Capacity Choice, Foreign Trade and Exchange Rates

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Abstract

We investigate the effects of exchange rate movements on investment decisions of firms in an oligopolistic market. In a two-country-world model, we focus on the capacity investment decisions of small (small initial capacity and high marginal cost) and large (large initial capacity and low marginal cost) domestic firms. Both type of firms use foreign inputs in production and sell their output in the foreign market, thus they are prone to changes in exchange rate from both cost and demand side. Results show that devaluations alter the composition of production and the relative share of small and inefficient firms at the expense of large and efficient firms in the economy. The investment response to exchange rates is more pronounced in more competitive markets.

JEL Classifications: E22, F31, L13.

Key Words: Capacity investment, exchange rates, market structure.

1. INTRODUCTION

There is significant amount of theoretical and empirical research on the effects of exchange rate fluctuations on real economy. An important question is about the direction and size of the effects of exchange rate changes on investments. The question is particularly relevant for developing economies that lack sufficient investments for a sustainable growth. Majority of these countries impose heavy controls on exchange rates to deal with their balance of payments problems despite the regime in these countries are usually considered as flexible. While exchange rate interventions in these countries solve some of the short-run problems, how do they affect factor allocations are still an open question.

In this paper we propose a model in which we ask how individual firms respond to a devaluation of domestic currency. The model considers an oligopolistic industry in which heterogeneous firms that sell in both domestic and foreign markets compete with each other, taking foreign firms' production as given[1]. Domestic firms are grouped as small and large, and small firms are assumed to be less efficient in production than large firms. They engage in a two stage Cournot game. In the first stage firms simultaneously choose how much to invest in addition to their existing capacity for the next period and in the second stage they choose their output levels. A portion of the investment is assumed to use inputs imported from abroad; thus while a decrease in the value of currency provides a competitive edge to domestic firms in both markets, it also increases their costs and reduces their competitiveness.

Our findings show that small firms invest more for domestic production and less for foreign production, under reasonable assumptions. In our setting, a depreciation of domestic currency has negative impact on investments for domestic market of both types of firms, although it increases investment of small firms for foreign production and has ambiguous effect on large firms' investment. An interesting result is that a decline in the value of domestic currency always provides an advantage to small and inefficient firms, thus their market share increases relatively faster and consequently average efficiency in the industry declines.

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[1] In this model, we have a small developing economy in our minds. We are not interested how foreign firms behave against domestic firms competition affects firms. Rather we investigate the effects of exchange rates movements, particularly how these movements alter the composition of industry. Our assumption that foreign firms' supply is given also allows us to consider that exchange rates are exogenous.

A further result of our model is that the exchange rate fluctuations are more effective in competitive markets. An increase in the number of firms increases or decreases the exchange rate elasticity of investment when the net effect of devaluation is positive or negative, respectively.

Despite the vast amount of effort on to discover the effect of exchange rate movements on the pricing policies of firms (Goldberg and Knetter, 1997) and to unveil the impact of currency appreciation or depreciation on the profitability, thus the value, of firms (Clarida, 1997; Bodnar et al., 2002), the effects of exchange rate movements on the investment decisions of firms received relatively less attention. Among very few papers, the most notables are Goldberg (1993), Campa and Goldberg (1995,1999) and Nucci and Pozzolo (2001). While the first and second papers investigate the impact of exchange rate fluctuations on investment decision of manufacturing firms in the US the third compares the responsiveness of investment to exchange rate fluctuations in four developed economies, US, UK, Canada and Japan. The paper by Nucci and Pozzolo (2001) conducts a similar exercise using firm level data from Italian manufacturing industry.

The basic model of these studies proposes two channels through which exchange rates affects firms' investment decisions, similar to ours. Our model contributes to this literature by introducing strategic behavior and heterogeneity in an imperfectly competitive environment and focuses on the market share changes of different types of firms, as a result of additional investment due to exchange rate fluctuations.

The subsequent empirical analyses in these papers reveal that depreciations may be counterproductive in terms of investment behavior even in developed countries, such as U.S., Japan and Italy depending on the external exposure of firms. A further finding reported in these studies is that there are significant differences in the response of investment decisions to the changes in exchange rate across high- and low price-over-cost markups sectors, specifically, the evidence shows that firms that operate in markets with low price-over-cost markups are more responsive to exchange rates. The empirical results of these papers are in line with our conclusions.

