One way bets on pegged exchange rates

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Abstract

Measurement of the currency exposure of firms can yield insights into issues connected with exchange rate regimes and capital account liberalisation. We set out to measure the currency exposure of firms in India over the 1993-2008 period. We identify sources of bias in favour of non-rejection of the null of no-exposure, and address these in the estimation strategy. From 1998 to 2008, for some highly export-oriented industries, the null of zero exposure cannot be rejected. Barring these, for most industries, firms have stood to gain significantly from currency appreciation. This suggests that there was a consensus amongst firms about a one-way bet, and that there was enough *de facto* convertibility through which this view was translated into exposure.

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1 Introduction

In many developing countries, the incompleteness of financial markets, and capital controls, are believed to result in the inability of firms to engage in risk management. This is one motivation underlying pegged exchange rate regimes. Conversely, with incomplete markets and capital controls, firms are believed to be unable to modify their exposure to exploit forecasts of future currency movements.

Pegged exchange rates sometimes involve opportunities for profitable forecasting of future exchange rate movements. Sometimes, a central bank is implementing a pent-up adjustment over an extended period of time. Alternatively, if a central bank is doing sustained trading on the currency market, month after month, then the private sector knows that the exchange rate has been distorted. When there are inconsistencies in the monetary policy framework, the private sector can form a view that such one-sided trading by the central bank is not sustainable. This can be used for forecasting future movements of the currency. Finally, when large reserves are built up, the private sector can rule out the scenario of a large depreciation taking place.

When a large number of private players have a consensus on the future direction of currency movements, this constitutes a one-way bet on the exchange rate. Even with an environment with weak financial markets and *de jure* capital controls, firms will try to profit from expected exchange rate movements. The extent to which they are able to do this depends on the capabilities of financial markets and the *de facto* capital controls.

The measurement of currency exposure of firms can thus give insights into the extent to which markets are incomplete, the extent to which *de jure* capital controls are not a binding constraint for firms, the extent to which firms are unable to take care of themselves in terms of hedging against currency fluctuations, and the extent to which the exchange rate regime involves one-way bets.

With pegged exchange rates, the evolution of the exchange rate reflects decisions by the government. This would, in turn, be influenced by political interests in favour of appreciation or depreciation. The examination of the currency exposure of firms would yield an understanding of the map of interests; of the firms who gain from appreciation and the firms who gain from depreciation.

In this paper, we embark on an examination of the currency exposure of firms in India from 1993 onwards. India is an interesting laboratory for these explorations for several reasons. India has a well functioning and liquid equity market, which yields data for thousands of firms with active trading. India has a pegged rupee-dollar exchange rate regime, but has been through four sub-periods with different characteristics of the pegged exchange rate. Finally, while India started out with harsh capital controls and weak financial markets, over the years, financial markets have improved and there has been a substantial movement towards *de facto* convertibility.

We build on, and improve, the methodology of obtaining estimates of the currency exposure of firms based on stock price fluctuations (Adler and Dumas, 1984; Jorion, 1990; Doukas *et al.*, 2003; Priestley and Odegaard, 2007). We draw on previous work on identifying structural change in the exchange rate regime, and analyse four sub-periods of the Indian rupee-dollar pegged exchange rate over the 1993-2008 periods.

We show that in measuring the currency exposure of a *firm*, statistical precision is hard to obtain in an emerging markets setting with a pegged exchange rate. Hence, we shift focus from individual firms to industry indexes. In the literature, currency exposure with industry indexes has often not been discernable, owing to the cancelling out of positive and negative exposures across firms in the industry. However, since the phenomenon of interest in India lies in the one-way bets in a pegged exchange rate, there is a possibility that firms can have homogeneous views and unhedged exposures, and that strong exposures are visible at the level of industry indexes.

We address four key questions in the paper.

Question 1: *Does the market index contain currency exposure in some of the four sub-periods? In other words, does the average firm ever have currency exposure?* We find that this is, indeed, the case.

Question 2: *Is exposure of industry indexes stable through time, reflecting industry characteristics? Or does it fluctuate through time, reflecting the views of firms?* We find that while the currency exposure of industry indexes does reflect industry characteristics, there is substantial variation across time. Fairly large changes in exposure are found over periods where the trade exposure of an industry did not significantly change.

Question 3: *Are industry exposures dispersed, reflecting the heterogeneity of industry characteristics? Or are industry exposures also homogeneous?* We find that in period 3 and 4, a remarkable set of industries were setup to benefit from rupee appreciation. Industry exposures are not dispersed reflecting industry characteristics.

Question 4: *Do export-oriented industries benefit from depreciation?* While most industries stand to gain from rupee appreciation, in the case of some highly export-oriented industries such as the software industry, the null hypothesis of zero exosure cannot be rejected at a 95% level.

These results contradict the sense that India has weak financial markets and a system of capital controls that bind. The results suggest that there is enough *de facto* convertibility that firms are able to substantially modify their currency exposure.

These results undermine the case for exchange rate pegging. If firms are sophisticated and able to do their own risk management, there is a reduced case for the government to socialise risk management services by running a pegged exchange rate.

The results show that the Indian pegged exchange regime has been a one-way bet in the eyes of a large fraction of firms, particularly in period 3 and period 4. A remarkable consensus is

found within firms of an industry. If firms within an industry disagreed on exposures, the cancelling out of positive and negative exposures within an industry would yield a lack of significance of the exposure of an industry. Further, there is remarkable coherence between the estimates across various industries with very different trade exposures. By period 4, a remarkable range of industries had set themselves up to benefit from a rupee appreciation.

From the viewpoint of political economy, these results suggest that by and large, Indian firms stood to gain from rupee appreciation in periods 3 and 4. A few highly export-oriented sectors had exposures of roughly zero. There was no industry index which stood to lose from rupee appreciation. This contradicts the view that many export oriented industries have been, and will be, adversely affected by rupee appreciation.

2 The problem of currency exposure of firms

The investigation of the currency exposure of firms is motivated by questions connected with exchange rate pegging and capital account liberalisation. Under a flexible exchange rate regime, there is a diversity of views about future currency movements. Some firms believe that the exchange rate will appreciate, others believe it will depreciate, while others are agnostic. When firms act on these beliefs to adjust their currency exposures, a diverse array of currency exposures are found at the firm level. Some exposures are positive, some exposures are zero, and some exposures are negative.

Exchange rate pegging can lead to distorted exchange rates. When a central bank buys on a massive scale on the currency market, month after month, economic agents know that the exchange rate is undervalued; an appreciation is likely when the pattern of one-way intervention ended. When reserves become very large, large depreciations become unlikely. If the monetary policy framework is perceived to be inconsistent, economic agents expect that the pattern of continual intervention is unsustainable. Alternatively, a managed exchange rate can be on a trajectory where a large adjustment of the exchange rate is being spread over an extended period through trading by the central bank. In these scenarios, a 'one way bet' can arise, where a large fraction of firms agree on the predicted direction of the exchange rate. When such a consensus comes about, it would be manifested in a reduction in the diversity of the sign of exchange rate exposures of firms.

