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Kaushik Basu*

The Art of Currency Manipulation: How Some Profiteer by Deliberately Distorting Exchange Rates

Abstract: A frequent charge in foreign exchange markets in developing countries is that of manipulators being at work. Since to buy is to raise prices and to sell is to lower prices, the question that naturally arises is whether the widespread charge of market manipulation is valid. The paper shows that (whether or not "widespreadness" has any merit) it is possible for a player to manipulate and profiteer. By using some simple principles of game theory, the paper outlines a strategy that a manipulator may use. The aim of this paper is not to provide a manual for the manipulator but to enable the regulator to understand the art and develop policies to curb manipulation.

Keywords: Cournot oligopoly; currency depreciation; exchange rates; market manipulation.

JEL Classification Numbers: F31; L13.

***Corresponding author: Kaushik Basu,** The World Bank, 1818 H Street, DC 20433, NW, Washington; and Department of Economics, Cornell University Ithaca, New York 14853, e-mail: kb40@cornell.edu

1 The Problem

The Indian rupee, which had been volatile through the last 2 years, went in for especially sharp gyrations last year. On 1 August, 2013, it stood at Rs. 60.57 to the US$. Then it went for a sudden sharp depreciation. By August 28, it had dropped in value to Rs. 68.85 to the US$, a depreciation of close to 14%. It recovered quickly after that, reaching Rs. 62.20 to the US$ on 15 September, 2013.

There were reasons enough for the fluctuations from the middle of 2011. There was S&P's downgrading of US sovereign credit in August 2011, which caused a flight of investor money out of equity in different countries, including India, to the safety of US treasuries and German bunds. There was uncertainty caused by the Greek election on 17 June, 2012, taking the Eurozone to the edge of the precipice. More recently, in early 2013, the hint from the U.S. Fed that the US would soon begin to withdraw its large Quantitative Easing injections, until the end of 2013 of the order of US $85 billion per month, caused interest rates to rise in the US and money to be withdrawn from emerging economies, which resulted in depreciations of currencies across the board for emerging market economies, including South Africa, Brazil, Indonesia, and India. Nevertheless, the sharp depreciation that occurred through all of August 2013 and the sharp recovery during the first 2 weeks of September 2013 left many observers questioning if this was the play of competitive markets with hundreds of thousands of small players unwittingly moving the exchange rate or a case of market manipulation by a few big players, that is, of persons or firms deliberately moving prices in order to profiteer.[1]

Despite the widespread talk and suspicion of market manipulation, a natural question to ask is whether it is at all possible to move prices and profiteer, with rational market players. After all, buying will raise the price and selling will lower it. So it is legitimate to ask how anyone can profit by this. It is true that if someone bought dollars on August 1, sold on August 28 and again bought on September 15, the person would have made a tidy profit. The question is: Could someone have manipulated to move the exchange rate first and then bought and sold at appropriate times? The answer is not immediately obvious.

The view that behind every movement of a price there is someone deliberately doing this to make a profit may be dismissed as a figment of the human tendency to look for someone behind every observable phenomenon, which has led to graver existential mistakes than this simple economic one. Yet, we cannot for that very reason rule out that in the case of sharp exchange rate movements there may indeed be someone trying to profiteer at the expense of others. However, straightforward economic reasoning, as the previous paragraph suggests, cannot explain how this is possible. And under these circumstances it is easy to fall into the textbook, neoclassical-economics view that if speculators make money speculating, then they invariably play the useful role of stabilizing prices.

The aim of this paper is to show, by using more complex reasoning, that it is indeed possible to manipulate the market so as to make a profit by deliberately making the exchange rate fluctuate. All one needs is a deep pocket, moderate intelligence, and unfussiness about moral scruples. The purpose of this paper is to show exactly how the art of market manipulation works.

It should be clarified that I am not talking here about individuals profiteering from exogenous (that is, exogenous to these individuals) price movements, which would simply require one to have the sagacity to know when prices have

1 This is distinct from shorting a currency, where one takes up a position in anticipation of a price change that is exogenous to oneself, and on which much has been written.

bottomed out and will rise or the other way around. Then one can time one's purchase and sale to make a profit from exogenous fluctuations. This refers to speculation, which can be rational even when it is common knowledge that it will end in a crash (Abreu and Brunnermeier 2003), but is different from manipulation. Manipulation refers to actions that *cause* an otherwise stationary price to move and enable the manipulator to make a profit out of this. It is with manipulation that this paper is concerned.