This paper is organized as follows. Section 2 presents our theoretical model and results. Concluding remarks and projected extensions are given in Section 3.

2. THE THEORETICAL MODEL

We consider an oligopolistic industry with n small and m large firms. These firms have some initial capacity and their sizes are classified with respect to these capacities. In a two-period game, these firms decide how many units of capacity to add to their initial capacities in the first stage and how many units to sell in the domestic and foreign markets, in the second stage. The firms install additional capacities for domestic and foreign markets separately. We consider an environment where the installation cost is assumed to be different for domestic and foreign market production[2]. Firms install additional capacities using both domestic and foreign inputs according to the following functions:

$$ktd_{2i}(x_i, x_i^*) = (x_i)^{1-s}(x_i^*)^s, \quad if\ t = s \quad i = 1,....,n\ and\ if\ t = l \quad i = 1,....,m \quad (1a)$$

$$ktf_{2i}(y_i, x_i^*) = (y_i)^{1-s}(x_i^*)^s, \quad if\ t = s \quad i = 1,....,n\ and\ if\ t = l \quad i = 1,....,m \quad (1b)$$

where x_i and y_i are the domestic inputs used for capacity installation for domestic and foreign markets respectively and x_i^* is the foreign inputs, m is the number of large firms and n is the number of small firms, ktd_{2i} and ktf_{2i} is the additional output capacity level of the i^{th} firm for domestic and foreign markets, and s is the share of imported inputs in total costs. Using the functions in equation (1a) and (1b), the unit indirect installation costs for domestic and foreign market production accruing to each domestic firm can be written as follows:

$$cd_i(r_d, r^*, e) = Ar_d^{\,1-s}(er^*)^s, \quad (2a)$$

$$cf_i(r_f, r^*, e) = Ar_f^{\,1-s}(er^*)^s, \quad (2b)$$

where $A = ((1-s)/s)^s$, e is the exchange rate and r_d and r_f are the unit costs of domestic inputs for domestic and foreign markets respectively and r^* is the unit cost of foreign inputs (given in foreign currency unit). Thus, the total cost functions of the small and large firms respectively, are

$$C_i(q_i, ks_{2i}) = cs\, q_i + cd_i ksd_{2i} + cf_i ksf_{2i} \quad i = (1,...,n) \quad (3a)$$

$$C_j(qj, kl_{2j}) = cl\, q_j + cd_j kld_{2j} + cf_j klf_{2j} \quad j = (1,...,m) \quad (3b)$$

[2] We assume that the installment costs differ for foreign and domestic markets due to variation in regulation in both countries, or due to different packaging requirements etc.

where $ksd_{2i}, ksf_{2i}, kld_{2j}$ and klf_{2j} are the additional capacity levels of small and large firms for domestic and foreign markets, cs and cl are the marginal production cost levels and q_i and q_j are the output levels of i^{th} small and j^{th} large firms. The large firms are assumed to be more efficient i.e. $cl < cs$ [3].

Publicly known linear demand function is assumed to be linear in both countries

$$p_d = a - Q_d \ , \qquad Q_d = \sum_{i=1}^{n} q_{di} + \sum_{j=1}^{m} q_{dj} + Q_{rd} \tag{4a}$$

$$p_f = b - Q_f \ , \qquad Q_f = \sum_{i=1}^{n} q_{fi} + \sum_{j=1}^{m} q_{fj} + Q_{rf} \tag{4b}$$

where p_d is the domestic price in domestic currency unit and p_f is the foreign price in foreign currency unit. Q_{rd} and Q_{rf} are the total amounts produced by foreign firms for domestic and foreign markets respectively. We assume that Q_{rd} and Q_{rf} are taken as given by domestic firms. Knowing both supply and demand sides, we can now write the profit functions of small and large firms as follows;

$$\pi_i = (a - Q_d)q_{di} + e(b - Q_f)q_{fi} - cs\,(q_{di} + q_{fi}) - cd_i ksd_{2i} - cf_i ksf_{2i},\ i = (1,...,n) \tag{5a}$$

$$\pi_i = (a - Q_d)q_{dj} + e(b - Q_f)q_{fj} - cl\,(q_{dj} + q_{fj}) - cd_j kld_{2j} - cf_j klf_{2j},\ \mathrm{j} = (1,...,m) \tag{5b}$$

