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The Relationship between Exchange Rate Uncertainty and Investment in Some Sub-Saharan African Countries

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This paper examines the important factors which can influenced domestic investment by emphasizing the exchange rate uncertainty in some Sub-Saharan African countries. There are many methods for obtaining the uncertainty of any variable. The method of GARCH(1,1) has been used for this plan. In other words the results obtained from this method are suitable proxies for volatility or variability of exchange rate. The results from the Fixed Effects Approach show the existence of a negative relationship between exchange rate uncertainty and investment in these countries. There is something to note that these countries rely on imports to increase their investments.

1. Introduction

Macroeconomic uncertainties in a high degree make suffering for developing economies. Inflation, growth, real exchange rate and other macroeconomic variables are much more volatile than in industrial economies and the consequences of this volatility for aggregate performance in several dimensions such as growth, investment and trade have attracted some attention in recent empirical literature. Because of the importance of investment and its role in the income of countries, examination of factors which can change investment is important, too. There are many obstacles to fixed investment decisions but uncertainty and instability can be serious obstacles whereas the conventional theory of investment has paid little attention to this problem, because casual empiricism also suggests that most fixed investments are easily done and undone. The link between investment decisions and uncertain environments is a focus of a recent and rapidly growing investment literature, whereby this literature has shown that if investment is costly or impossible to reverse, then investors have another option to choose instead of investment. They have an incentive to postpone commitment and wait for new information in order to avoid costly mistakes. This kind of option is called "value of waiting" which can be quite considerable especially in highly uncertain environments. So it seems that uncertainty can become a powerful investment deterrent from this literature. The exchange rate is a factor that can influence investment indirectly. In other words, exports and imports can be affected by the changes of exchange rate, especially for countries which rely on imports of capital goods. Real exchange rate volatility can influence performance of private investors regarding both the profitability and the cost of investment. On the one hand, exchange rate volatility makes the profitability of trade and non-traded goods unpredictable and, on the other hand, real exchange rate volatility causes irregular changes in the cost of capital goods,

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especially for developing countries which rely on importing the capital goods for investment.

Serven (1996) suggested that the standard net present value investment rule must be modified whereby the anticipated return must exceed the purchase and installation cost by an amount equal to the value of keeping the option alive. Serven (1996) states that this modification of the net present value is discussed by Abel et al. (1996). Net present value or NPV is a method to recognize whether investors can invest or not. If the net present value (NPV) is positive investors can invest, otherwise the expenditures of investors are more than their incomes so they do not invest. But this method is suitable for investment which is reversible. Irreversibility is an unavoidable principle of investment that makes another option for investors. In other words, investors are faced with "invest, wait, do not invest" instead of "invest, do not invest" in the existence of irreversibility of investment.

Most of the research which has been done in the field of investment has relied on the conventional investment theory that was established by Jorgenson (1963) and Tobin (1969). Jorgenson (1963) established the cost of capital view which suggests that the desired stock of capital is found by equating the marginal product and the user cost. Tobin (1969) suggested the q ratio which focuses on the value of the marginal unit of capital relative to its replacement cost. Hartman (1972) and Abel (1983) developed the conventional investment theory by involving the impact of uncertainty on investment. Hartman (1972) and Abel (1983) had some assumptions to examine the impact of uncertainty on investment. Hartman (1972) and Abel (1983) assumed that investors are risk neutral, there is a constant return, marginal profitability is a convex function of output prices and, finally, the factor of uncertainty is output price. They suggested that, based on Jensen's inequality, any increase in price uncertainty raises the expected profitability of capital, so raises the desired capital stock and thus raises investment.

On the one hand, the empirical failure of these traditional views of investment and, on the other hand, the lack of realism in some of their foundations especially in the assumption of convex adjustment costs have lead to the emergence of a new view of investment which was established by Dixit and Pindyck (1994). They emphasized that there are three important features in this view. First, irreversibility is an unavoidable factor for a part or all of most fixed capital investments. Second, investors have to face uncertainty about their future income. Third, there is a possibility of delaying investment decisions for investors to get more information about the future.

Some researchers, such as Caballero (1991) and Abel and Eberly (1994), show that irreversibility is not enough to turn around the positive impact of uncertainty on investments following from the convexity of the profit function, whereby the profit function is a convex function of uncertainty and, by increasing uncertainty, the profit of investment will increase and irreversibility of investment is not an obstacle to profitability of investment. They also state that even under asymmetric adjustment costs, it can be shown that optimal investment by a competitive principle continues to be a non - decreasing function of uncertainty.