Even if a one way bet is present, the translation of the view into currency exposure of firms requires access to financial markets and other tools for modifying currency exposure of the firm. This takes us to issues of incomplete markets and capital account liberalisation. At one polar extreme is an emerging markets setting characterised by poorly developed financial markets and a system of capital controls that is pervasive and thus effective. In this setting, the exposure of firms would be driven by industry characteristics. As an example, in a highly export-oriented industry, firms would generally be hurt by an exchange rate appreciation. Even if firms had views about future exchange rate fluctuations, they

would not be able to express them given malfunctioning markets and capital controls. These exposures would be relatively invariant across time: changes in conditions on the currency market would not result in changes in currency exposure of firms.

On the other hand, when the process of capital account liberalisation has made significant progress, and financial markets are starting to come about, firms would have greater flexibility in modifying their exposures across time. Two key characteristics that would be observed are:

1. The currency exposures of firms would change across time, reflecting changing currency market conditions, the evolution of the pegged exchange rate and thus the changing expectations about future evolution of the exchange rate;
2. Exposures would diverge from those expected from industry characteristics. Even though an industry might be export oriented, firms might not be hurt by a currency appreciation if they expect an appreciation and are able to setup hedging structures which protect themselves.

A third perspective which motivates an examination of the currency exposure of firms is in obtaining an understanding of the political economy of pegged exchange rates. Different firms stand to gain or lose from exchange rate appreciation. Measurement of exposures could help identify the map of interests in the politics of exchange rate setting under a pegged exchange rate regime.

The examination of the currency exposure of firms can thus help us in obtaining insights into exchange rate regimes and the process of capital account liberalisation. The key question we focus on is: *Do the exposures of firms suggest there are one-way bets on the exchange rate?* In this paper, we are able to obtain clear evidence on this question for Indian firms over the 1993-2008 period.

In the literature, substantial exposures of firms have generally not been found. This could partly reflect the fact that with floating exchange rates, there are no one-way bets, and firms have an incentive to do hedging (Bartram, 2007) and thus reduce their currency exposure. It may also be because of difficulties in measurement. In this paper, a series of difficulties of measurement are identified and addressed.

A greater clarity on these questions has important policy implications. Exchange rate pegging is partly motivated by the desire in the part of the government to protect firms. The belief that hedging markets are inadequate, and that firms are unable to cope with currency risk, is part of the very motivation for pegging. There are two perspectives here. On one hand, there are fears of 'original sin': if firms have done unhedged foreign currency borrowing, a large depreciation will hurt them. Equally, there are fears that exporting firms would be adversely affected by an exchange rate appreciation. Both kinds of fears have been used to justify exchange rate pegging.

Conversely, the belief that capital controls are effective, and that firms are unable to act on their views about future exchange rate fluctuations, is an important part of the intellectual framework of pegging under a closed capital account. Do the *de jure* controls

work, or is there substantial *de facto* convertibility, where firms are able to alter exposures and speculate on future exchange rate fluctuations? Better evidence on this question would help clarify debates about capital account liberalisation.

The remainder of this paper is organised as follows. Section 3 describes ways to measure currency exposure. Section 4 describes the estimation strategy of this paper. Section 5 poses the specific economic questions that this estimation strategy will seek to answer. Section 6 describes the results. Finally, Section 7 concludes.

3 Measurement of currency exposure

3.1 Measurement using accounting data

Many researchers have measured the currency exposure of firms through accounting disclosures (Kamil, 2006; Cowan *et al.*, 2004; Martinez and Werner, 2002). However, this strategy of is of limited usefulness, for a variety of reasons:

1. Disclosures required to compute the currency risk associated with foreign currency borrowing, and the currency derivatives position of the firm, are generally not available.
2. Deeper issues of currency exposure that arise through import parity pricing of raw materials and/or finished goods are outside the scope of accounting disclosure.
3. The currency exposure of financial firms is particularly important in thinking about financial fragility in the context of pegged exchange rates. Burnside *et al.* (2001) argue that in a world with government guarantees it is optimal for banks to have an unhedged currency mismatch between their assets and their liabilities. At the same time, it is difficult to estimate exposure from accounting disclosures, particularly for opaque financial firms such as banks.
4. In India, firms disclose direct imports and exports. However, if a firm sells to a trading company which (in turn) exports, this is not observed. The invoicing currency of transactions is not disclosed.

For these reasons, the analysis of accounting disclosures yields a incomplete understanding of the currency exposure of the firm.

3.2 Measurement using the stock market

The currency risk visible in the stock price process is an attractive alternative mechanism through which currency exposure can be measured. An 'augmented market model':

$$r_j = \alpha + \beta_1 r_{M1} + \beta_2 r_{M2} + \epsilon \quad (1)$$

relates firm returns r_j to market index movements r_{M1} and currency fluctuations r_{M2}. The coefficient β_2 measures the sensitivity of the firm valuation to changes in the exchange rate. If an exporting firm is unhedged and gains when there is a currency depreciation, it would have $\beta_2 > 0$. This approach for measuring exposure of firms has been the workhorse of empirical papers which have explored currency risk using firm level data (Dominguez and Tesar, 2006).

In an efficient market, this has the advantage of reflecting the efforts of speculative markets at putting together all aspects of currency exposure of the firm. This approach works identically for financial firms as it does for non-financial firms. If a firm sells a product which is priced through import parity, stock market speculators who form a judgment about future profits of the firm will embed currency fluctuations into the stock price process. Stock market speculators have an incentive to unearth information about the currency derivatives position of the firm and the invoicing currency of international trade of the firm.

4 Estimation strategy

While Equation 1 is an attractive approach for the measurement of currency exposure of firms, there are many hurdles faced in translating this idea into a concrete estimation strategy. In this section, we discuss the difficulties faced, and the strategy that we adopt in addressing these difficulties.

4.1 Trade weighted exchange rate or bilateral exchange rate?

Much of the literature that studies firm currency exposure focuses on exposure to the trade weighted exchange rate. We choose to focus on a bilateral exchange rate – the rupee-dollar exchange rate. This is because more than 80 percent of India's trade is denominated in the US dollar. In addition, the exchange rate regime is a *de facto* pegged rupee-dollar rate. The dollar is thus the relevent currency for questions relating to the relationship between the currency regime and firm exposure.

4.2 Currency market returns or innovations?

In a competitive market, exchange rate changes are unpredictable, but this need not be the case when there is pegging. The stock price of a firm at any point of time takes into

account all information available at that point. If a change in the exchange rate is expected in time $t+1$, the stock price at time t takes this into account. Thus, the stock market price responds only to unanticipated changes in the exchange rate (Doukas *et al.*, 2003).

Hence, we measure the response of the stock market to innovations in the currency returns time-series. We find that the time-series of the INR/USD exchange rate often deviates from a random walk. ARMA identification based on the Akaike Information Criterion suggests that r_{M2} often has an AR time-series structure. Hence, we shift from raw currency market returns r_{M2} to ARMA innovations, that we call e_t.