2.1. Solution of the two-stage game

Since the unit production and installation costs are constant, we can solve domestic and foreign market games separately. We assume that initial capacity can only be used for domestic production. We start to solve our two-stage game from the output choice stage. Maximizing above profit functions subject to the constraints $ksd_{2i} + (1-\delta)ksd_{1i} - q_{di} \geq 0$ and $kld_{2j} + (1-\delta)kld_{1i} - q_{dj} \geq 0$, where ks_{1i} and kl_{1j} are the initial capacity levels and δ is the depreciation rate. The equilibrium output choices are then:

[3] It is possible that small firms could be more efficient. The main points of the paper survive this reversal in the assumption though requires stronger conditions to hold. The results are available upon request.

$$(\bar{q}_{di}, \bar{q}_{dj}) = \begin{cases} (q^c_{di}, q^c_{dj}) & if \quad ksd_i \geq q^c_{di} \text{ and } kld_{\mathrm{j}} \geq q^c_{dj} \\ (ksd_i, q^t_{dj}) & if \quad ksd_i < q^c_{di} \text{ and } kld_j \geq q^t_{dj} \\ (q^t_{di}, kld_j) & if \quad ksd_i \geq q^t_{di} \text{ and } kld_j < q^c_{dj} \\ (ksd_i, kld_j) & if \quad \begin{array}{l} ksd_i < q^c_{di} \text{ and } kld_j < q^t_{dj} \\ \text{or } ksd_i < q^t_{di} \text{ and } kld_j < q^c_{dj} \end{array} \end{cases} \tag{6}$$

where $$(q^c_{di}, q^c_{dj}) = \left(\frac{(a-cs) - m(cs-cl) - Q_{rd}}{1+m+n}, \frac{(a-cl) + n(cs-cl) - Q_{rd}}{1+m+n} \right),$$

$(q^t_{di}, q^t_{dj}) = (\frac{a - n\,cs - m\,ksd_i - Q_{rd}}{1+n}, \frac{a - m\,cl - n\,kld_i - Q_{rd}}{1+m})$, $ksd_i = ksd_{2i} + (1-\delta)ksd_{1i}$ and $kld_j = kld_{2j} + (1-\delta)kld_{1i}$[4].

Proceeding backwards the equilibrium capacity choices are obtained as follows:

$$k\bar{s}d_{2i} = \frac{(a-cs) - m(cs-cl) - cd_i - (1-\delta)ksd_{1i}N - Q_{rf}}{N} \tag{7a}$$

$$k\bar{l}d_{2j} = \frac{(a-cl) + n(cs-cl) - cd_j - (1-\delta)kld_{1j}N - Q_{rf}}{N} \tag{7b}$$

for all $i = 1,...,n$ and $j = 1,...,m$, where $N = 1+n+m$.

A similar analysis for the foreign market yields the following equilibrium capacities for the foreign market production[5]:

$$k\bar{s}f_{2i} = \frac{(e\,b - cs) - m(cs-cl) - cf_i - eQ_{rd}}{eN} \tag{8a}$$

$$k\bar{l}f_{2j} = \frac{(e\,b - cl) + n(cs-cl) - cf_j - eQ_{rd}}{eN} \tag{8b}$$

The following proposition summarizes the results obtained from comparison of small and large firms' additional capacity installation levels for domestic and foreign markets.

Proposition 1: Small firms always invest less for the foreign market, however, they invest more for the domestic market as long as $(1-\delta)(kld_{1j} - ksd_{1i}) > cs - cl$.

[4] Derivations are provided in the appendix.

[5] While we are assuming different installment costs for foreign and domestic markets, these costs do not change with the type of the firm. As it is clear from Eqs (1a), (1b), (2a) and (2b), $cf_i = cf_j$ and $cd_i = cd_j$.

Proof: $ksf_{2i} - klf_{2j} = \dfrac{cl - cs}{e} < 0$ and $ksd_{2i} > kld_{2j}$ iff $(1-\delta)(kld_{1j} - ksd_{1i}) > cs - cl$.