There are two objectives in this paper which can be construed to answer some relevant questions. The first objective is to recognize the relationship between exchange rate volatility and investment in some Sub-Saharan countries and second objective is to show the impact of income in these countries. So some questions are established such as, if there is a relationship between exchange rate volatility and investment. What sis the effect of this relationship? What is the impact of income on their investment? What are the other effective factors which impact on investment?

The remaining parts of this paper include several sections. The theoretical part in the next section has been based on Amadou (2007). Methodology and explanation about the variables used in the model are shown in the third section which is divided into some sub-sections which include the calculation of exchange rate volatility as a proxy of the uncertainty factor, some unit root tests in panel and explanations about the estimation method. Empirical results and, finally, interpretation relative to empirical results and conclusion are in the fourth and fifth section, respectively. As in other research, the positive or negative impact or even no impact of exchange rate uncertainty on investment will be tested. However, some extra control variables are in the model of this study which can be useful to find the relationship between exchange rate uncertainty and investment; indeed, this is the different aspect of this study compared with the others. The selected countries are Cote d'Ivoire, Gambia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Nigeria, Rwanda, Senegal, Sudan, Togo, Zambia and Zimbabwe which are classified in the low middle income group by WDI (World Development Indicators).

2. Theoretical Framework and Literature Review

As we noted before, this section is based on Amadou (2007) which is started with the neoclassical functional form that production technology is a function of capital goods. It is considered that investors maximize their present value of future profit by choosing their investment level. In this function Y is the production function and K is the capital goods index.

$$Y = F(K) \tag{2.1}$$

Capital goods are homogenous but can be produced domestically or imported from abroad. The change in the firm's capital stock is given by

$$\dot{K} = I - \delta K \tag{2.2}$$

Where δ is the rate of depreciation of capital goods. The cost of each unit of investment is 1 plus an adjustment cost.

$$C(I) = I(1 + \emptyset\left(\frac{I}{K}\right)) \tag{2.3}$$

The price of each unit of capital goods, in real term is, $(r+\delta)^{\theta}(\epsilon\frac{p_{mk}}{p_{\cdot}})^{1-\theta}$. Where, r is the real interest rate, ϵ the real exchange rate, p_{mk} the nominal price of imported capital goods, $p_{\cdot}$ the foreign price index and θ a weighting factor. As, $0<\theta<1$, the price of capital is a geometric mean of domestic price of capital, $r+\delta$, and the foreign price of capital expressed in real terms, $\epsilon\frac{p_{mk}}{p_{\cdot}}$. Similarly, the price of one unit of output, in real terms is, $(\epsilon\frac{p_{xf}}{p_{\cdot}})^{1-\rho}$. In this expression p_{xf} is the nominal price of exported output and ρ a weighting factor which is, $0<\rho<1$.

For the role of volatility as Campa and Goldberg (1995), following Abel and Blanchard (1992), argued that in the presence of uncertainty, investment is a function of expected per period profits and the cost of capital. In their studies exchange rate is log normally distributed with mean μ and σ^2 as the variance, the distribution of the exchange rate is exogenous to the firm.

$$I=\psi\left(E\left(\pi(\mu,\sigma^2)\right)\right)=\psi(Z(\mu,\sigma^2)) \tag{2.4}$$

This relationship shows that investment is a function of μ and σ^2, in which they are mean and variance, respectively. We can differentiate from (2.4), which we have:

$$dI=\frac{\partial E(\pi(.))}{\partial\mu}\psi' d\mu+\frac{\partial E(\pi(.))}{\partial\sigma^2}\psi' d\sigma^2 \tag{2.5}$$

In (2.5) $Z(.)$ has been substituted by $E(\pi(.))$. Consider the production function is a Cabb Douglas function:

$$Q=F(K)=K^{\alpha} \tag{2.6}$$

So the per period profits are then:

$$\pi=(\epsilon\frac{p_{xf}}{p_{\cdot}})^{1-\rho}Q-(r+\delta)^{\theta}(\epsilon\frac{p_{mk}}{p_{\cdot}})^{1-\theta}Q^{\frac{1}{\alpha}} \tag{2.7}$$

The right-hand side of (2.6) equals the revenue minus cost. The cost function has resulted from the production function, that is:

$$C(.)=(r+\delta)^{\theta}(\epsilon\frac{p_{mk}}{p_{\cdot}})^{1-\theta}Q^{\frac{1}{\alpha}}$$

