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Identifying the exchange-rate balance sheet effect over firms

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Abstract:

I use firm-level data on investment and evaluate the balance sheet effect of changes in the exchange rate. The fact that a depreciation not only generates an expansion (for a small open economy that exports raw materials) but also has the potential of recession (in a dollarized economy in which most firms' liabilities are in foreign currency) brings up the question on what the final effect of a depreciation over either investment or production is. Following Bleakley and Cowan (2008), I evaluate if this channel is operating. My estimations indicates that this effect tends to disappear when terms of trade are considered, result that is robust to different specifications.

JEL Classification: E22, F41, G31

Key words: Balance sheet effect, exchange rate, investment.

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1. INTRODUCTION

One part of the Third generation currency-crisis literature highlight the fact that, if there is a large foreign-currency debt then an expansionary monetary policy and a depreciation of the currency are not necessarily optimal policy answers in response to an adverse foreign shock.[1] Therefore, if a balance sheet channel is operating, a weaker local currency increases the value of debt service. Even more, those effects may wreck the balance sheets of both domestic banks and firms. If that is the case, a high degree of dollarization of assets and liabilities from the part of firms and banks may play a critical role for the monetary authority at the time of deciding, for example, intervention in the FOREX market or even an exchange rate regime.

On theoretical grounds, Krugman (1999), Aghion et al. (2001, 2004) and Cespedes et al. (2004) are among the first to utilize the open economy designed by Bernanke at al. (1999) i.e. in order to invest a firm should finance first the investment process. Given the assumption that most borrowing comes from abroad in foreign currency,[2] there is a balance sheet effect when there are changes in the exchange rate that directly affects firms' liabilities. So that currency depreciations may be contractionary because revenues and liabilities are denominated in different currencies.

On empirics, the usual way of evaluating the existence of a balance sheet channel is through its effects over capital accumulation. Firms tend to invest less if there are scenarios of financial distress regarding the increase of the adquired debt in foreign currency because of a large devaluation. In turn, those effects over investment translate into a lower level of production. Here the literature focuses on the components of the firms' balance sheet. The original version of Bleakley and Cowan (2008) motivated more empirical studies in this field. In 2003, six independent research teams evaluated the presence of balance sheet effects in Latin American countries by estimating how firm's investment is affected by real exchange rate fluctuations in the

[1] See Chang and Velazco (2000).
[2] See Hale and Arteta (2009) for evidence of the link between balance-sheet effects and credit markets.

presence of liability dollarization. They find that there is a balance sheet channel for the cases of Mexico and Argentina, no clear evidence for Colombia and Peru, and no evidence for Brazil and Chile.[3]

In the case of Peru, two periods can be observed. In between 1994 and 2001, this economy was in the transition from high to moderate inflation, with a clear tendency to a depreciation of the exchange rate, and a negative tendency in the terms of trade. Since 2002, the central bank of Peru has adopted an inflation targeting regime. Not only the Peruvian economy had a revaluation of its currency and a clear increase in the capital accumulation but also Peru experienced a long period of good terms of trade (see Figure 1).

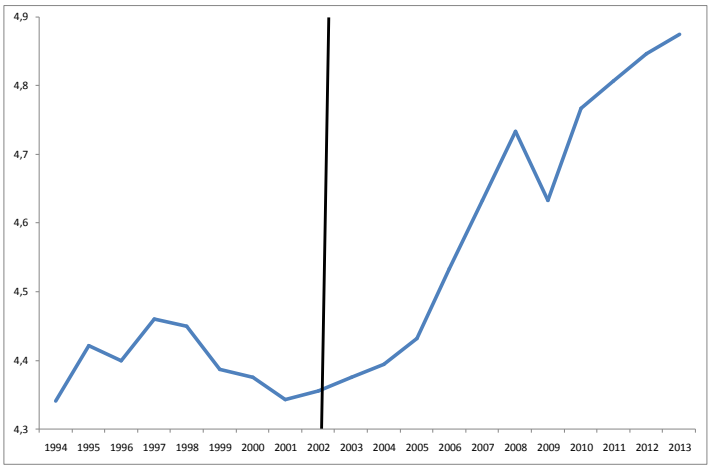
In other words, the strong negative correlation between exchange rate and investment between 2002 and 2013 may lead to the conclusion that a balance sheet channel is operating and over-powers the competitiveness channel. It is necessary to control for the terms of trade as well in order to account for great incentives to invest and produce for firms that exports (given the higher external demand) which in time translate to more investment in firms that are not involved in external trade (spillover effects).