In our setting, inefficient small firms behave aggressively in domestic market. Moreover, the larger initial capacity differences the larger the capacity investment of small firms compared to the large firms. Thus, imperfect competition not only allows inefficient firms to continue their operation, it also provides them larger share in domestic market. It is important to note here that small firms still have smaller capacity after the equilibrium capacity increase realized, thus there will not be a reversal in the types of firms as long as the requirement in the proposition that initial capacity differential is sufficiently large is preserved.

Before getting into the analysis how exchange rate affects capacity investment decisions of our firms, we would also like to highlight the importance of degree of competition. This analysis will be helpful later on to understand how the relationship between exchange rates and investment depends on the degree of competition.

***Proposition 2*:** Increasing competition reduces capacity investments.

Proof: $\dfrac{\partial k\bar{s}d_{2i}}{\partial n} = \dfrac{\partial k\bar{l}d_{2j}}{\partial n} = -\dfrac{(a - Q_{rf}) + cl\,m - cs(1+m) - A(er^*)^s\, r_d^{\text{1-s}}}{N^2} < 0$ from (7a)

$\dfrac{\partial ks\bar{f}_{2i}}{\partial n} = \dfrac{\partial kl\bar{f}_{2j}}{\partial n} = -\dfrac{e(b - Q_{rd}) + cl\,m - cs(1+m) - A(er^*)^s\, r_d^{\text{1-s}}}{e\,N^2} < 0$ from (8a),

$\dfrac{\partial k\bar{s}d_{2i}}{\partial m} = \dfrac{\partial k\bar{l}d_{2j}}{\partial m} = -\dfrac{(a - Q_{rf}) + cs\,n - cl(1+n) - A(er^*)^s\, r_d^{\text{1-s}}}{N^2} < 0$ from (7b) and

$\dfrac{\partial ks\bar{f}_{2i}}{\partial m} = \dfrac{\partial kl\bar{f}_{2j}}{\partial m} = -\dfrac{e(b - Q_{rd}) + cs\,n - cl(1+n) - A(er^*)^s\, r_d^{\text{1-s}}}{e\,N^2} < 0$ from (8b).

***Corollary*:** The capacity investment reductions of both small and large firms for both domestic and foreign markets are more intensive when there is an increase in the number of large firms.

Proof: $\dfrac{\partial k\bar{s}d_{2k}}{\partial n} - \dfrac{\partial k\bar{s}d_{2k}}{\partial m} = \dfrac{cs - cl}{N} > 0,\ k = i, j$ and $\dfrac{\partial k\bar{s}f_{2k}}{\partial n} - \dfrac{\partial k\bar{s}f_{2k}}{\partial m} = \dfrac{cs - cl}{e\,N} > 0,\ k = i, j$.

Corollary: Small and large firms respond similarly to an increase in either *n* and *m*.

Proof is obvious.

It is clear that capacity investments are less attractive for the firms in more competitive environments. Furthermore, if the competition is by relatively more efficient firms, in our case through an increase in the number of large firms, capacity investments fall relatively more.

2.2. The effects of exchange rates

In this subsection we analyze the effects of exchange rates on optimal capacity choices of firms. The following elasticities show the effects of exchange rate changes on small and large size firms' additional capacity investments

$$\varepsilon di_e = \frac{\partial \bar{k}sd_{2i}}{\partial e}\frac{e}{\bar{k}sd_{2i}} = -\frac{A(er^*)^s r_d^{1-s}\mathrm{s}}{Dd_i} \tag{11a}$$

$$\varepsilon fi_e = \frac{\partial \bar{k}sf_{2i}}{\partial e}\frac{e}{\bar{k}sf_{2i}} = \frac{cs(1+m) - cl\, m + A(er^*)^s r_f^{1-s}(1 - \mathrm{s})}{Df_i} \tag{11b}$$

$$\varepsilon dj_e = \frac{\partial \bar{k}sd_{2j}}{\partial e}\frac{e}{\bar{k}sd_{2j}} = -\frac{A(er^*)^s r_d^{1-s}\mathrm{s}}{Dd_j} \tag{11c}$$