There is a substantial literature on what Allen and Gale (1992) called "information-based manipulation," where a person with insider information or simply greater sagacity can manipulate others (Kyle 1985; Benabou and Laroque 1992). It is possible to go a step further and consider cases where an agent has no insider information but others believe she has. Allen and Gale (1992) showed how that can also be a basis of manipulation.

The present paper analyzes a very different kind of manipulation, one where the manipulator may have no information or belief-in-information advantage. The argument is more relevant to foreign exchange markets where special information is more difficult to obtain and where the market structure is more like the one that will presently be assumed. The model shows that by cleverly gaming other players on the market, you can actually lower the price of dollars, even when buying up dollars, and you can raise the price of dollars while selling dollars. The next section spells out the strategy that achieves this. This so-called art of currency manipulation is known, at least subliminally, to those who indulge in such practices. Since the manipulator already knows the art, the reason for writing this paper, which tries to lay bare the art of market manipulation, is to educate the regulators, such as central bankers and stock market regulators, so that they can curb market manipulation.

Most regulators have an inadequate understanding of what currency manipulators do. This lack of clarity results in two ubiquitous mistakes. The first is to regulate so inadequately as to have no impact and to allow currency manipulators to continue to create exchange rate fluctuations and profiteer from that. The second is to use poorly-targeted and far-reaching controls that inflict a lot of collateral damage on legitimate and socially-useful activities and bring wealth-creating exchange to a halt in an effort to excise manipulation.

Before moving on to the formal model, it is worth clarifying that while this paper is focused on currency speculation and all the stylized facts are drawn from this context, the analysis in the abstract belongs to the larger literature on speculation and price stabilization and as such has some relevance to price manipulation and speculation in different kinds of markets, from stock markets, and real estate to commodities (Newbery and Stiglitz 1981; Mclaren 1999; Wright and Williams 2005; Knittel and Pindyck 2013). In some cases, such as perishable vegetables, for instance, onions, the model in this paper will not apply too well, since it entails multi-period action and the need to hold stocks over some periods of time. In those cases, speculation has other sources, and usually involves collusive behavior by middle traders. My model carries over well to some other areas of price manipulation, such as stock markets and some durable goods, like gold. However, I shall restrict my attention to the case that has relevance to all nations, namely, exchange rates.

2 The Model

The kind of market where the manipulator's art could work is one where there are some small price-taking agents and also some larger strategic agents (Cournot firms). The foreign exchange markets in most nations mimic this well. There are ordinary people who buy and sell at bureaus of exchange with no hope of affecting the exchange rate posted on the board by their acts of buying or selling currencies. Then there are the foreign exchange dealers and banks that can reasonably expect to influence the exchange rate by their own actions. In India, for instance, several of the over-100 members of the Foreign Exchange Dealers' Association of India (FEDAI), consisting of banks and financial institutions, are strategic agents on the foreign exchange market and the millions of individuals, including tourists who buy and sell small quantities of currency, are the price-taking agents. In other words, exchange rate manipulation is, in principle, possible in India. That is what I am about to demonstrate.

Modeling markets of this kind is a simple exercise in extending the standard Cournot model; and this has a history dating back to Stigler (1950) – see also Encaoua and Jacquemin (1980), Dixit and Stern (1982), and Basu (1993).

Let me begin by sketching such a model for the foreign exchange market. Let the domestic currency be called the rupee and the foreign currency the dollar. The price of one dollar expressed in rupees is denoted by p. If p rises, the rupee depreciates; if it falls, the rupee appreciates.

Let the demand for dollars from price-taking agents (henceforth, agents) be

$$d=d(p), \quad d'(p)<0, \tag{1}$$

and the supply of dollars for agents be given by

$$s=s(p), \quad s'(p)>0. \tag{2}$$

Hence, if the exchange rate is p, the net demand, x, for dollars from agents is given by:

$$x(p) = d(p) - s(p).$$

Note that as p rises, $x(p)$ declines.