This argument may be different in terms of disaggregated firm data. Some sectors may be more benefited from a revaluation of the local currency and take more debt in foreign currency. When a revaluation occurs, the debt decreases and firms may have a wealth effect and more incentives to take more debt. Especially during 2008-2012, it was observed an increase in international bonds emission from the part of local firms. This type of borrowing may be associated with large investment processes. In fact this is a question I intend to analyze.

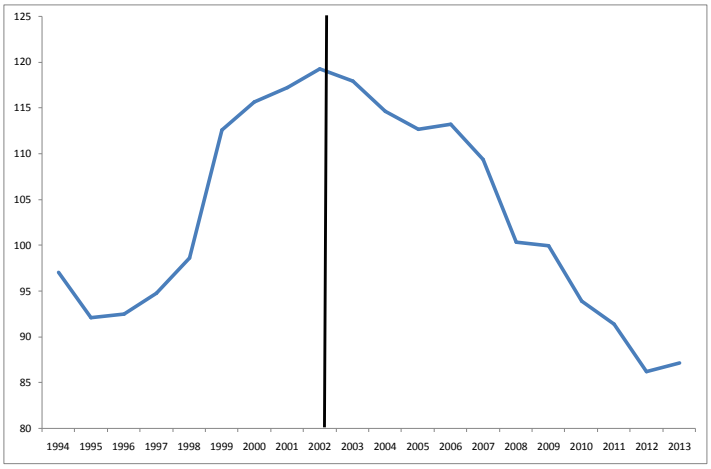
[3] See Galindo et al. (2003) for a review.

FIGURE 1 – AGGREGATE VARIABLES

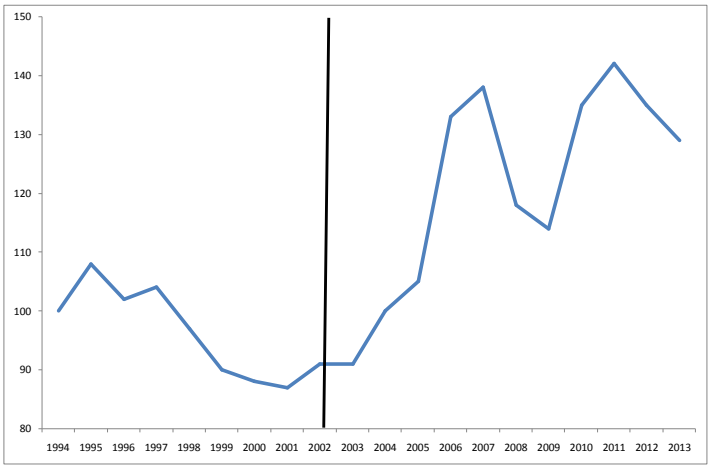
A: INVESTMENT



B: REAL EXCHANGE RATE



C: TERMS OF TRADE



Note. Investment is measured in real terms and logs, the real exchange rate and the terms of trade are indexes (1994=100). The real exchange rate is the bilateral exchange rate between Peru and the U.S. taking into account consumer price indexes for Peru and the U.S.

In terms of studies for the Peruvian economy using firm-level data, Carranza et al. (2003) analyzes the impact of the exchange rate changes over capital accumulation using financial information. The authors find that investment decisions are negatively affected by real exchange rate depreciation however this result is not robust to different specifications.

I fine tune Carranza et al. (2003) study, extend the sample of firms and frame time, and follow on Bleakley and Cowan (2008). I work an unbalanced panel that ranges from 2002 to 2013. In this way, I am able to analyze for a time period in which the Peruvian economy is more stable and the central bank of Peru commits to an inflation targeting regime so a low inflation was observed since. Also during this time, it was observed changes in the exchange rate. Similar to Carranza et al., I mainly use non-financial listed firm's balance sheet information. In contrast to Carranza et al., I consider net exports that each firm made during the period under analysis and control for terms of trade.