$$\varepsilon fj_e = \frac{\partial \bar{k}sf_{2j}}{\partial e}\frac{e}{\bar{k}sf_{2j}} = \frac{cl(1+n) - cs\, n + A(er^*)^s r_f^{1-s}(1 - \mathrm{s})}{Df_j} \tag{11d}$$

where $Dd_i = a - Q_{rf} - cs(1+m) + cl\, m - cd_i - (1-\delta)ksd_{1i}N > 0$,

$Df_i = e(b - Q_{rd}) + cl\, m - (1+m)cs - cf_i > 0$,

$Dd_j = a - Q_{rf} - cl(1+n) + cs\, \mathrm{n} - cd_i - (1-\delta)kld_{1i}N > 0$ and

$Df_j = e(b - Q_{rd}) + cs\, n - (1+n)cl - cf_i > 0$.

Proposition 3: Domestic capacity investment of both small and large firms decreases with the devaluation of the domestic currency.

Proof is obvious.

***Corollary*:** The extent of the decrease in investment as a result of a devaluation increases with the share of foreign inputs for both small and large firms.

Proof is obvious.

The proposition and its corollary are very intuitive. As firms use foreign inputs for producing goods to be sold in domestic market, the exchange rate effects work only through the 'installation cost channel,' hence capacity levels are expected to be lower as a response to a devaluation of domestic currency.

Proposition 4: When small and inefficient firms invest more in domestic market then their elasticity of investment for domestic market is relatively smaller than the elasticity of large and efficient firms, $|\varepsilon di_e| < |\varepsilon dj_e|$.

Proof: $ksd_{2i} > kld_{2j} \Leftrightarrow Dd_i > Dd_j$ and $|\varepsilon di_e| < |\varepsilon dj_e|$.

Proposition 1 has shown that in an imperfectly competitive environment small and inefficient firms may invest heavily for domestic market production. Now, Proposition 4 shows that a devaluation of domestic currency strengthens their position relative to large and efficient firms. Thus, at the end, a devaluation of the currency results in a decline in average efficiency in the economy.

Proposition 5: Foreign capacity investment of the small (inefficient) firms always increase with the devaluation of the domestic currency but the foreign capacity investment of the large (efficient) firms increase with devaluation if and only if the marginal production cost of the small firms is sufficiently low.

Proof: Since $Df_i, Df_j > 0$ and $cs > cl$ $\varepsilon fi_e > 0$ but, $\varepsilon fj_e > 0$ iff $(cl(1+n) + A(er^*)^s r_f^{1-s}(1-s))/n > cs$.

***Corollary*:** The extent of the increase in investment as a result of a devaluation decreases with the share of foreign inputs.

Proposition 6: The small and inefficient firms' elasticity of investment for foreign market is relatively larger than the elasticity of large and efficient firms, $|\varepsilon fi_e| > |\varepsilon fj_e|$.

Proof: It is easy to see that since $cs > cl$ the numerator of εfi_e is always greater than the numerator of εfj_e and the denominator of εfi_e is always smaller than the denominator of εfj_e thus, $|\varepsilon fi_e| > |\varepsilon fj_e|$.

It is interesting to observe that devaluations always induce higher investment by small firms' in foreign market. The effect of a devaluation on large firms' investment level is positive only when the rival small firms are sufficiently strong competitors. Furthermore, even when both firms increase their capacity investment (that is, the condition that small firms are really strong competitors holds), the response of small firms is still larger. The result is a consequence of the fact that firms use foreign inputs in production. A devaluation of domestic currency, while increasing revenues obtained through sales in foreign market, increases costs. Thus, the gain from devaluation is constrained by the extent of the share of foreign inputs in production. While the 'revenue channel' works similarly for both types of firms, the 'cost channel' works against large and efficient firms because at equilibrium they invest heavily for foreign market production.