The market, as already explained, has these (price-taking) agents but also some big foreign-exchange dealers (henceforth, dealers), that operate like Cournot agents, buying and selling dollars and each having an impact on the exchange rate. The model works equally well whether these dealers buy and sell dollars or if some buy and some sell dollars.[2] But purely for expositional ease, I shall make assumptions so that these large dealers in this domestic market are all sellers of dollars. They buy dollars in the US or Singapore, where they are (again for simplicity) price-takers, and sell in India, where they have market power.

It is assumed there are n dealers. All dealers have access to some international foreign exchange market where they buy dollars at price c. Assume $x(c)>0$. It is possible to derive the same result with heterogeneous dealers, with access to dollars at different prices; but for reasons of simplicity I assume homogeneity. A picture of what has been described thus far is captured in Figure 1.[3]

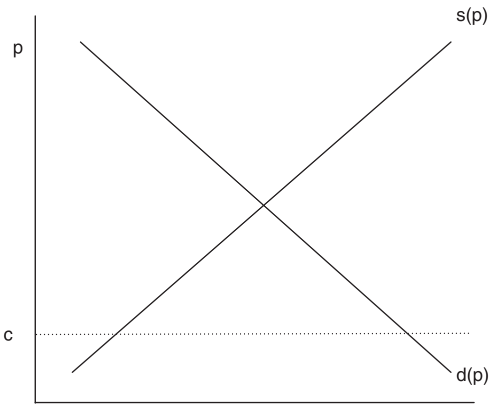

Figure 1 Supply and Demand for Foreign Exchange.

2 The modeling of markets where there are oligopolistic (and oligopsonistic) players on the two sides of the market, some buying dollars because they can put them to high-valued use and some selling dollars because they have access to cheap dollars, requires an adaptation of the standard model of either oligopoly or oligopsony. Adapting some pre-existing work of a very different nature (e.g., Armstrong 2006), this is not hard to do. But in this paper I shall confine our attention to a case where all big players happen to be on the same side of the market.

3 I am also ruling out here the presence of foreign exchange hedging. In reality, when there is expectation of some fluctuation in the exchange rate market, many players do go in for complex hedging strategies (see, e.g., Ware and Winter 1988; Brown 2001). But for reasons of simplicity, this is ruled out in the present model.

It is easy to describe the equilibrium in this model. Suppose, for every i, dealer i sells q_i dollars. Then the price that will occur in the market is implicitly given by

$$d(p)-s(p)=q_1+\cdots+q_n. \tag{3}$$

Inverting this function, write

$$p=\varnothing(q_1+\cdots+q_n). \tag{4}$$

The profit earned by dealer i is given by:

$$\pi_i(q_1,\ldots,q_n)=[\varnothing(q_1+\cdots+q_n)-c]q_i. \tag{5}$$

The equilibrium in this market is simply the Nash equilibrium of this game. Let us describe $(q_1^\star,\ldots,q_n^\star)$ as the equilibrium. The exchange rate in equilibrium is then given by $p^\star=\varnothing(q_1^\star+\cdots+q_n^\star)$.

Note that at the equilibrium, (price-taking) agents demand and supply, respectively $d(p^\star)$ and $s(p^\star)$ and the dealers supply $d(p^\star)-s(p^\star)$.

In closing, note that all dealers have been assumed to be identical. Hence, though dealer i is free to choose any quantity q_i, in the final equilibrium all dealers will tend to behave identically. Indeed, given some minor conditions, it can be shown that in equilibrium $q_1^\star=q_2^\star=\ldots=q_n^\star$. It is easy to verify this is the case where the demand and supply functions are linear. It is however important to stress that the assumption of ex ante identical dealers is by no means necessary and is made here purely for reasons of algebraic convenience. Indeed, it is possible to introduce great variability among the dealers, so much so that in the same market some enter as buyers and some as dealers, and the main results in this paper will continue to be valid.