By taking the expectation of profit function, we have:

$$E(\pi)=(\frac{p_{xf}}{p_{\cdot}})^{1-\rho}exp\{(1-\rho)\mu+1/2(1-\rho)^2\sigma^2\}Q$$
$$-(r+\delta)^{\theta}exp\{(1-\theta)\mu+1/2(1-\theta)^2\sigma^2\}(\frac{p_{mk}}{p_{\cdot}})^{1-\theta}Q^{\frac{1}{\alpha}}$$

By deriving the expectation function with respect to μ and σ^2, we have:

$$\frac{\partial E(\pi)}{\partial \mu} = (1-\rho)\, exp(\Phi)\, (\frac{p_{xf}}{p_{\cdot}})^{1-\rho} Q - (1-\theta) exp(\Phi')(r+\delta)^{\theta} (\frac{p_{mk}}{p_{\cdot}})^{1-\theta} Q^{\frac{1}{\alpha}} \quad (2.8)$$

$$\frac{\partial E(\pi)}{\partial \sigma^2} = \frac{1}{2}(1-\rho)^2\, exp(\Phi)\, (\frac{p_{xf}}{p_{\cdot}})^{1-\rho} Q - \frac{1}{2}(1-\theta)^2 exp(\Phi')(r+\delta)^{\theta} (\frac{p_{mk}}{p_{\cdot}})^{1-\theta} Q^{\frac{1}{\alpha}} \quad (2.9)$$

The expression Φ in (2.8) and (2.9) is $(1-\rho)\mu + \frac{1}{2}(1-\rho)^2\sigma^2$ and Φ' is $(1-\theta)\mu + \frac{1}{2}(1-\theta)^2\sigma^2$. In (2.8), the effects of exchange rate uncertainty on investment are ambiguous. Refer to Amadou (2007, p5-9) for more details.

Zeira (1990) suggests that investors who are risk averse suffer from the impact of uncertainty on their investment decisions. Overall, it makes a negative impact of uncertainty on investment. Some researchers such as Lee and Shin (2000) have noted a positive impact of uncertainty on investment by emphasizing the role of variable inputs and their share of output which may increase the convexity effect and thus investment is more likely to increase with uncertainty. Sarkar (2000) realized that there is a threshold effect in the link of investment and uncertainty in which there would be a positive relationship when the quantity of uncertainty is small but it makes a negative relationship beyond some critical value. Goldberg (1993) and Darby (1999) by examining the impact of exchange rate uncertainty on aggregate investment in some industrialized countries found that exchange rate uncertainty has a negative impact on aggregate investment. Serven (1996) entered the factor of irreversibility of investment in the research and then found evidence which suggests that there is a negative association between investment performance and instability in some African countries in recent decades. Serven (2002) examined the relationship between real exchange rate volatility and investment in developing countries and found that real exchange rate volatility has a strong negative impact on investment and this negative impact is significantly larger in economies that are highly open and with less developed financial systems. Campa and Goldberg (1995) realized that the exchange rate uncertainty has an ambiguous impact on profits. Campa and Goldberg (1999), Lafrance and Tessier (2001) and Harchaoui et al. (2005) found that exchange rate and its changes are an ineffective factor to change the investment in Canada whereas more examinations by Hachaoui et al. (2005) show that there are non-linear effects of exchange rate on investment in Canada whereby the investment has different reactions against exchange rate volatility. Darby et al (1999) researched something that was different from others. They expanded the impact of exchange rate uncertainty on the level of investment. They stated that there are threshold effects which can be used to identify the situation of increase or decrease of investment by raising the volatility and also to identify which types of industries would gain and which would suffer from a move to fixed exchange rates. Serven (1996) entered the factor of irreversibility of investment in the research and then found evidences in which suggest there is a negative association between investment performance and instability in some African countries in recent decades. Atella et al (2003) by employing a large panel of Italian firms and using a model of

signal extraction found that exchange rate volatility reduces investment with decreasing sensitivity the greater the firm market power. So any economic system can benefit from a stable exchange rate. Byrne and Davis (2005) examined the short-run and long-run impact of exchange rate uncertainty on investment by using a panel of some industrial countries. Amadou (2007) examined the link between real exchange rate volatility and investment by using the method of panel data co-integration and the result illustrated that there is a negative relationship between real exchange rate volatility and investment in which volatility based on the real exchange rate has a strong negative impact on investment in some of developing countries.