The rest of this paper is structured as follows: section 2 contains a review of the literature. In section 3, I present the data used in section 4. Section 5 concludes.

2. LITERATURE REVIEW

In terms of modeling most of the literature focuses on balance sheet effects and exchange rate policy regimes. Krugman (1999) is one of the pioneering work in the field. Afterward, most work follows the formulation of Bernanke et al. (1999) such as Aghion et al. (2002) and Cespedes et al. (2004).

In Krugman (1999) the transfer problem is born from comparing the foreign real interest rate with the return achieved by converting foreign goods into domestic, then converting the next-period return back into foreign goods. This mechanism is key for his argument that a decline in capital inflows can adversely affect the balance sheet of domestic entrepreneurs, reducing their

ability to borrow and hence further reducing capital inflows because the volume of capital inflows affects the terms of trade and hence the valuation of foreign-currency-denominated debt.

Aghion et al. (2002) model is based on nominal prices stickyness. Here, a currency depreciation leads to an increase in the foreign currency debt repayment obligations of firms, and thus to a fall in their profits. This reduces firms' borrowing capacity and therefore investment and output in a credit-constrained economy, which in turn reduces the demand for the domestic currency and leads to a depreciation.

In Cespedes et al. (2004), the price of capital in terms of home goods is an increasing function of the real exchange rate. With incomplete depreciation, a real depreciation would raise the value of capital, thereby increasing networth. The keys of their mechanism are entrepreneurs who finance investment by borrowing abroad and borrowing is subject to frictions (either informational or enforcement problems). In this setup, the risk premium is an increasing function of the value of investment relative to networth. So, a real devaluation (an increase in real exchange rate) has a negative impact on networth and increases the next period's risk premium. These authors follow on Calvo (1999, 2001) who argue that if an entrepreneur's assets and liabilities are denominated in units of different goods, changes in their relative prices affect creditworthiness.

In terms of empirics, the presence of balance sheet effects is evaluated by estimating how the investment made by individual firms is affected by real exchange rate fluctuations in the presence of liabilities in U.S. dollars. In 2003, six independent research teams collected and analyzed balance sheet data for 8500 firms in Argentina, Brazil, Chile, Colombia, Mexico, and Peru. All these studies are inspired in the original version of Bleakley and Cowan (2008) and analyze the significance of an interaction term between real exchange rate fluctuations and the ratio of foreign currency debt to total debt. If the coefficient of the interaction term is negative, a depreciation have a negative balance sheet effect and leads firms with more debt in U.S. dollars to reduce investment more compared with firms with less U.S. dollar debt. Galindo et al. (2003) present a

review of those papers and report that there is a balance sheet channel for the cases of Mexico and Argentina, no clear evidence for Colombia and Peru, and no evidence for Brazil and Chile. For the case of Peru, Carranza et al. (2003) analyze the impact of the exchange rate changes over capital accumulation using financial information from 163 non-financial listed firms. For firms holding U.S. dollar-denominated debt, investment decisions are negatively affected by real exchange rate depreciation, however this result is not robust to different specifications.

Bleakley and Cowan (2008) find that for Argentina, Brazil, Chile, Colombia and Mexico there is no clear evidence of a balance sheet effect either in long term investment (capital expenditure) or short term investment (inventory investment). If any effect, this should be positive i.e. a devaluation of the exchange rate is correlated with an increase in investment. Bleakley and Cowan (2008) point out that those significant balance sheet effect reported in previous studies is the result of omitted variables that downward bias the parameter under analysis.

Some other work that use the interactive term between exchange rate and debt liabilities are Malone (2009) who includes balance sheet effects on the determinants of emerging market spreads.