3 The Claim

It will now be shown that in a market such as the above one, it is possible for an agent with a deep pocket to come in and manipulate the exchange rate to her advantage. This essentially involves not playing the game like a Cournot player who basically chooses an amount of foreign exchange she will sell. Instead, the "manipulator" chooses a strategy of "conditional sale." A manipulator's strategy is best described as a function, $f(p)$. The function states how much the manipulator will buy if the exchange rate happens to be p. Note that $f(p)$ can take negative values, which means for certain prices the manipulator offers to sell dollars. Fortunately, to analyze the impact of this somewhat unusual strategy, we do not have to start from scratch, since there is a literature on which we can draw (see Bresnahan 1981; Hart 1985; Klemperer and Meyer 1989). What these papers had suggested was that there is no need to take the extreme view that the standard Cournot or Bertrand model takes whereby the seller pre-commits to a particular value of quantity or price. They allow for the fact that an agent can make conditional decisions – ones which say, if the price is such and such, I will supply so many units; otherwise I will supply a different amount. It can be shown that such behavior leads to an "abundance" of equilibria (Basu 1993).

Let us suppose that a manipulator arrives on the scene. It can be shown that she can game the existing foreign exchange dealers and small agents in a way so as to cause the exchange rate to move in a particular way and make a profit in the process.

I shall illustrate this in a very simple way. Let p^* be the equilibrium price in the model described in Section 2 where all dealers are basically Cournot agents. I will show that for the manipulator it is possible to buy dollars and still leave the exchange rate unchanged. Then in the next period she can sell these dollars and, at the same time, have the price p rise above p^*. In other words, she causes a depreciation of the currency and profits by it.

Consider a number $x(p^*)>y>0$. I shall first show that there exists a strategy, $f^1(.)$, that the manipulator can use to make sure the exchange rate is p^* and she gets to buy y dollars. The superscript on f reminds us that this is what the manipulator does in period 1, when she is trying to buy y dollars without altering the price of the original equilibrium, p^*. In period 2, she will off-load the y dollars but in such a manner that the price of dollars actually rises to a level above p^*.

Without burdening the reader with how I got there, let me straight away present the strategy, $f^1(.)$, that does the job for dealer 1, that is, the manipulator.

$$f^1(p)=\frac{[(p^*-c)n+p^*-p]\,[x(p^*)+y]}{(p^*-c)n}-x(p). \tag{6}$$

It is important to understand what the manipulator's strategy says. It says that, in case the market price of dollars is p, she will buy $f^1(p)$ dollars as defined by (6). Observe that (6) is a well-defined function. Recall $x(p)$ is the net demand for dollars after the price-taking agents have bought and sold what they would like at price p. And p^* is the price that prevailed in the original equilibrium before the currency manipulator arrived on the scene.[4]

4 It is being assumed the currency manipulator is a new agent that comes into the foreign exchange market. It is entirely possible to think, instead, in terms of one of the dealers turning manipulator. This simply entails changing n to $(n–1)$ in equation (6) and also in (7).

It is laborious but easy to check that if the n dealers face the net demand function for dollars, $x(p) = d(p)-s(p)$, and take as given the manipulator's strategy, equation (6), described above,[5] then, in equilibrium, they will end up selling $x(p^*) + y$ dollars. The price will be p^* and the manipulator will buy y dollars since $f^1(p^*) = y$. A formal proof of this is given in the Appendix to the paper.

All that the manipulator now has to do is to think of strategy $f^2(p)$ in period 2 so that the price in period 2 ends up being greater than p^* and she manages to sell off the y dollars at that price. In short, she would have made a tidy profit, buying y dollars at p^* rupees per dollar in one period and selling y dollars at a higher price in another period.

To demonstrate this, define $\hat{\hat{p}}$ implicitly by $d(\hat{\hat{p}})=s(\hat{\hat{p}})$. Now choose any price level $\hat{p}$ such that $\hat{\hat{p}}>\hat{p}>p^*$. I shall show that the manipulator can choose a strategy $f^2(p)$, which enables her to sell off y dollars at a price of $\hat{p}$ rupees per dollar.

Again, without burdening the reader on how I get to this, let me directly specify the strategy, $f^2(p)$, that does the job.

$$f^2(p)=\frac{[(\hat{p}-c)n+\hat{p}-p]\,[x(\hat{p})+y]}{(\hat{p}-c)n}-x(p). \tag{7}$$

Faced with the manipulator's strategy, which is described in (7), and the demand and supply functions of the price-taking agents, the n dealers will get to an equilibrium such that the price of dollars is $\hat{p}$ and the manipulator gets to sell off the y dollars she had bought at a lower price in the previous period.