4.3 Lags in the response of stock prices to currency innovations

Exchange rate fluctuations usually do not find their way into the stock price on the same day. It could take some time for stock market speculators to understand their implications. Further, this delay in information flow will differ across stocks based on their liquidity.

To address this issue, we enlarge the model to link the present stock market returns to present and past currency market innovations:

$$r_{jt} = \alpha + \beta_1 r_{M1,t} + \sum_{i=0}^{k} a_i e_{t-i} + \epsilon_t \tag{2}$$

Under this specification, an innovation e_t on the currency market has an impact on the stock price at time t and the following k time periods. Under the model 2, currency exposure is embedded in the vector of a_i coefficients; it is no longer a simple scalar β_2 as was the case under the model 1.

We identify the k that yields the best value of the Schwartz Bayesian Criterion for each r_j series separately. This allows the lag structure to vary based on stock market liquidity.

Since the exchange rate series has been re-expressed as a series of innovations, the total impact of an unexpected change in the exchange rate on a stock price is the sum of β_2 coefficients across all lags. Further to address the problem of heteroscedasticity in r_{M1} and r_{M2} we use a HAC estimator of the covariance matrix.[1]

When there are lags in the impact of exchange rate innovations upon the stock price, and if a researcher uses a fixed $k = 1$, this would lead to a bias in favour of obtaining exposures which are closer to zero.

[1]This is implemented using the methods of Zeileis (2004).

4.4 Choice of time periods

While India has broadly had a pegged exchange rate regime (Patnaik, 2007), there has been substantial structural change in the exchange rate regime. We identify break dates in the exchange rate regime using Zeileis *et al.* (2007). This gives us four subperiods in India's exchange rate regime:

1. 4/1993 – 2/1995: Low flexibility, appreciation prevented by reserves accumulation
2. 2/1995 – 8/1998: High flexibility, Asian crisis, fears of depreciation
3. 9/1998 – 3/2004: Low flexibility, appreciation prevented by reserves accumulation
4. 3/2004 – 2/2008: Higher flexibility, massive reserves accumulation.

When there is such a fine structure in a pegged exchange rate regime, and the risk and return from currency speculation have evolved over various time periods, this is expected to influence the behaviour of firms. In this paper, we undertake measurement of currency exposure across these four time periods rather than a single model covering the entire time-period.[2] If a researcher used a single model covering the entire time-period, this could lead to the averaging of positive and negative exposures across different time periods, and generate a bias in favour of obtaining exposures which are closer to zero.

4.5 Market portfolio in the regression

The market index, r_{M1}, that plays an important role in the estimation of the market model, reflects the average stock market returns of firms in the market index. If one-way bets *are* present on the currency, and a large number of firms have a certain direction of exposure, this will result in currency exposure *of the market index*.

Under these conditions, when the estimated $\beta_2 = 0$, this means that the stock has the same exposure as the market index. The exposure measured by β_2 is not the currency exposure of the firm: it is the exposure of a particular firm over and above the exposure of the market index or the average firm.

Some studies (Bodnar and Wong, 2003; Dominguez and Tesar, 2001) suggest utilisation of an equally weighted market portfolio, rather than the more conventional value weighted market portfolio, as a consequence of this problem. They argue that a value weighted index gives greater importance to larger firms which are more internationalised and likely to have more currency exposure. In contrast, an equal weighted index gives greater importance to small firms who may produce more non-traded goods and have less exposure, thus diminishing the currency exposure of the market index.

[2] As mentioned above, we expect that stock prices respond to unexpected changes in the exchange rate. The shift from currency returns to currency innovations is done separately for each of the four sub-periods, to reflect the differences in the exchange rate regime.

The alternative strategy consists of orthogonalising the market index time-series by first estimating a regression model explaining r_{M1} as a function of past and present currency innovations, and extracting the residual from this regression (Griffin and Stulz, 2001). Priestley and Odegaard (2007) go further, orthogonalising the market index return with respect to a number of macroeconomic variables which also affect the exchange rate. However, this requires the use of low-frequency macroeconomic time-series.

We follow the methodology of Griffin and Stulz (2001), which is better suited for use with high-frequency returns data. We set up a regression of r_{M1} on currency innovations with five days of lags, and extract residuals from this. These residuals represent pure equity index returns, uncontaminated by exchange rate effects (if any). These residuals are then used in the estimation of exchange rate exposure at the industry level.

If one-way bets were indeed present, and if the regression utilised r_{M1} as the explanatory variable, the estimated β_2 would reflect the *divergence* of the exposure of the firm from the exposure of the market index. This would, on average, be close to zero. This represents another source of a bias in favour of obtaining currency exposures of zero.

4.6 Difficulties of statistical precision

In the model

$$r_j = \alpha + \beta_1 r_{M1} + \beta_2 r_{M2} + \epsilon$$

high statistical efficiency in estimation of β_2 requires a high $\text{Var}(r_{M2})$ and low $\text{Var}(\epsilon)$. With pegged exchange rates, $\text{Var}(r_{M2})$ is low. In emerging markets, $\text{Var}(\epsilon)$ is high. Thus, an emerging markets setting with pegged exchange rates is one where statistical precision for estimation of β_2 is hard to obtain.

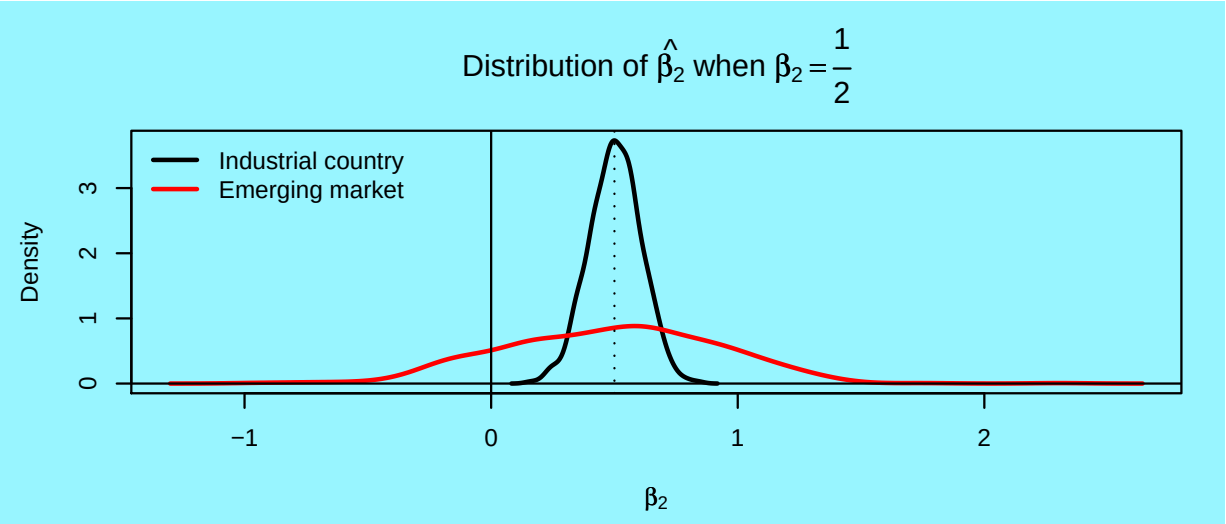
The numerical significance of this issue is judged through a Monte Carlo experiment where a true $\beta_2 = \frac{1}{2}$. Weekly data from 2003 to 2007 is simulated using the following assumptions. For an industrial country, currency volatility is set to the volatility of the GBP/USD exchange rate, while for the emerging market, the INR/USD volatility is employed. For the unsystematic risk in an emerging market, the value for one large Indian company (Satyam Computer Services) is used. For the industrial country, unsystematic risk is set to half this value.[3]

Figure 1 shows the distribution of β_2 obtained in this simulation. This suggests that if a firm had a true $\beta_2 = \frac{1}{2}$, this would be fairly accurately picked up in an industrial country setting, but there is substantial sampling variation in an emerging market setting.