2.3. Competition and the effects of exchange rates

The size of the response of investments to exchange rates depends on factors such as the number of firms, sales amounts of foreign firms, initial capacity level and the share of foreign inputs. The below derivatives determines the direction of relationship between the degree of competition and exchange rate elasticities of domestic capacity investments of small firms:

$$\frac{\partial \varepsilon di_e}{\partial n} = -\frac{(1-\delta)k\bar{s}d_{1i}A(er^*)^s\, r_d^{\,1\text{-s}}\mathrm{s}}{Dd_i^{\,2}} \tag{13a}$$

$$\frac{\partial \varepsilon di_e}{\partial m} = -\frac{\mathrm{s}\,(cs - cl + (1-\delta)k\bar{s}d_{1i})A(er^*)^s\, r_d^{\,1\text{-s}}}{Dd_i^{\,2}} \tag{13b}$$

Similarly,

$$\frac{\partial \varepsilon dj_e}{\partial m} = -\frac{s\, A(er^*)^s\, r_d^{\,1\text{-s}}\,(1-\delta)k\bar{l}d_{1i}}{Dd_j^{\,2}} \tag{14a}$$

$$\frac{\partial \varepsilon dj_e}{\partial n} = -\frac{(cl - cs + (1-\delta)k\bar{l}d_{1i})A(er^*)^s\, r_d^{\,1\text{-s}}\mathrm{s}}{Dd_j^{\,2}} \tag{14b}$$

are the respective elasticities for the large firms. Those elasticities for foreign capacity investment of small and large firms can be written as follows:

$$\frac{\partial \varepsilon fi_e}{\partial n} = \frac{\partial \varepsilon fj_e}{\partial m} = 0 \tag{15a}$$

$$\frac{\partial \varepsilon fi_e}{\partial m} = \frac{(cs - cl)(e(b - Q_{rd}) - A(er^*)^s r_f^{1-s} s)}{Df_i^2} \tag{15b}$$

$$\frac{\partial \varepsilon fj_e}{\partial n} = \frac{(cl - cs)(e(b - Q_{rd}) - A(er^*)^s r_f^{1-s} s)}{Df_j^2} \tag{15c}$$

Foreign firms' sales in both domestic and foreign market have also a significant effect on the exchange rate elasticities of investments. We calculate these effects with the following derivatives.

$$\frac{\partial \varepsilon di_e}{\partial Q_{rf}} = -\frac{A(er^*)^s r_d^{1-s} \mathrm{s}}{Dd_i^2}, \quad \frac{\partial \varepsilon dj_e}{\partial Q_{rf}} = -\frac{A(er^*)^s r_d^{1-s} \mathrm{s}}{Dd_j^2} \tag{16a}$$

$$\frac{\partial \varepsilon di_e}{\partial Q_{rd}} = \frac{\partial \varepsilon dj_e}{\partial Q_{rd}} = \frac{\partial \varepsilon fi_e}{\partial Q_{rf}} = \frac{\partial \varepsilon fj_e}{\partial Q_{rf}} = 0$$

$$\frac{\partial \varepsilon fi_e}{\partial Q_{rd}} = \frac{cs(1+m) - cl\, m + A(er^*)^s r_f^{1-s}(1 - \mathrm{s})}{Df_i^2} \tag{16b}$$

$$\frac{\partial \varepsilon fj_e}{\partial Q_{rd}} = \frac{cl(1+n) - cs\, n + A(er^*)^s r_f^{1-s}(1 - \mathrm{s})}{Df_j^2} \tag{16c}$$

Proposition 7: The extent of the response of both *small* and large firms' investments (except for the foreign investments of the large firms) to exchange rates is more pronounced when market becomes more competitive by an increase in the number of firms or the market share of the foreign firms.

Proof: As it can easily be seen from Eqs. (11) and (13), (14), (15) and (16) that

$$Sign(\varepsilon di_e) = Sign(\frac{\partial \varepsilon di_e}{\partial n}) = Sign(\frac{\partial \varepsilon di_e}{\partial m}) = Sign(\frac{\partial \varepsilon di_e}{\partial Q_{rf}}),$$

$$Sign(\varepsilon dj_e) = Sign(\frac{\partial \varepsilon dj_e}{\partial m}) = Sign(\frac{\partial \varepsilon dj_e}{\partial n}) = Sign(\frac{\partial \varepsilon j_e}{\partial Q_{rf}}),$$

$$Sign(\varepsilon fi_e) = Sign(\frac{\partial \varepsilon fi_e}{\partial m}) = Sign(\frac{\partial \varepsilon fi_e}{\partial Q_{rd}}) \text{ and } Sign(\varepsilon fj_e) = Sign(\frac{\partial \varepsilon fj_e}{\partial Q_{rd}}).$$

The results presented in the above proposition indicate that the exchange rate fluctuations are more effective on capacity investments in more competitive markets. When investments response positively (negatively) to a decline in the value of domestic currency, the increase (decrease) in investment will be more in a more competitive environment. There is one exception here, exchange rate sensitivity of investment of the large firms for the foreign market may decrease with competition under certain conditions. More specificly, when the rival small firms are efficient enough, large firms increase their foreign market investment less as a result of a devaluation.