The proof of this is almost identical to the claim following equation (6), and hence mirrors the proof given for that in the Appendix. The intuitive idea behind both these proofs is quite straightforward. In period 1, assume that the price-taking agents behave as specified above, demanding and supplying as per the functions described in (1) and (2); assume that the manipulator plays the strategy described in (6). Basically, what the manipulator does is to alter the net demand curve in Figure 1, thereby altering the strategic environment in which the n dealers operate. Now, let the dealers play the standard Cournot oligopoly game taking (1), (2), and (6) as given. It is easy to check that equilibrium price will be p^* and the manipulator will be buying y dollars in equilibrium. Now in period 2, say the following month, when the game is being played again, assume everything else remains the same except that the manipulator now uses the strategy

5 In this sense the manipulator is like a Stackelberg leader (as in, for instance, Basu and Singh 1990). However, in this paper we do not work out the sub-game perfect equilibrium but simply show how the manipulator or the Stackelberg leader can make a profit.

described in (7). It can be easily checked that in the Cournot equilibrium the price will be $\hat{p}$ and the manipulator will be selling y dollars. Since $\hat{p} > p^{\star}$, she would have made a profit.

A large part of this analysis carries over easily to the case where there are several manipulators. If, for instance, m manipulators each buy up y/m dollars in period 1 and sell the same amount in period 2, then the overall equilibrium is unchanged and all manipulators make profits (though each manipulator now earns $1/m$ share of the manipulator's profit). What the model does not analyze and remains an open question is what happens when the manipulators begin to game one another. This is indeed a matter that deserves future investigation.

4 Discussion

Basically, the manipulator works by making contingent plans for how many dollars she will buy and sell at out-of-equilibrium prices. This is what drives ordinary dealers, playing a Cournot game, to behave in a way that allows the manipulator to profiteer. At a more intuitive level what is happening is the following. We know that where the final equilibrium price of a commodity settles in an oligopolistic market depends on not just the amount of (net) demand from the small price-taking agents but the elasticity of demand as well. It is this that the manipulator exploits. While buying up rupees, a manipulator can actually drive down the price of rupees by altering the slope of the demand curve (and, hence, the elasticity of demand). Hence, a higher demand can go hand in hand with a lower price, if there is a manipulator with the power and inclination to twist the slope of the demand curve and exploit other agents. This is exactly what he (I take it no woman will object to the use of this pronoun) does in many situations of currency manipulation.

This also explains what was referred to in passing, earlier – the need for a deep pocket for the manipulator. Actually, the need for a deep pocket arises for two reasons. Note that the manipulator buys up dollars in one period and then sells it at a later date. Hence, he must have enough wealth or access to money in order to buy dollars in one period and hold the dollars for a while, since the profit comes only later after the dollars are sold. In reality, there will be the additional problem of the off-chance that something exogenous happens which makes it not possible to sell the dollars in the later period or causes a collapse in the price of dollars and so inflicts an unanticipated cost on the manipulator.

Secondly, while in this abstract model with no stochastic shocks, the manipulator's assurances regarding out-of-equilibrium behavior are never put to test, in reality, a market often gets thrown out of equilibrium. For reasons of credibility, the manipulator will then have to buy or sell as he committed to do. This will mean that to maintain his reputation he will need access to enough rupees in case the need to buy rupees arise and access to enough dollars in case the need to sell dollars arise. It is true that these will, in the long-run equilibrium, cancel out but the inability to demonstrate one's commitment to carry out ones conditional strategy can do irreparable harm to the manipulator. This is what makes it unlikely that a small player or even a medium-sized dealer can, individually, play the role of manipulator.

Though the paper is focused on the behavior of the manipulator, its main target is the regulator, so that he or she understands the art of manipulation and is able to design regulation to curb some of these unwanted behaviors. The central bank and regulator, especially in emerging economies, have little notion of how the currency manipulator works and so have dealt with this problem inadequately. The first step in rectifying this is to study the dubious art of currency manipulation and to get a firm understanding of how the manipulator works. That is what this paper tried to do. As must be evident, the manipulator's art is not as straightforward as popular discourse makes it out to be. Lack of scruples may be a necessary condition but it is by no means sufficient. The manipulation requires a level of sophistication and a deep pocket (to make the out-of-equilibrium behavior credible) that all may not have. Moreover, it should be evident from the model that the scope for market manipulation arises in the first place because of the presence of oligopolistic agents on the market. So the promotion of greater competition is the first step to take to deter manipulation of exchange rates. But this action may not always be open to a national regulator because operations on foreign exchange deals typically take place globally and in regions where the national regulator's arm does not reach.