[3]This yields parameters for the simulation as follows:

	Industrial	India
$\text{Var}(r_{M2})$	1.16	0.57
$\text{Var}(\epsilon)$	1.86	3.72

Figure 1 Measurement difficulty with β_2 in the emerging markets setting



One way in which this imprecision can be contained is by averaging β_2 across many firms. Even though each β_2 estimate has low efficiency, it is unbiased, and greater efficiency can be obtained by averaging across firms.

To do this, we shift focus from individual firms to industry indexes. We utilise the suite of 164 industry indexes computed by Centre for Monitoring Indian Economy (CMIE), which are organised as a tree ranging from broad industry groups (such as services) all the way to finely defined industries (such as banking).

All firms in an industry are likely to have similar characteristics in terms of imports, exports and the inherent currency exposure. If there is a one-way bet, and firms in an industry think alike, then this will materialise in significant values for β_2 for the industry index. If, on the other hand, firms have diverse views, then averaging to get to an industry index will involve averaging positive and negative values, thus giving industry β_2 values of near zero. Finding significant exposures for broad market indexes or industry indexes is, then, critically linked to the presence of one-way bets.

In the literature, measurement of currency exposure at the level of industries has given even smaller estimates of exposure as compared with measurement of currency exposure at the level of firms. Allayannis and Ihrig (2000) find that 4 out of 18 US industries have significant exposure. Similarly, Dahlquist and Robertsson (2001) find that while Swedish *firms* carry significant exchange rate exposure, industry indexes do not. This could be related to the lack of a one-way bet under floating exchange rates, which would result in a diversity of currency views across firms, and a cancellation of positive and negative exposures within an industry.

Another perspective comes from Griffin and Stulz (2001) who examine the argument that

some industries in a country complete with the same industries in other countries, and an appreciation of the exchange rate renders them less competitive. They find that the impact of exchange rate movements is trivial for most industries in Japan, US, Canada, France, Germany and UK. Industry shocks matter much more than exchange rate shocks. If the automobile sector in the rest of the world is doing badly, US firms are most likely to be negatively affected, than by the movement of the Yen/USD. They conclude that firms have many ways of hedging their exchange rate exposure, and even firms who export in international markets are able to efficiently organise themselves so that exchange rate changes have little effect on their valuation.

4.7 Summary of estimation strategy

In summary, the estimation strategy followed in this paper consists of the following steps:[4]

1. Work within dates of structural breaks of exchange rate regime as identified by Zeileis *et al.* (2007). In the case of India, this induces four periods.
2. Shift from r_{M2} series to innovations for each period separately, using an AR model.
3. Purge r_{M1} of currency effects and shift to residuals, using a lag structure chosen based on the SBC. This is also done separately in each of the four periods of the exchange rate regime, in order to reflect changing currency market conditions and views of firms.
4. Apply this strategy to 164 tree-structured industry indexes. Compute the augmented market model using orthogonalised equity index returns and currency innovations for each industry index, using the SBC to choose the lag structure.
5. The overall currency exposure of an industry is the sum of currency coefficients. Statistical significance is assessed using heteroscedasticity-consistent inference.

4.8 Data

We utilise the NSE-50 index (Nifty) as the r_{M1}. We use the INR/USD series from the Federal Reserve Bank of New York. For industry indexes, the 164 tree-structured market indexes computed by CMIE are utilised.

All data is at a daily frequency, since the stock market appears to rapidly process information about currency innovations. While Nifty and the CMIE indexes are observed from July 1990 onwards, we utilise data from April 1993 onwards, since that represents the starting point of a relatively undistorted currency market.

[4]The estimation strategy of this paper represents a set of refinements over that used in Patnaik and Shah (2007). Greater details about the econometrics are presented in that paper.

5 Hypotheses

There are four key questions which the empirical work must address:

Question 1: *Does the market index contain currency exposure in some of the four sub-periods? In other words, does the average firm ever have currency exposure?* Pegged exchange rates can induce predictability in exchange rates. If such predictability comes about in a given sub-period, and if firms have enough access to sophisticated financial markets and *de facto* convertibility to translate a consensus in views into a consensus in exposures, then the market index will have significant currency exposure.

Question 2: *Is exposure of industry indexes stable through time, reflecting industry characteristics? Or does it fluctuate through time, reflecting the views of firms?* If the exchange rate regime does not throw up one-way bets, then firms will not be attempting to modify currency exposures from time to time. Further, if markets are incomplete and if capital controls bind, then firms would not be able to modify their exposures. If both these conditions do not hold (i.e., the exchange rate regime has one-way bets and firms are able to act on these), then th exposure of industry indexes would vary through time and not merely reflect industry characteristics.

Question 3: *Are industry exposures dispersed, reflecting the heterogeneity of industry characteristics? Or are industry exposures also homogeneous?* If there are one-way bets, if markets are complete and capital controls do not bind, then industry exposures will become homogeneous.

Question 4: *Do export-oriented industries benefit from depreciation?* If markets are incomplete and capital controls bind, then export-oriented industries will have the usual pattern of benefiting from currency depreciation. If, however, there is enough *de facto* convertibility and financial market development through which firms can alter their exposures, then export-oriented industries will not have the exposures simplistically expected of them.

6 Results

6.1 Exchange rate exposure in the overall market index

As argued above, one key step of the estimation strategy is the task of purging the average currency exposure of firms that is embedded in the market index. This is not merely a statistical exercise. If the exchange rate were not a one-way bet or if firms were constrained by capital controls and illiquid financial markets, there would be a dispersion of currency exposure at the firm level and these exposures would tend to cancel out, giving a market index with low or zero exposure.