On the other hand, Bigio (2010) studies the behavior a central bank that has model uncertainty. In a standard new-Keynesian small-open economy model, the aggregate demand equation describes how the output gap depends on a group of variables that includes the expected nominal depreciation. The standard model have the parameter associated to the expected nominal depreciation to be positive (nominal devaluations expand output) while the balance sheet model implies that parameter to work the opposite way (nominal devaluation has a negative effect on output). This parameter has an unknown value to both policy makers and agents within the model and may come from either the standard or the balance sheet model. Bigio suggest that this approach is consistent with the hypothesis that by believing in the balance-sheet model, countries

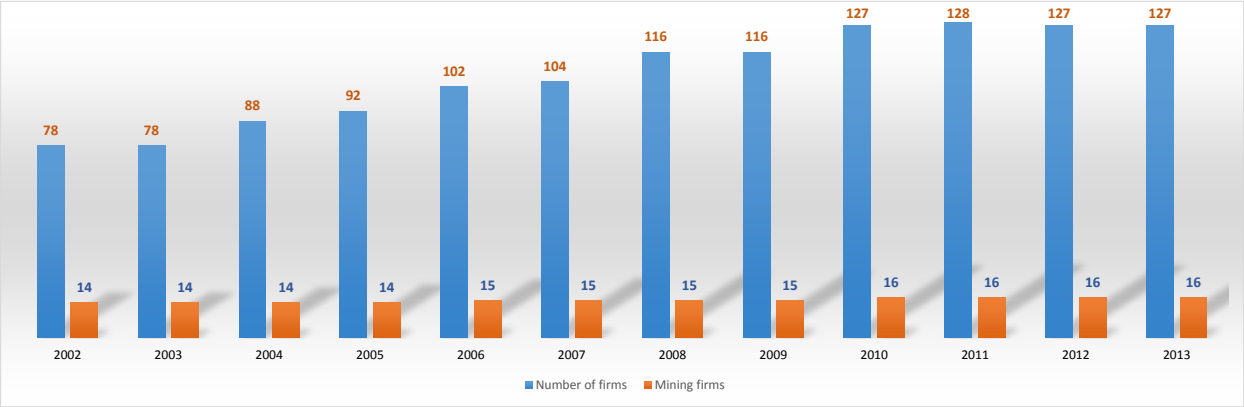
intervened substantially in their exchange rate markets and by doing this, they lost the ability to learn about the balance-sheet effect.

3. DATA CHARACTERISTICS

This study relies on the financial information collected from individual-firm balance sheets. Here I describe the sample and variables under study. My main data consist of firm-level accounting information for Peruvian non-financial firms organized as an unbalanced panel data set.

About the sample of firms, I collect information for 130 firms however, it varies from 78 to 127 firms from year to year. The time period under investigation ranges from 2002 to 2013, with yearly observations (see Figure 3). This period coincides with the adoption of Inflation Target scheme as the monetary policy for the central bank in Peru. Following Bleakley and Cowan (2008), the variables under study are in logs.

FIGURE 3 – NUMBER OF FIRMS



I approach investment as the change in the gross fixed capital (real terms). I take into account total liabilities, liabilities denominated in dollars, and short term liabilities (liabilities with maturity less than 1 year). Other financial variables such as sales, total assets, and EBITDA are also taken into consideration.

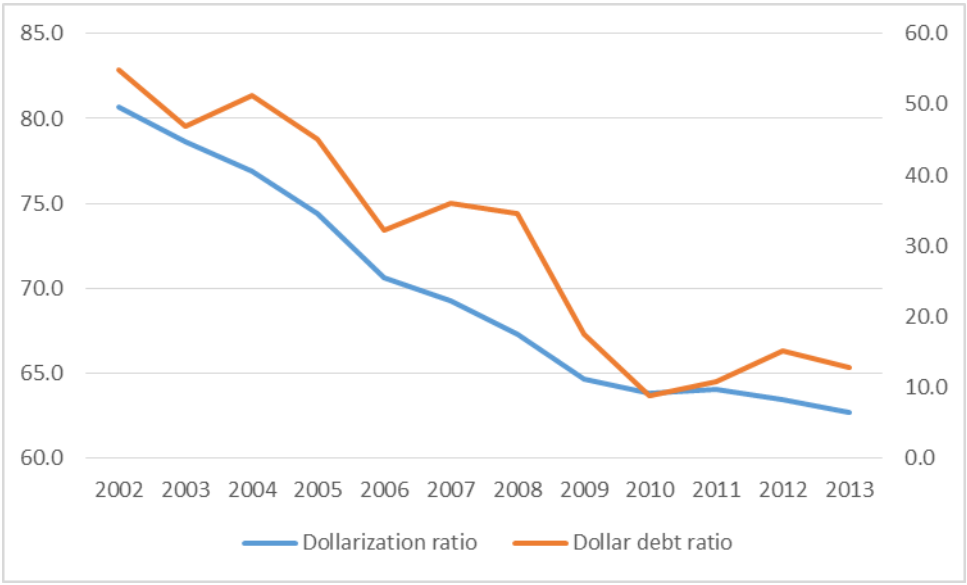
Regarding external variables, I take exports for each individual firm, terms of trade, a real exchange rate index, and the average lending rate in dollars (TAMEX). The real exchange rate is