As many theory papers do, this one opens up several follow-up research questions. One may wish to ask, what would happen if more than one manipulator enters the market or what if the central bank uses strategic interventions with contingent buying and selling plans? It can be shown that, given strategic substitutability among dealers (*a la* Singh and Vives 1984), central banks can intervene to move exchange rates in desirable directions without altering their foreign exchange reserves (Basu 2012; Basu and Varoudakis 2013). It will be interesting to investigate whether such central bank interventions can be used to neutralize the manipulator.

Although this paper does not go into what the regulator should do when faced with the manipulation problem (although it does the spade work for such an exercise), it casts an interesting light on futures trading in currency. Since the manipulator needs somehow to convey to the market her contingent plans – "I will buy so much, if the price is such and such; I will sell so much, if the price is something else" and so on – and contingent plans are like commitments on futures trade, restrictions on futures trade could curb the manipulator's domain of function. Given that futures markets serve other valuable functions, we must not jump to policy conclusions. This simply shows the kinds of policy issues that can open up with the kind of analysis done in this paper.

Finally, as was pointed out earlier, while the focus of this paper was on the exchange rate, the model in its abstract form carries over to other markets, such as equity and commodity. All of these raise difficult questions concerning how the regulator should react. We have examples from other areas how price fluctuations have been poorly handled by policymakers, often exacerbating the initial problem (see, for instance, Anderson et al. 2013, on food prices). Given that speculation of the kind discussed in this paper occurs in other areas, especially where the product in question is a durable good, it is hoped that some of the lessons learnt in this paper will carry over to other markets as well.

Acknowledgment: This paper emerged out of practical policy engagement in 2011–2013 and, especially, the last few months when the exchange rates of emerging economies went through a period of sharp fluctuations. I am grateful to my colleagues in the world of both policymaking and research for many discussions and would like to specially thank Anil Bisen, Tito Cordella, Jose Luis Diaz Sanchez, Sergei Guriev, T. Rabi Sankar, Aristomene Varoudakis, and Vivian Hon for many discussions. Finally, I am grateful to two anonymous referees of the journal for several helpful comments and criticisms.

Appendix

It will be proved here that if the manipulator's strategy is given by $f^1(p)$, as defined by (6), in equilibrium, the price of dollars will be $p^\star$ and the manipulator will buy y dollars.

To prove this note that the aggregate demand function for dollars, faced by the n dealers, is given by $f^1(p)+x(p)$. Let us denote this by $Q(p)$. Using (6) we have

$$Q(p)=\frac{[n(p^\star-c)+p^\star-p]\,[x(p^\star)+y]}{n(p^\star-c)}. \tag{8}$$

The inverse demand function is therefore given by

$$p(Q)=n(p^\star-c)+p^\star-\frac{n(p^\star-c)}{[x(p^\star)+y]}Q. \tag{9}$$

If the n dealers produce $q_1,\ldots, q_n$, the profit earned by dealer i will be:

$$\pi_i(q_1,\ldots,q_n)=\{n(p^\star-c)+p^\star-\frac{n(p^\star-c)}{[x(p^\star)+y]}(q_1+\cdots+q_n)-c\}q_i.$$

Hence, dealer i's first-order condition is:

$$n(p^\star-c)+p^\star-\frac{n(p^\star-c)}{[x(p^\star)+y]}(q_1+\cdots+q_n)-c-\frac{n(p^\star-c)}{[x(p^\star)+y]}q_i=0. \tag{10}$$

Since every dealer will satisfy this condition, using $q^\star$ to denote the Nash equilibrium supply of each dealer, we have from (10):

$$p^\star-c-\frac{(p^\star-c)nq^\star}{x(p^\star)+y}=0.$$

Since $Q^\star=nq^\star$, this gives us:

$$Q^\star=x(p^\star)+y.$$

Hence $f^1(p^\star)+x(p^\star)=x(p^\star)+y$.
This establishes $f^1(p^\star)=y$. □

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