Table 1 Model explaining Nifty using present and lagged r_{M2}

	Period 1	Period 2	Period 3	Period 4
Same day	0.538	**-0.283**	**-1.204**	**-1.249**
	(0.8)	**(-2.4)**	**(-4.0)**	**(-8.1)**
Lag 1	1.060	-0.055	**-0.603**	**-0.398**
	(1.6)	(-0.5)	**(-2.0)**	**(-2.6)**
Lag 2	0.877	0.092	0.002	-0.267
	(1.3)	(0.8)	(0.0)	(-1.7)
Lag 3	-0.287	0.180	-0.342	0.173
	(-0.4)	(1.5)	(-1.1)	(1.1)
Lag 4	0.656	0.124	0.431	-0.251
	(0.9)	(1.0)	(1.4)	(-1.6)
Lag 5	1.008	-0.029	0.455	-0.119
	(1.6)	(-0.2)	(1.5)	(-0.8)
$\bar{R}^2$	0.005	0.005	0.015	0.073

Table 1 shows results for the four periods of India's exchange rate regime. In each time-period, an AR model is used to convert daily INR/USD percentage changes into a time-series of innovations. The regression shown in the table explains daily Nifty percentage changes using present and past currency market innovations.

Period 1 ran from 4/1993 to 2/1995. The INR had very little flexibility, capital controls were binding, and financial markets had little liquidity. In this period, the average firm had no exposure. The adjusted R^2 was 0.005, suggesting that currency fluctuations had very little impact on Nifty.

Period 2 runs from 2/1995 till 8/1998. There were fears of depreciation and the highest exchange rate flexibility in India's history. In this period, there was a small contemporaneous rise in Nifty of 0.283% for a 1% rupee appreciation. However, the adjusted R^2 was just 0.005, suggesting that currency fluctuations still did not matter for Nifty.

In period 3, there was low exchange rate flexibility, and reserves were built up at a high pace suggesting exchange rate undervaluation. Some appreciation of the rupee began. Towards the end of this period, difficulties of sterilisation were visible, which helped generate expectations of rupee appreciation. In this period, substantial coefficients are visible: a 1% rupee appreciation yields a 1.2% rise in Nifty on the same day and a 0.6% rise in Nifty on the next day adding up to a total benefit for Nifty of 1.8%. The adjusted R^2 rose to 0.015. Currency fluctuations thus started being relevant to Nifty in this period.

Finally, in period 4, which run from 3/2004 till 2/2008, there was greater exchange rate flexibility thus increasing currency risk as seen by firms. But at the same time, there was a massive reserves accumulation, which helped firms feel confident there was no risk of a substantial depreciation. There may also be certain lagged effects at work: Given that it takes time for firms to learn how to evade capital controls, decisions taken to undertake a certain exposure in Period 3 may have yielded results in Period 4. In this period, a 1% rise in the rupee yields a 1.25% rise in Nifty on the same day and another 0.4% rise in

Table 2 Currency exposure of the broad market (CMIE Cospi index)

	Period 1	Period 2	Period 3	Period 4
Exposure	2.3969	-0.2345	-2.394	-1.8856
	(7.03)	(-6.89)	(-8.83)	(-23.94)

Nifty on the next day adding up to a total benefit for Nifty of 1.65% (slightly smaller than that seen in Period 3). The adjusted R^2 rose substantially to 0.073. This suggests that by period 4, currency fluctuations were important in shaping Nifty.

In all four periods, the stock market processes information relatively rapidly: there are no lags beyond one day. This encourages us to obtain statistical precision using high frequency data.

This procedure results in orthogonalisation of Nifty returns with respect to currency innovations. Table 2 shows the results of applying the full measurement strategy to the CMIE Cospi index, which is a broad market index. While Nifty has only 50 stocks, Cospi has nearly 3000 stocks. It thus reflects the behaviour of a broad swathe of Indian firms.

The results show that in all periods, firms as a whole had a bet on currency movements, in the sense of having high statistical significance. firms stood to gain from depreciation in Period 1. In Period 2, this changed to a small coefficient of 0.23 with the opposite sign. This enlarged to a big gain of 2.39% in Period 3 for a 1% rupee appreciation. In Period 4, increased currency volatility gave a smaller coefficient of -1.88%, but the consensus went up as reflected by a t statistic of -23.9.

These results answer Question 1: *Does the market index contain currency exposure in some of the four sub-periods? In other words, does the average firm ever have currency exposure?* In all four periods, the average firm had setup a position so as to benefit from currency movements of some direction or the other.

6.2 Currency exposure of industry indexes

Results of measurement of currency exposure of all industry indexes are presented in Appendix A.

Table 3 Net exports to sales ratio of major industry groups

	'89	'91	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07
Chemicals	−0.08	−0.11	−0.15	−0.13	−0.13	−0.13	−0.23	−0.20	−0.15	−0.17	−0.15	−0.17	−0.20	−0.17	−0.21	−0.26	−0.22
Construction	−0.01	−0.02	−0.01	0.02	0.02	0.00	0.03	0.05	0.05	0.08	0.05	0.07	0.07	0.06	0.06	0.06	0.05
Diversified	0.01	−0.01	−0.01	0.02	−0.02	−0.04	−0.03	0.01	−0.03	−0.03	0.02	0.02	0.02	0.00	0.00	−0.03	−0.04
Electricity	−0.01	−0.22	−0.22	−0.10	−0.12	−0.07	−0.06	−0.03	−0.03	−0.03	−0.04	−0.06	−0.04	−0.03	−0.03	−0.04	−0.07
Food & bev.		0.05	0.07	0.09	0.06	0.06	0.05	0.06	0.01	0.00	0.00	0.02	0.02	0.01	0.00	−0.02	0.03
Machinery	−0.08	−0.06	−0.06	−0.05	−0.07	−0.09	−0.08	−0.07	−0.09	−0.07	−0.06	−0.07	−0.06	−0.05	−0.08	−0.09	−0.07
Mining	0.10	0.19	0.01	0.01	−0.26	−0.05	−0.03	−0.05	−0.11	−0.03	0.00	−0.02	0.00	0.01	−0.04	0.00	−0.04
Misc. manuf.	−0.09	−0.06	−0.06	−0.02	−0.05	−0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.02	0.00	0.00	−0.03	−0.03
Non-met. min. prod.	−0.07	−0.06	−0.06	−0.04	−0.06	−0.09	−0.08	−0.04	−0.05	−0.01	−0.02	−0.02	0.01	0.00	0.00	−0.05	−0.03
Textiles	−0.03	0.01	0.06	0.07	0.05	0.06	0.11	0.14	0.15	0.16	0.17	0.15	0.16	0.15	0.14	0.12	0.14
Transp. equip.	−0.06	−0.03	−0.02	−0.01	−0.02	−0.04	−0.03	−0.03	−0.04	−0.05	−0.04	−0.02	0.00	0.01	0.01	0.01	0.01

