal exchange rate of currency A relative to currency B.	Financial Statistics of the Tunisian Central Bank
$Real_{A/B}$	Index of the real exchange rate of currency A relative to currency B.	Financial Statistics of the Tunisian Central Bank
VOL_{NEER}	Volatility of the nominal effective exchange rate of the dinar.	Authors' calculation using the GARCH (1,1) model
VOL_{REER}	Volatility of the real effective exchange rate of the dinar.	Authors' calculation using the GARCH (1,1) model
$VOL\ Nominal_{A/B}$	Volatility of the nominal exchange rate of currency A relative to currency B.	Authors' calculation using the GARCH (1,1) model
$VOL\ Real_{A/B}$	Volatility of the real exchange rate of currency A relative to currency B.	Authors' calculation using the GARCH (1,1) model