3. CONCLUSION

In this paper, we analyzed the impact of exchange rate fluctuations on investment decision of firms that operate in an oligopolistic market. Following the existing literature in which exchange rates affect investment through cost and revenue channels, we focused on how this relationship depends on firm heterogeneity (via firm size and production cost), and degree of competition in the market.

Our theoretical model suggests that exchange rate movements alter the allocation of resources across different markets and across different types of firms in an important way. A devaluation of domestic currency increases the share of production to foreign markets. The motivation of this paper is based on our observation of large devaluations in most developing countries to solve their short-run payments problems. Usually devaluations are seen by the governments of these countries as a way to improve the competitiveness of domestic firms and industries. However, we have shown that in an environment as depicted in our model, devaluations may decrease the average inefficient firms within the economy. Although we had a small country in our minds, most of the results could be also relevant for many developed economies.

Our model is a simple one and could be extended to various directions. For instance, we assumed that the behavior of foreign firms is given; thus we omitted strategic interaction between domestic and foreign firms. To reach more general conclusions, the model has to be extended to incorporate strategic actions of foreign firms as well. A further extension is possible by allowing small and large firms to be integrated vertically.

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Appendix

Solution of the two-stage game:

Solution to the second stage game is obtained by maximizing profits choosing output level given capacity choices of firms in the first stage. We obtain the following reaction functions for the small and large firms for the domestic market from the Kuhn-Tucker conditions;

$$R_{q_{di}}(q_{dj}) = \begin{cases} \dfrac{a - m\, q_{dj} - cs - Q_{rd}}{1+n} & \text{if} \quad ksd_i \geq q_{di} \\ ksd_i & \text{otherwise} \end{cases} \tag{A1a}$$

$$R_{q_{dj}}(q_{di}) = \begin{cases} \dfrac{a - n\, q_{di} - cl - Q_{rd}}{1+m} & \text{if} \quad kld_i \geq q_{dj} \\ kld_i & \text{otherwise} \end{cases} \tag{A1b}$$

where $ksd_i = ksd_{2i} + (1-\delta)ksd_{1i}$ and $kld_i = kld_{2j} + (1-\delta)kld_{1j}$. Solving these equations simultaneously yields the equilibrium output choices of the firms given in Eq. (6) in the paper.

After solving the last stage of the game as above, we proceed backwards and compute the reaction functions for the capacity choice game as follows:

$$R_{k_{di}}(k_{dj}) = \begin{cases} \dfrac{a - cs - cd_i - m\, kld_{2j} - (n+1)(1-\delta)ksd_{1i} - m(1-\delta)kld_{1j} - Q_{rd}}{1+n} & \text{if } kld_{2\text{j}} \leq C_{dj} \\ q_{di}^{c} & \text{otherwise} \end{cases} \tag{A2a}$$

$$R_{k_{dj}}(k_{di}) = \begin{cases} \dfrac{a - cl - cd_j - n\, ksd_{2i} - (m+1)(1-\delta)kld_{1j} - n(1-\delta)ksd_{1i} - Q_{rd}}{1+n} & \text{if } ksd_{2\text{i}} \leq C_{di} \\ q_{dj}^{c} & \text{otherwise} \end{cases} \tag{A2b}$$

where

$$C_{dj} = \frac{a - (1+n)cl + n(cs + cd_i + m(1-\delta)kld_{1i}) + Q_{rd})}{1+m+n},$$

$$C_{di} = \frac{a - (1+m)cs + m(cl + cd_j + n(1-\delta)ksd_{1j} + Q_{rd})}{1+m+n}.$$

Solving these reaction functions we obtain the equilibrium capacity levels given in Eqs. (7a) and (7b).