Table 4 Currency exposure of broad industry groups

	P.1	P.2	P.3	P.4
Food and beverages	1.1613	-0.022	-0.8499	-1.3462
	(2.29)	(-0.21)	(-3.35)	(-7.89)
Textiles	0.702	-0.1006	-0.8832	-0.4695
	(1.06)	(-2.15)	(-2.87)	(-1.45)
Chemicals	1.6803	0.0519	-0.6813	-1.6609
	(3.3)	(0.3)	(-2.23)	(-12.95)
Non-metallic minerals	2.3461	-0.0146	-1.0844	-1.4509
	(4.57)	(-0.07)	(-3.96)	(-7.46)
Metals and metal products	3.8096	-0.4037	-2.6453	-2.308
	(3.28)	(-3.22)	(-5)	(-9.76)
Machinery	1.8535	-0.2224	-2.138	-3.2046
	(2.49)	(-3.83)	(-5.3)	(-3.42)
Transport equipment	4.2014	-0.2024	-1.7437	-1.7125
	(3.55)	(-3.88)	(-5.73)	(-13.15)
Electricity	4.5418	-0.1062	-0.7007	-1.7608
	(4.96)	(-0.74)	(-1.8)	(-8.57)
Non-fin services	-1.024	-0.1895	-1.9138	-1.1068
	(-1.07)	(-3.03)	(-4.37)	(-2.25)
Construction	0.8585	0.0357	-1.9572	-2.3282
	(1.36)	(0.18)	(-2.66)	(-2.59)
Finance	2.7802	-0.3202	-3.8574	-1.1467
	(2.54)	(-5.99)	(-2.64)	(-2.95)

Table 3 shows the net exports to sales ratio of braod industry groups. As expected, this ratio changes only slowly. The most import-oriented sector is chemicals, where the net exports to sales ratio has been stable at roughly -20% for a decade. Exports to sales of textiles rose in the early 1990s and have stabilised at roughly 15% for roughly a decade. None of the other sectors have large import or export to sales ratios.

Table 4 shows the currency exposures of broad industry indexes. In period 1, there is a greater heterogeneity of exposures. Six of the 11 industries stand to gain from a depreciation with significance at a 95% level. Only one industry had a negative coefficient (though not statistically significant).

In period 2, a series of negative values are seen - i.e. firms that stand to gain from appreciation. Statistical significance at a 95% level is found with six of the 11 industries. The numerical values are, however, small. Large changes in exposure are visible. As an example, the Transport equipment index went from an exposure of +4.2 (with a t statistic of 3.55) in period 1 to an exposure of -0.2 (with a t statistic of -3.88) in period 2. Yet, a comparison against Table 3 shows that there was no large change in the net exports of this industry over these years.

In period 3, all industries show a negative exposure by sign, and all but one are significant at a 95% level of significance. This is inconsistent with the view that trade linkages lead to exchange rate exposure, for in Table 3, there is strong heterogeneity in the net exports

Table 5 Currency exposure of textiles and sub-industries and thereof

	P.1	P.2	P.3	P.4
Cotton	0.6135	-0.098	-0.7757	-0.4239
	(0.79)	(-1.56)	(-2.35)	(-1.16)
Yarn	0.8841	-0.1045	-0.7159	-0.2588
	(0.76)	(-1.54)	(-2.45)	(-0.78)
Cloth	0.3798	-0.0903	-0.9554	-1.354
	(0.57)	(-1.06)	(-2.16)	(-3.31)
Synthetics	2.3176	-0.0563	-2.1602	-1.3412
	(3)	(-0.81)	(-3.13)	(-5.63)
Processing	1.4462	-0.162	-1.4804	-1.4616
	(1.2)	(-1.22)	(-1.08)	(-3.33)
Readymade garments	1.2525	0.4035	-2.8493	-0.4856
	(0.45)	(1.4)	(-2.38)	(-0.61)
Overall	0.702	-0.1006	-0.8832	-0.4695
	(1.06)	(-2.15)	(-2.87)	(-1.45)

Table 6 Two other export-oriented sectors

	P.1	P.2	P.3	P.4
Automobile components	1.4031	0.1301	-1.9393	-1.3239
	(1.08)	(0.45)	(-1.81)	(-5.76)
Software + BPO	-0.8566	-0.4183	-3.7425	-0.3094
	(-0.41)	(-1.09)	(-3.46)	(-1.45)

to sales ratio across industries, and some industries are exporters which would generally not suggest benefits from appreciation.

Finally, in period 4 also, all exposures are negative, but in one out of the 11 industries (Textiles), this is not statistically significant.

A closer examination of some export-oriented industries would be of interest. In Table 4, there was one industry (Textiles) where there was no statistically significant gain from appreciation in period 4. Table 5 focuses on this industry and its sub-industries. In period 4, there are three sub-industries which gain from appreciation at a 95% level of significance : Cotton Cloth (-1.354), Synthetics (-1.34), and Processing (-1.46). There are three sub-industries where the exposure is in the direction of gaining from appreciation, but statistical significance at a 95% level is not obtained. These are : Overall Cotton, Cotton Yarn, and Readymade garments.

Similarly, Table 6 examines two other highly export-oriented sectors: automobile components and the software + BPO sectors. In the case of components, at a 95% level of significance, the industry gains from appreciation. In the case of software, there appears to be no exposure at a 95% level of significance.

By and large, in Period 3 and particularly in Period 4, a lot of industries seem to have setup a position which profited from INR appreciation. These results support the Griffin and Stulz (2001) finding that industry groups in a country are not exposed to exchange

rate risks and their conclusion that firms are able to organise themselves such that they are not hit by currency movements.

The next result, about the exposure of highly export-oriented industries also supports this result. Indeed, some highly exported oriented industries *benefit* from INR appreciation. In Period 4, for highly export-oriented industries, the null of no impact of INR/USD appreciation cannot be rejected.

7 Conclusion

Understanding the currency exposure of firms is important from many points of view:

- Weak financial markets and capital controls are believed to render firms unable to undertake financial transactions through which their currency exposure is modified.
- The notion that firms are helpless when faced with exchange rate fluctuations is part of the motivation for exchange rate pegging. Since firms cannot protect themselves from fluctuations in the exchange rate, it is felt that government must produce the public good of an exchange rate that does not fluctuate.
- If there is a consensus about the direction of future exchange rate movements, and if firms are not hobbled by capital controls and incomplete markets, stock market indexes at the industry level and at the aggregate level would show currency exposure. Pegging could therefore produce an adverse set of incentives whereby firms bear unhedged currency risk.
- An examination of currency exposures by industry groups helps to show the map of interests in the political economy of exchange rate setting.

In previous work (Patnaik and Shah, 2007), a relationship between exchange rate *exposure* using firm level data, and exchange rate flexibility has been established. This evidence suggested that when there was a less flexible exchange rate peg, firms adopted bigger exposures, and vice versa. This evidence was about $|\beta_2|$ without regard for the *direction* of exposure.

In this paper, the question of homogeneity of exposure in the context of a one-way bet on the currency market has been addressed. we have obtained answers to the four interesting questions posed at the outset:

- The market index does contain currency exposure in all the four sub-periods: the exposures of firms within the index do not cancel out.
- While the currency exposure of industry indexes does reflect industry characteristics, this exposure varies a lot across time. It appears to substantially reflect the currency views of firms.

- In period 3 and period 4, a remarkable set of industries had setup a position to benefit from rupee appreciation.
- There are highly export-oriented industries where the null of no-exposure cannot be rejected. There are no export-oriented industries where there is a statistically significant estimate showing a drop in the industry index with a rupee depreciation.

These results contradict the sense that India has weak financial markets and a system of capital controls that bind. The results suggest that there is enough *de facto* convertibility that firms are able to substantially modify their currency exposure.