the bilateral exchange rate between the U.S. and Peru, adjusted by the consumer price index of each country.

The main objective for this paper is the assestment of a relationship between dollar debt and the investment process in the Peruvian economy. In order to do so, I need good indicators of both dollarization in the credit market and aggregate investment. I argue that the ratio of dollar debt to total debt is a good proxy for dollarization and the investment process of the firms in the BVL maps correctly the investment process followed in Peru.

In Figure 4 I present the dollarization ratio and the dollar debt ratio. I define dollarization as the ratio between bank credits in US dollars measured in Nuevos soles and the total of bank credits. As for dollar debt, it is the ratio between the debt in US dollars and the total debt in the sample of firms. The Pearson product-moment correlation coefficient (a measure of the linear correlation between the dollarization ratio and the dollar debt ratio) is 0.95 which indicates almost total positive correlation.[4]

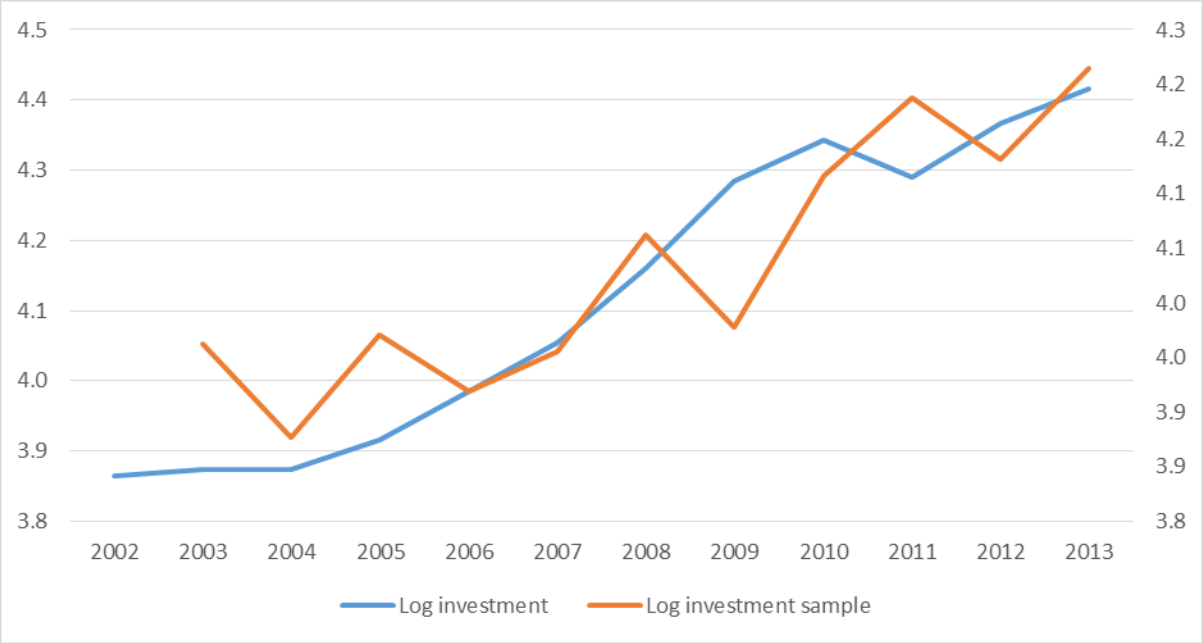
FIGURE 4 – DOLLARIZATION AND DOLLAR DEBT



[4] This coefficient correlation is widely used in the sciences as a measure of the degree of linear dependence between two variables.