Demir (2009) analyzed the relationship between macroeconomic volatility and private investment in Argentina, Mexico and Turkey and realized that increasing macroeconomic volatility hurts fixed investment in these countries. Serven (2002) by examination of the link between real exchange rate volatility and investment in developing countries and using a large cross country time series data set has found that there is some evidence of threshold effects. The negative impact of real exchange rate uncertainty on investment is significantly larger in economies that are highly open and in those with less developed financial systems.

3. Methodology, Model and Variables

This section is divided into four parts. The first part includes the method of calculation of the exchange rate uncertainty, the second part explains the unit root tests for panel data, briefly. Panel data models are in the third part and, finally, we will define the variables in the model in the fourth part.

3.1. Exchange Rate Uncertainty

There are many methods for obtaining exchange rate uncertainty but the more popular of them are ARCH (Auto Regressive Conditional Heteroskedasticity) and GARCH (Generalized Auto Regressive Conditional Heteroskedasticity). In this study, we used GARCH(1,1) to obtain the uncertainty of exchange rate. The GARCH(1,1) includes two equations:

$$Y_t = X_t^{'}\theta + \epsilon_t \qquad (3.1)$$

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \qquad (3.2)$$

The first equation is called the mean equation and the second is called the variance equation. Actually, the second equation is variance of remained disturbances from the mean equation which depends on its lag and the lag of disturbances. See Engle (2001) for more details. It should be noted that we used $Dln(ex_t)$ as the dependent variable Y_t, so we have:

$$Dln(ex_t) = \beta_0 + \epsilon_t$$

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2$$

3.2. Unit Root Test in Panel Data

Recent literature suggests that panes based unit root tests have higher power than unit root tests based on individual time series. There are five types of panel unit root tests in which EViews will compute:

1. Levin, Lin and Chu (2002)
2. Breitung (2000)
3. Im, Pesaran and Shin (2003)
4. Fisher type test using ADF and PP tests (Maddala and Wu (1999) and Choi (2001))
5. Hadri (2000)

Consider the following AR(1) process for panel data:

$$y_{it} = \rho_i y_{it-1} + X_{it}\delta_i + \epsilon_{it} \quad (3.3)$$

$$i = 1,2,\dots,N \qquad t = 1,2,\dots,T$$

The X_{it} is a representative of the exogenous variable in the model, including any fixed effects or individual trend, ρ_i are the auto regressive coefficients and the errors ϵ_{it} are assumed to be mutually independent idiosyncratic disturbances. If $|\rho_i| < 1$, y_i is said to be weakly (trend) stationary. On the other hand, if $|\rho_i| = 1$ then y_i contains a unit root. The following table summarizes the basic characteristics of the panel unit root tests available in EViews:

Table 3.1: Summary of Panel Unit Root Tests

Test	***Null***	***Alternative***	***Possible Deterministic Component***	***Auto Correlation Correction Method***
Levin, Lin and Chu	*Unit root*	*No Unit Root*	*None, F, T*	*Lags*
Breitung	*Unit root*	*No Unit Root*	*None, F, T*	*Lags*
Im, Pesaran and Shin	*Unit Root*	*Some cross section with or without UR*	*F, T*	*Lags*
Fisher (ADF)	*Unit Root*	*Some cross section with or without UR*	*None, F, T*	*Lags*
Fisher (PP)	*Unit Root*	*Some cross section with or without UR*	*None, F, T*	*Kernel*
Hadri	*No Unit Root*	*Unit Root*	*F, T*	*Kernel*

Source: user guide of EViews

Note: the expressions of None, F and T indicate no exogenous, fixed effect and individual effect and individual trend, respectively.

3.3. Fixed Effects Approach

First differencing is just one of many ways to eliminate the fixed effect. An alternative method, which works better under certain assumptions, is called fixed effects transformation. It should be noted that the Hausman test has been used to determine the estimation method between Fixed or Random effects in panel. Consider a model with a single explanatory variable, for each i:

$$y_{it} = \beta_1 x_{it} + a_i + u_{it} \quad (3.4)$$

$t = 1,2, \dots, T$

a_i is the fixed effect. For each i, average this equation over time. We get:

$$\bar{y}_i = \beta_1 \bar{x}_i + a_i + \bar{u}_i \quad (3.5)$$

If we subtract (3.5) from (3.4) for each t, we wind up with

$$y_{it} - \bar{y}_i = \beta_1 (x_{it} - \bar{x}_i) + u_{it} - \bar{u}_i \quad (3.6)$$

$t = 1,2, \dots, T$

Or

$$\ddot{y}_{it} = \beta_1 \ddot{x}_{it} + \ddot{u}_{it} \quad (3.7)$$

$t = 1,2, \dots, T$

$\ddot{y}_{it} = y_{it} - \bar{y}_i$ is the time demeaned data on y and similarly for $\ddot{x}_{it}$ and $\ddot{u}_{it}$. The fixed effects transformation is also called the within transformation. The important thing about (3.7) is that the unobserved effect, a_i, has disappeared. This suggests that we estimate (3.7) by pooled OLS. A pooled OLS estimator that is based on the time demeaned variables is called the fixed effects estimator or the within estimator (Gujarati 2004).