These results undermine the case for exchange rate pegging. If firms are sophisticated and able to do their own risk management, there is a reduced case for the government to socialise currency risk management services by running a pegged exchange rate.

The results show that the Indian pegged exchange regime has been a one-way bet in the eyes of a large fraction of firms, particularly in period 3 and period 4. A remarkable consensus is found within firms of an industry: if firms within an industry disagreed on exposures, the cancelling out of positive and negative exposures within an industry would yield a lack of significance of the exposure of an industry. Further, there is much coherence between the estimates across various industries with very different trade exposures. By period 4, a remarkable range of industries had set themselves up to benefit from a rupee appreciation.

From the viewpoint of political economy, these results suggest that by and large, Indian firms stood to gain from rupee appreciation in periods 3 and 4. A few highly export-oriented sectors had exposures of roughly zero. There was no industry index which stood to lose from rupee appreciation. This contradicts the view that many export oriented industries have been, and will be, adversely affected by rupee appreciation.

A Currency exposure of all CMIE industry indexes

	P.1	P.2	P.3	P.4
Full COSPI	2.3969	-0.2345	-2.394	-1.8856
Full COSPI t	(7.03)	(-6.89)	(-8.83)	(-23.94)
Non financial	2.3737	-0.2236	-2.9128	-1.5693
Non financial t	(6.91)	(-5.86)	(-5.98)	(-6.3)
Manufacturing	2.4281	-0.1977	-2.8823	-1.0953
Manufacturing t	(6.68)	(-5.21)	(-4.06)	(-2)
Food and beverages	1.1613	-0.022	-0.8499	-1.3983
Food and beverages t	(2.29)	(-0.21)	(-3.35)	(-8.18)
Food	1.1437	-0.1548	-0.8291	-1.0088
Food t	(2.14)	(-2.87)	(-3.79)	(-6.33)
Dairy products	0.2792	-0.115	-0.806	-0.3664
Dairy products t	(0.31)	(-1.34)	(-2.28)	(-1.83)
Tea	-0.5358	-0.231	-1.4078	-1.5425
Tea t	(-0.79)	(-2.33)	(-4.06)	(-4.81)
Sugar	2.5084	-0.2045	-0.4123	-1.2095
Sugar t	(1.55)	(-2.01)	(-0.77)	(-3.76)
Vegetable oils and products	2.9223	0.0926	-0.474	-1.083
Vegetable oils and products t	(2.41)	(0.99)	(-1.26)	(-5.75)
Coffee	1.8714	-0.4563	-0.7021	-1.004
Coffee t	(0.53)	(-2.78)	(-1.42)	(-3.22)
Other food	2.4935	-0.0617	-0.5984	-0.639
Other food t	(2.17)	(-0.74)	(-1.96)	(-3.47)
Cocoa products and confectionery	0.8277	-0.1286	-0.8454	-0.9277
Cocoa products and confectionery t	(0.75)	(-0.83)	(-1.89)	(-2.27)
Bakery products	2.391	-0.0184	0.3349	-0.7035
Bakery products t	(1.59)	(-0.15)	(0.74)	(-2.82)
Processed food	3.7601	-0.0501	-1.119	-0.7732
Processed food t	(2.05)	(-0.22)	(-1.28)	(-2.49)
Starches	-0.1519	-0.1281	-0.6536	-0.5651
Starches t	(-0.46)	(-0.6)	(-1.28)	(-2.19)
Marine foods	1.6864	-0.1458	-1.0103	-0.0121
Marine foods t	(1.04)	(-0.66)	(-1.55)	(-0.03)
Poultry and meat products	0.601	0.5223	0.1154	-0.5046
Poultry and meat products t	(0.41)	(1.21)	(0.19)	(-2.3)
Floriculture	1.6276	-0.2962	-1.2655	-2.247
Floriculture t	(0.71)	(-0.88)	(-1.22)	(-3.43)
Milling products	7.1808	0.3315	-1.4815	0.351
Milling products t	(2.25)	(1.06)	(-0.52)	(0.76)
Other agricultural products	-1.1588	-0.0599	-2.5369	-0.5039
Other agricultural products t	(-0.7)	(-0.58)	(-1.48)	(-2.75)
Beverages and tobacco	1.2188	0.2262	-0.8796	-1.5213
Beverages and tobacco t	(1.31)	(0.99)	(-2.29)	(-6.85)
Tobacco products	1.4186	0.2168	-0.8806	-1.3509
Tobacco products t	(1.45)	(0.85)	(-2.15)	(-6)
Beer and alcohol	-1.4858	0.1621	-3.7154	-1.0335
Beer and alcohol t	(-1.05)	(1.03)	(-2.84)	(-5.73)
Textiles	0.702	-0.1006	-0.8832	-0.912
Textiles t	(1.06)	(-2.15)	(-2.87)	(-2.29)

Cotton textiles	0.6135	-0.098	-0.7757	-0.4645
Cotton textiles t	(0.79)	(-1.56)	(-2.35)	(-1.26)
Cotton and blended yarn	0.8841	-0.1045	-0.7159	-0.3029
Cotton and blended yarn t	(0.76)	(-1.54)	(-2.45)	(-0.91)
Cloth	0.3798	-0.0903	-0.9554	-2.1335
Cloth t	(0.57)	(-1.06)	(-2.16)	(-2.99)
Synthetic textiles	2.3176	-0.0563	-2.1602	-1.4167
Synthetic textiles t	(3)	(-0.81)	(-3.13)	(-5.91)
Textile processing	1.4462	-0.162	-1.4804	-1.5284
Textile processing t	(1.2)	(-1.22)	(-1.08)	(-3.47)
Readymade garments	1.2525	0.4035	-2.8493	-0.5378
Readymade garments t	(0.45)	(1.4)	(-2.38)	(-0.68)
Other textiles	1.6932	-0.0276	-0.9531	-0.8341
Other textiles t	(1.37)	(-0.27)	(-1.84)	(-1.09)
Chemicals	1.6803	0.0519	-0.6813	-1.7186
Chemicals t	(3.3)	(0.3)	(-2.23)	(-13.41)
Inorganic chemicals	1.0649	0.079	-1.5965	-0.4142
Inorganic chemicals t	(0.7)	(0.73)	(-1.83)	(-2.43)
Alkalies	0.6518	0.059	-0.5132	-1.4745
Alkalies t	(1.19)	(0.36)	(-1.12)	(-6.17)
Fertilisers	1.9621	-0.077	-0.5222	-1.524
Fertilisers t	(2.32)	(-0.96)	(-1.55)	(-6.23)
Pesticides	1.9346	-0.1689	-2.5454	-1.0635
Pesticides t	(1.88)	(-1.64)	(-3.75)	(-5.33)
Paints and varnishes	3.4596	-0.3093	-1.216	-0.5384
Paints and varnishes t	(2.12)	(-3.13)	(-3.76)	(-4.75)
Dyes and pigments	0.3107	-0.0267	-1.0308	-0.7226
Dyes and pigments t	(0.42)	(-0.25)	(-3.39)	(-4.42)
Drugs and pharmaceuticals	1.5892	-0.1637	-0.9864	-1.0774
Drugs and pharmaceuticals t	(1.81)	(-3.38)	(-4.06)	(-8)
Cosmetics toiletries soaps detergents	1.5618	-0.1783	-1.6918	-1.7902
Cosmetics toiletries soaps detergents t	(3.73)	(-2.28)	(-4.4)	(-8.18)
Organic chemicals	1.1326	0.0628	-0.6246	-1.5395
Organic chemicals t	(0.91)	(0.61)	(-1.72)	(-6.18)
Other chemicals	1.0235	0.0531	-1.0004	-1.183
Other chemicals t	(1.03)	(0.57)	(-3.46)	(-5.61)
Polymers	0.7198	-0.3417	-0.4819	1.3131
Polymers t	(0.88)	(-3.3)	(-0.77)	(0.65)
Plastic products	2.3147	0.5457	-1.0068	-0.1446
Plastic products t	(2.39)	(1.29)	(-2.3)	(-0.35)
Plastic tubes sheets etc	3.5363	0.2185	-2.2495	-0.7068
Plastic tubes sheets etc t	(2.65)	(1.09)	(-3.68)	(-4.16)
Plastic films	-0.1689	-0.0163	-0.5224	-1.0603
Plastic films t	(-0.13)	(-0.16)	(-0.91)	(-3.36)
Plastic packaging goods	0.7398	0.0048	-1.0287	-0.1931
Plastic packaging goods t	(1.13)	(0.05)	(-2.93)	(-0.39)
Petroleum products	1.3166	-0.2078	-1.9281	-1.9243
Petroleum products t	(1.36)	(-3.01)	(-4.07)	(-8.32)
Refinery	0.9136	-0.236	-1.9609	-1.9317
Refinery t	(0.73)	(-2.81)	(-3.91)	(-8.27)
Lubricants etc	5.6107	-0.1081	-0.7092	-1.0383