In Figure 5 I present the second variable of interest: investment. Here I present the aggregate private investment from national accounts and the investment made by firms in my sample (sample investment). Both variables are measured in logs. The Pearson product-moment correlation coefficient is 0.82 which indicates a high positive correlation.

FIGURE 5 – AGGREGATE INVESTMENT AND INVESTMENT IN THE SAMPLE



So the regression presented in the following section consider good proxies for the identification of the exchange rate balance sheet effect.

4. ESTIMATIONS AND EMPIRICS

For the estimation of the model I use the GMM in differences which is an estimator proposed by Arellano and Bond (1991) for dynamic panel data. The generalized method of moments (GMM) estimator is typically used to correct for bias caused by endogenous explanatory variables and considers the lagged dependent variable as a valid instrument. Arellano and Bond' estimator is

designed for situations in which a linear functional relationship is estimated, the one left-hand-side variable has dynamic and depends on its own past realizations.[5]

4.1 Model especification

Let k_{it} be the investment in firm *i* in period *t* and it is estimated as the log difference of gross fixed capital (real terms) for firm *i*. I follow a standard specification for firm *i* investment process:

$$\mathrm{k}_{it} = \theta_1 \Delta er_t + \theta_2' \mathrm{Z}_{it} + \varepsilon_{it} \qquad (1)$$

where Δer_t is the variation of real exchange rate in year *t*; and Z_{it} is a set of firm-specific variables such as leverage or cash flows for firm *i*. Z_{it} also includes macroeconomic variables and lagged values of investment.

The parameter θ_1 captures the effect on investment due to unexpected changes in the real exchange rate, which in time is affected by either real debt service burden or real incomes from exports. As Malone (2009) points out, a rise in real debt service burden, for a firm with a positive amount of dollar denominated debt, could occur for example due to a real depreciation, because this makes the value of dollar denominated debt service higher in domestic currency terms. The opposite occurs for firms that export and then have revenues in dollars. Moreover, Bleakley and Cowan (2008) argue that higher indebtedness leads to an increase in the cost of external finance and to a reduction in investment.[6] If so, the final effect of exchange rate changes over investment is subject to the level foreign currency liabilities and/or the total indebtedness level that each individual firm has, as well as a measure of competitiveness in external markets:

$$\theta_1 = \gamma d^*_{it-1} + \phi d_{it-1} + \lambda x_t \qquad (2)$$

[5] Arellano-Bond estimation begins with the transformation of all regressors, usually by differencing, and uses the generalized method of moments (GMM).
[6] Bleakley and Cowan (2008) also argue that omitting the interaction between total debt and the real exchange rate results in a sizeable downward bias in the estimated coefficient of the balance sheet effect.

where d_{it}^{*} and d_{it} are foreign currency liabilities and total liabilities of firm *i* over total assets in period *t*; and x_t is a measure of competitiveness in terms of exports in period *t*.

Replacing (2) in (1):

$$k_{it} = \gamma(d_{it-1}^{*}\,\Delta er_t) + \phi(d_{it-1}\Delta er_t) + \lambda(x_t\,\Delta er_t) + \theta_2' \mathrm{Z}_{it} + \varepsilon_{it} \qquad (3)$$

The strategy is to test directly for the balance sheet effect of the exchange rate by estimating (3) and check on the sign and statistically significance of γ.