3.4. Variables

We applied the panel data and fixed effect model to estimate a model of the form:

$$I_{it} = \gamma ue_{it} + \beta' X_{it} + \alpha_i + \delta_i t + \epsilon_{it} \quad (3.8)$$

In this form, I_{it} is investment and it is calculated from GCF_{it}/GDP_{it}, so we can call it domestic investment. ue_{it} is uncertainty of exchange rate, that is obtained from GARCH(1,1) model of real effective exchange rate for every country and X_{it} is the other exogenous variables that includes price of the capital goods, $pinv_{it}$, the changes of GDP, gdp_{it}, long term debt, ltd_{it}, the changes of price, lp_{it}, index of exports, exp_{it} and index of imports, imp_{it}. It should be noted that all variables except exchange rate uncertainty are used as proportionals of GDP.

4. Empirical Results

This study examines the relationship between uncertainty of exchange rate and investment by using the annual data for Cote d'Ivoire, Gambia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Nigeria, Rwanda, Senegal, Sudan, Togo, Zambia and Zimbabwe from 1975 until 2006. It should be noted that these data based on availability have been gathered from the WDI and IFS databases. At first, the exchange rate uncertainty is obtained from $GARCH(1,1)$. then the stationarity of variables is tested by panel unit root tests and, finally, the model is estimated and the hypotheses tested by looking at the coefficient of exchange uncertainty and the other coefficients. The interpretation of the results comes in next section.

4.1 Panel Unit Root Tests

Table 4.1: Unit Root Tests

Variables	*Method of Test*	*Test Statistic*	*P Value*
I_{it}	*Levin, Lin & Chu*	-19.2414	0.0000
	Im, Pesaran and Sihn	-17.8456	0.0000
	Fisher Chi square (ADF)	303.013	0.0000
	Fisher Chi square (PP)	328.565	0.0000
ue_{it}	*Levin, Lin & Chu*	0.19562	0.5775
	Im, Pesaran and Sihn	-2.99374	0.0014
	Fisher Chi square (ADF)	102.159	0.0000
	Fisher Chi square (PP)	160.739	0.0000
$pinv_{it}$	*Levin, Lin & Chu*	-2.62148	0.0044
	Im, Pesaran and Sihn	-3.34926	0.0004
	Fisher Chi square (ADF)	60.6717	0.0008
	Fisher Chi square (PP)	58.3385	0.0015
gdp_{it}	*Levin, Lin & Chu*	-11.9547	0.0000
	Im, Pesaran and Sihn	-14.1303	0.0000
	Fisher Chi square (ADF)	234.132	0.0000
	Fisher Chi square (PP)	283.938	0.0000
exp_{it}	*Levin, Lin & Chu*	-2.62607	0.0043
	Im, Pesaran and Sihn	-3.48243	0.0002
	Fisher Chi square (ADF)	83.7862	0.0000
	Fisher Chi square (PP)	118.078	0.0000
lp_{it}	*Levin, Lin & Chu*	-7.39432	0.0000
	Im, Pesaran and Sihn	-9.65645	0.0000
	Fisher Chi square (ADF)	156.555	0.0000
	Fisher Chi square (PP)	150.590	0.0000
imp_{it}	*Levin, Lin & Chu*	-14.2452	0.0000
	Im, Pesaran and Sihn	-13.7903	0.0000
	Fisher Chi square (ADF)	216.719	0.0000
	Fisher Chi square (PP)	240.266	0.0000
ltd_{it}	*Levin, Lin & Chu*	-3.76307	0.0001
	Im, Pesaran and Sihn	-1.98577	0.0235
	Fisher Chi square (ADF)	43.8118	0.0496
	Fisher Chi square (PP)	50.4553	0.0111

Source: Author's findings

We tested the existence of unit root for every variable used in the model. The results show that all variables are stationary in level. The results of the unit root test have been shown in Table (4.1), briefly. The results in Table (4.1) show that we can use the variables in their levels.

