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

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1. The Problem

On 27 July 2011 India's exchange rate stood at Rs 43.94 to the US dollar. By 15 December this had dropped in value to Rs 54.23, a depreciation of 19%. By 6 February 2012 it rose again to Rs 48.68, an appreciation of over 10%. By May 18 it was down again to Rs 54.82 to the dollar. On 22 June, when this paper was a work in progress, it sharply depreciated to Rs. 57.32. This has led to a lot of soul searching and also acrimony.

There are, first of all, the hindsight experts, who, after the event, know why what happened had to happen. There was S&P's downgrading of U.S. sovereign credit in August 2011, they will point out, causing 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. But, given that this 'knowledge' is in hindsight, it is difficult to treat it as true understanding. And the fact remains that the fluctuations seem more than can be comfortably explained purely in terms of these exogenous events. This has often led to the charge that when there are such sharp gyrations in prices—be that of the exchange rate or of some stock or even some commodity such as gold—they are likely to have been caused by market manipulation, 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 really 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.

The widespread 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

[1] This is distinct from shorting a currency where one takes up a position in anticipation of a price change which is exogenous to oneself.

sharp exchange rate movements there may indeed be someone trying to profiteer at the expense of others. On the other hand, straightforward economic reasoning, as the previous paragraph shows, cannot explain how this is possible.

The aim of this paper is to show, by using a 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 short paper is to show exactly how the art of market manipulation works.

It should be clarified that I am here not talking about individuals profiteering from exogenous (that is, exogenous to these individuals) price movements, which simply requires one to have the sagacity to know when prices have bottomed out and will rise or the other way around. Then one can time ones purchase and sale to make a profit out of 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 which *cause* an otherwise stationary price to move and enables the manipulator to make a profit out of this. It is with manipulation that this paper is concerned.

Basically, what will be shown is that by 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 the central banks and the stock market regulator, 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.

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 who can reasonably expect to influence the exchange rate by their own actions. In India, for instance, several of the 99 members of the Foreign Exchange Dealers' Association of India (FEDAI), consisting of banks and financial institutions, are strategic agents on the forex market, and the millions of individuals, including tourists who buy and sell small quantities 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), 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 1 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

$$d = d(p), d'(p) < 0 \qquad (1)$$

And the supply of dollars for agents be given by

$$s = s(p), s'(p) > 0 \qquad (2)$$

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), who operates 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. 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 will be assumed that there are *n* dealers. Each dealer has access to some international forex market where they buy dollars at price *c*. Assume *x(c) > 0*. A picture of what has been described thus far is captured in Figure 1.

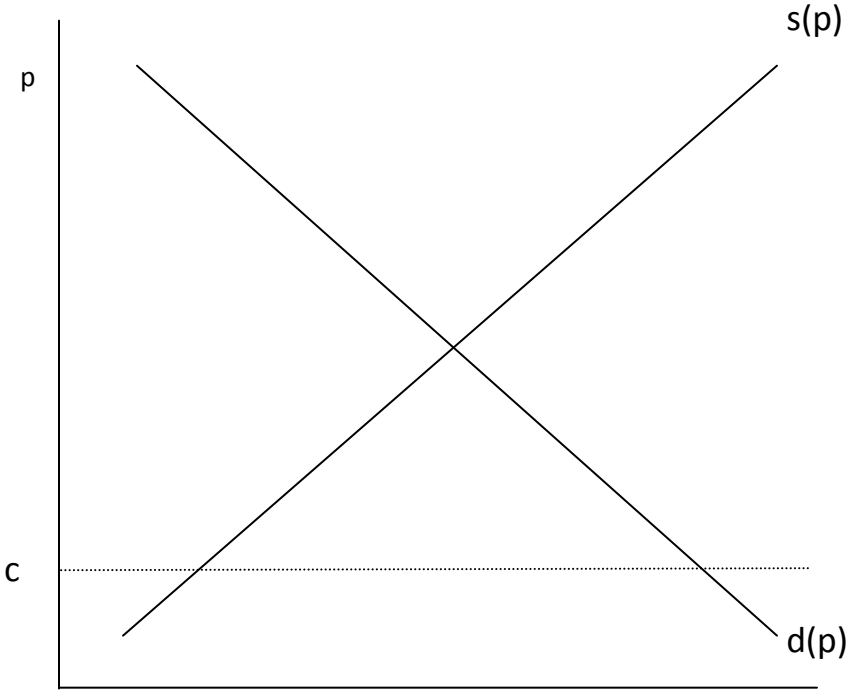

Figure 1

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

$$d(p) - s(p) = q_1 + \cdots + q_n \qquad (3)$$

Inverting this function, write

$$p = \emptyset(q_1 + \cdots + q_n) \qquad (4)$$

The profit earned by dealer *i* is given by:

$$\pi_i(q_1, \ldots, q_n) = [\emptyset(q_1 + \cdots + q_n) - c]q_i \qquad (5)$$

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

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

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 it 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*. The function *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 that we can draw on (see, for instance, Bresnahan, 1981; Klemperer and Meyer, 1989).

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. Get 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, $f^1(.)$, by using which the manipulator can make sure that the exchange rate is p^* and he gets to buy y dollars. The superscript on f reminds us that this is what the manipulator does in period 1, when he is trying to buy y dollars without altering the price of the original equilibrium, p^*. In period 2 he will off load the y dollars but in such a manner that the price of dollars actually rise 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.

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

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 to at price p. And p^* is the price that prevailed in the original equilibrium before the currency manipulator arrived on the scene[2].

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, (6), described above[3], then, in equilibrium, they will end up selling $x(p^*)$

[2] 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).

[3] 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

+ y dollars. The price will be *p** and the manipulator will buy *y* dollars since $f^1(p^*) = y$.

All that the manipulator now has to do is to think of strategy, $f^2(p)$, in period 2 so that price in period 2 ends up being greater than *p** and he manages to sell off the *y* dollars at that price. In short he 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 him 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 they strategy, $f^2(p)$ that does the job.

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

Faced with dealer 1's strategy 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 my claim is easy to establish as follows. 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). Let now 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 excepting that the manipulator now uses the strategy 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*, she would have made a profit.

4. Discussion

Intuitively, the manipulator works by making contingent plans of how many dollars he 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.

The central bank and regulator, especially in emerging economies, have very little notion of how the currency manipulator works and so have dealt with this problem very 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. It requires a level of sophistication and deep pocket (to make the out-of-equilibrium behavior credible) that all may not have.

As with many theory papers this opens up as 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, central banks can intervene to move exchange rates in desirable directions without altering its foreign exchange reserves (Singh and Vives, 1984; Basu, 2012). It will be interesting to investigate if such central bank interventions can be used to neutralize the manipulator.

While this paper does not go into what the regulator should do faced with the manipulation problem (though it does the spade work for such an exercise), it casts an interesting light on futures trading in currency. Since the manipulator needs to somehow 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.

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