4.2 Baseline regression

In this section I stablish the baseline regression. In all exercises the constant is added to the instrument list and the set of control variables are debt in US dollars, total debt, terms of trade, and the lagged of the dependent variable. All regressions have valid instruments, according to the J-test.[7]

I first estimate the relationship between investment and real exchange rate so I capture the principal first-order interaction (U.S. dollar debt times change in the exchange rate):

$$k_{it} = \beta_1(d_{it-1}^{*}\Delta er_t) + \varepsilon_{it} \qquad (4)$$

Equation 1 in Table 1 estimates (4) and shows the negative coefficient of the interactive term. This result suggest that following periods of real depreciation, investment by dollar-indebted firms is lower than the investment of their domestic-currency indebted counterparts i.e. there is some evidence of a balance sheet channel operating in the Peruvian economy.[8]

Then, I consider that some firms have large levels of debt and that may reinforce any balance sheet effect in the investment process, as suggested in Bleakley and Cowan (2008). The new specification considers the interaction term between total debt and exchange rate changes:

[7] The J test or test for over-identifying restrictions is a test of the validity of instrumental variables. The hypothesis being tested with the J test is that the model is valid i.e. the data come close to meeting the restrictions. In other words, the number of moment conditions are the same than the dimension of the parameter vector of the model.
[8] Micro-level indepent variables are lagged one year, so "current year" means contemporaneous with the macro variable.

$$k_{it} = \beta_1(d^*_{it-1}\Delta er_t) + \beta_2(d_{it-1}\Delta er_t) + \varepsilon_{it} \quad (5)$$

Equation 2 in Table 1 estimates (5) and, as expected, the negative coefficient that captures the balance sheet effect becomes stronger and statistically significant. According to this result, investment by dollar-indebted firms is lower than those firms with debt in domestic currency when a real depreciation occurs.

TABLE 1 – EFFECT OF DOLLAR DEBT AND EXCHANGE RATE MOVEMENTS ON INVESTMENT

Independent variables	(1)	(2)	(3)
Interactions			
Dollar debt x (Δ log real exchange rate)	-0.03	-1.58 ***	0.66
	0.04	0.45	0.79
Total debt x (Δ log real exchange rate)		1.34 ***	-6.91 ***
		0.40	1.06
Terms of trade x (Δ log real exchange rate)			15.71 ***
			1.62
Controls			
Dollar debt	-0.03 ***	-0.08 ***	0.02
	0.01	0.02	0.03
Total debt	-0.04	0.01	-0.18 ***
	0.04	0.05	0.05
Terms of trade	0.01	-0.01	0.38 ***
	0.05	0.05	0.07
Lagged dependent variable	-0.13 ***	-0.12 ***	-0.12 ***
	0.01	0.01	0.01
Prob (J-statistic)	0.85	0.85	0.74

Finally, I consider the case of any gain in competitiveness for the part of firm that export as well as any spillover to the other firms. The new baseline specification is:

$$k_{it} = \beta_1(d^*_{it-1}\Delta er_t) + \beta_2(d_{it-1}\Delta er_t) + \beta_3(x_t\Delta er_t) + \varepsilon_{it} \quad (6)$$

Equation 3 in Table 1 is the baseline regression and represents the dynamic panel based on (6). Here x_t is represented for the terms of trade given the fact that the Peruvian economy (and some other exporting countries) has been favored for higher commodity prices, especially in the mining sector. It is generally accepted that this good moment in exporting firms spillovers to the other firms in the economy and then consider it as an aggregate variable that affects all firms in the

sample. As a matter of fact, Equation 3 in Table 1 suggests that, if any, changes in the exchange rate has a positive impact over investment. Even though this result is not statistically significant, it may indicates that, after controlling for the gains in competitiveness at the aggregate level that is independent of changes in the exchange rate, firms in Peru tend to be more productive and require higher levels of investment.[9]

As suggested by Bleakley and Cowan (2008), I also consider the case of timing. The dependent variable is from the following period and the lagged dependent variable is therefore from the current period. It captures the fact of any feedback between exchange rate movements and investment between periods. Results are similar to those found in Table 1, and the negative coefficient for the interaction term between exchange rate and dollar debt becomes no significant when the terms of trade effects are taking into account.

4.3 Spillover effect?

One of the main arguments in this paper is that competitiveness affects those firms that are not directly involved in international trade. In order to test so, first I add the exports made by these firms to the baseline regression. As a second step, I estimate the baseline regression for firms that did not have any type of international trade and compare results.