4.2. Model Specification

In this section we estimate the model by using the fixed effects approach and obtain the coefficients of variables and, so, their impacts on the dependent variable. The results of the estimation have been shown in Table (4.2).

Table 4.2: Results of the panel estimation

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob*
C	-0.000471	0.015413	-0.030541	0.9757
ue_{it}	-0.084144	0.026471	-3.178769	0.0016
$pinv_{it}$	-0.047646	0.013894	-3.429341	0.0007
$pinv_{it-1}$	0.043516	0.018760	2.319605	0.0209
$pinv_{it-2}$	-0.008074	0.013765	-0.586575	0.5579
gdp_{it}	0.176666	0.056211	3.142916	0.0018
gdp_{it-1}	0.061745	0.062067	0.994813	0.3205
exp_{it}	0.339608	0.062905	5.398713	0.0000
imp_{it}	0.017135	0.017245	0.993620	0.3211
lp_{it}	0.033308	0.023654	1.408142	0.1600
ltd_{it-1}	-0.066297	0.037182	-1.783056	0.0754
ltd_{it-2}	0.064898	0.034929	1.857990	0.0640

F	$Probability$	DW
3.410211	0.000000	2.020927

Source: Author's findings

As the results in Table (4.2) illustrate that investment which is the dependent variable reacts to exchange rate uncertainty. Exchange rate uncertainty has negative and completely significant impact on domestic investment. The price of capital goods can impact on domestic investment but it has opposite effects in different periods. The reason for this situation has been explained in the interpretation section. The changes of GDP and exports have the expected sign in the estimation. Like the price of capital goods, the long-term debt has opposite effects in different periods. Investment can be affected by the price of goods but it is insignificant. The estimated coefficient for imports is insignificant, too. Other statistics show that all of these coefficients have been estimated correctly and there is not any serial correlation and auto-regression among the

variables. It should be noted that the estimated model has been selected by model selection criteria such as AIC (Akaike information criterion) and SC (Schwarz criterion) and general to specific method.

5. Interpretation of the Results

In this section we conclude from the results of the estimation of the model and the results in Table (4.2). As the results show, exchange rate volatility is an effective factor to decrease domestic investment in these countries. Uncertainty is a factor which will be revealed in the long run, so the investors who need to invest long run should be careful because this uncertainty really affects investment in these countries. One of the solutions to offset the adverse effect of exchange rate uncertainty is to make investments with short periods. These countries really need to import capital goods to increase their investment, so every factor which impacts on the price of these goods can be effective to change the imports and, so, investment. It seems that exchange rate volatility has caused increases in the exchange rate and so the price of capital goods has increased. So, imports of these goods are reduced in the current period. The prices of product produced by investors have a positive effect on investment but insignificantly, that is, the value of domestic money has decreased and then the exchange rate has increased. On the other hand, the exchange rate volatility is a factor which caused the exchange rate to increase, severely. However, investment decreases due to increase in the price of capital goods. However, the price of capital goods has a negative effect in the same period but the price of capital goods in the previous period has a positive effect on domestic investment. Investors expect an increase in the price of capital goods, so they increase the imports of capital goods in the previous period and then, however, the price of capital goods increase in current period but their needs have been satisfied. By increasing the price of capital goods in the current period, their imports of them decrease and their investment too. But the investment has a positive relationship with the price of capital goods in the previous period. The results show that if the coefficient of the price of capital goods in the current period is more than the coefficient of the price of capital goods in the previous period, investment decreases.

Investment has a small share of GDP in these countries. The exports of the goods in which these countries are efficient can help to provide the financial sources for imports and then these countries can improve their domestic investments through GDP. So, these countries can decrease the effects of uncertainty of exchange rate by increasing the exports of goods or services which are in large production. The government is an important factor to protect these product.

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Appendix

To recognize the estimation method, Hausman test should be done. For doing this, at first, the model should be estimated by Random Effects Approach and then the correlated random effects should be tested by Hausman test. If the test statistic is more than the critical value, then the alternative hypothesis based on inequality of coefficients in Fixed Effects and Random Effects, would be accepted. So, the model should be estimated by Fixed Effects.

Results of the Hausman test

Test Summary	***Chi-Sq. Statistic***	***Chi-Sq. d.f***	***Prob***
Cross-section random	39.111108	11	0.0001

As the results of the Hausman test show, the alternative hypothesis would be accepted.