Equation 4 in Table 2 shows that adding exports to the baseline regression did not affect the main result: after a real depreciation, the investment made by dollar-indebted firms is not statistically different than the investment of their domestic-currency idebted counterparts. Terms of trade still remains as the main factor driven the investment process in this group of firms.

The main result still holds in equation 5. Here I consider only firms that were not involved in international trade. Even though the effect of terms of trade diminish, it is still strong enough to

[9] This regression consideres the lagged of investment in the set of controls. The inclusion of this variables in Equations 1 and 2 in Table 1 has similar results.

drive into more investment when a depreciation occurs, for this group of firms, in this period of time.

TABLE 2 – SPILLOVER EFFECTS

Independent variables	(4)	(5)
Interactions		
Dollar debt x (Δ log real exchange rate)	-0.94	0.46
	1.35	0.80
Total debt x (Δ log real exchange rate)	-8.03 ***	-6.43 ***
	1.62	1.05
Terms of trade x (Δ log real exchange rate)	22.08 ***	15.04 ***
	2.04	1.76
Export x (Δ log real exchange rate)	-0.22	
	1.96	
No trade x (Δ log real exchange rate)		3.38
		3.25
Controls		
Dollar debt	0.08 ***	0.01
	0.03	0.03
Total debt	-0.11	-0.17 ***
	0.08	0.05
Terms of trade	0.38 ***	0.37 ***
	0.11	0.08
Export	-0.02	
	0.02	
Lagged dependent variable	0.13 ***	-0.12 ***
	0.04	0.01
Prob (J-statistic)	0.76	0.74

4.4 Robustness of main results

Firms that have debt in dollars might differ from firms that have debt in domestic currency along other dimensions than the currency composition of debt which may imply that the main result is driven by omitted variables. Bleakley and Cowan (2008) points out cases such as firms that are able to issue debt in dollars may have different maturity structure of their debt as well. They also consider the possibility of a differential effect of depreciation between firms of different sizes. Following these authors I add possible proxies for the supposed omitted variables.

Table 3 shows how the baseline result changes as I add different control variables that intend to cope with the omitted variables. Proxi variables for size are total assets and sales as for debt

structure I use short-term debt. The value of the coefficient of interest ranges from -1.81 to -0.15 however all these results are statistically no significant which is consistent with the result of the baseline regression.

TABLE 3 – ESTIMATES USING ADDITIONAL CONTROL VARIABLES

	(6)
Baseline	0.66
	0.79
Add firm size (assets)	-0.56
	1.04
Add firm size (sales)	-0.15
	1.02
Add firm term structure (short term debt)	-1.81
	1.71

One last robustness test is to consider alternative estimators coming up from different methodologies. For example, Bleakley and Kowan (2008) use OLS for the estimation of their baseline regression. Again, the value of the main coefficient varies in between alternative methodologies, but all of those are no significant (see Table 4).

TABLE 4 – ESTIMATES USING AALTERNATIVE ESTIMATORS

	(7)
Baseline: Cross-section fixed (first differences)	0.66
	0.79
Alternative dynamic panels	
Cross-section fixed (first differences), period fixed (dummy variables)	-0.79
	0.66
Cross-section fixed (orthogonal deviations)	0.53
	0.68
Cross-section fixed (orthogonal deviations), period fixed (dummy variables)	-2.29
	1.33
Alternative static panels (OLS)	
No fixed effects	-0.07
	0.37
Cross-section fixed (dummy variables)	-0.21
	0.45

5. CONCLUSIONS

Preliminar results suggest that there is not balance sheet effect from changes in exchange rate to investment in the Peruvian economy. In other words, following periods of real depreciation, investment by dollar-indebted firms is the same as the investment of their domestic-currency indebted counterparts. The key for this conclusion is to add terms of trade to the set of control variables. In this period of time it is more important terms of trade rather than the exchange rate movements in order to understand the investment process for this group of firms. This result is robust to different specifications and controls.

Part of the agenda for this paper is to incorporate additional control variables. For example, Bleakley and Cowan (2008) points out cases such as firms that are able to issue debt in dollars may have better aces to international or domestic capital markets. It is also in agenda to robust the group of firms and add information for 2014.

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