Lubricants etc t	(3.96)	(-0.85)	(-2)	(-4.24)
Tyres and tubes	0.0283	-0.1395	-1.5304	-0.6821
Tyres and tubes t	(0.03)	(-1.44)	(-3.4)	(-4.23)
Rubber and products	0.8185	0.2282	-1.4272	-0.7133
Rubber and products t	(0.51)	(1.1)	(-0.85)	(-2.12)
Non metallic minerals	2.3461	-0.0146	-1.0844	-1.5062
Non metallic minerals t	(4.57)	(-0.07)	(-3.96)	(-7.76)
Cement	2.4579	-0.3449	-1.2229	-1.0835
Cement t	(4.11)	(-4.03)	(-4)	(-8.65)
Glass and glassware	4.6051	-0.1219	-0.711	-1.715
Glass and glassware t	(2.11)	(-0.55)	(-0.94)	(-5.7)
Gems and jewellery	0.6748	0.0756	-0.7202	-0.9543
Gems and jewellery t	(0.86)	(0.67)	(-1.5)	(-5.77)
Refractories	0.1411	0.0334	-1.4896	-0.5758
Refractories t	(0.08)	(0.15)	(-2.45)	(-2.85)
Ceramic tiles	0.9557	0.047	-3.2691	-0.7137
Ceramic tiles t	(0.91)	(0.2)	(-4.12)	(-4.26)
Abrasives	0.6178	-0.0062	-2.1214	-0.8158
Abrasives t	(0.25)	(-0.04)	(-2.36)	(-4.36)
Granite	-0.4964	-0.1252	-0.9604	-0.8622
Granite t	(-0.58)	(-0.66)	(-1)	(-4.44)
Other non metallic mineral products	2.7825	-0.2225	-0.3105	-1.094
Other non metallic mineral products t	(1.61)	(-1.32)	(-0.64)	(-4.72)
Metals and metal products	3.8096	-0.4037	-2.6453	-2.3884
Metals and metal products t	(3.28)	(-3.22)	(-5)	(-10.18)
Ferrous metals	4.153	-0.4765	-3.0555	-2.3929
Ferrous metals t	(3.07)	(-3.07)	(-4.45)	(-9.89)
Pig iron	1.4545	-0.2346	-1.0898	-1.4638
Pig iron t	(0.89)	(-1.31)	(-1.57)	(-4.76)
Steel	4.6552	-0.546	-1.2115	-1.3731
Steel t	(2.7)	(-3)	(-2.36)	(-5.17)
Castings and forgings	3.4186	0.1183	-0.6267	-1.236
Castings and forgings t	(1.46)	(0.87)	(-0.53)	(-4.1)
Steel tubes and pipes	3.6577	0.0162	-4.3739	-1.5875
Steel tubes and pipes t	(2.08)	(0.1)	(-3.12)	(-5.41)
Sponge iron	2.6155	-0.1446	-4.5326	-1.0121
Sponge iron t	(2.56)	(-0.86)	(-3.41)	(-2.7)
Metal products	2.0216	-0.1269	-1.8583	-1.8341
Metal products t	(1.34)	(-1.44)	(-4.03)	(-6.25)
Non ferrous metals	0.6512	-0.3081	-1.511	-2.3306
Non ferrous metals t	(1.56)	(-3.11)	(-3.63)	(-3.92)
Aluminium and products	0.8359	-0.3008	-2.1721	-2.3107
Aluminium and products t	(1.81)	(-2.7)	(-3.31)	(-7.93)
Copper and products	1.6214	-0.4545	-1.0824	-2.5756
Copper and products t	(1.95)	(-2.2)	(-1.57)	(-6.51)
Other non ferrous metals	0.3961	0.316	-3.3385	-2.8568
Other non ferrous metals t	(0.18)	(1.15)	(-2.73)	(-3.06)
Machinery	1.8535	-0.2224	-2.138	-3.256
Machinery t	(2.49)	(-3.83)	(-5.3)	(-3.47)
Non electrical machinery	0.9163	-0.3284	-1.0755	-2.0107
Non electrical machinery t	(0.89)	(-4.67)	(-2.85)	(-10)

General purpose machinery	1.4396	-0.2069	-0.9702	-1.1248
General purpose machinery t	(1.33)	(-2.66)	(-3.1)	(-4.63)
Industrial machinery	-0.7455	-0.0346	-1.2111	-0.8252
Industrial machinery t	(-0.95)	(-0.37)	(-1.39)	(-4.37)
Prime movers	1.1295	-0.4343	-2.1673	-2.2085
Prime movers t	(0.8)	(-3.26)	(-3.21)	(-8.64)
Machine tools	1.1111	-0.0705	-0.5154	-0.957
Machine tools t	(1.28)	(-0.45)	(-1.16)	(-3.61)
Material handling equipments	0.7934	0.0492	-0.6618	-2.1235
Material handling equipments t	(0.41)	(0.28)	(-1.32)	(-6.19)
Tractors	3.8023	-0.3971	-1.1328	-1.4422
Tractors t	(2.18)	(-2.97)	(-2.72)	(-4.14)
Other industrial machinery	1.1974	-0.0198	0.1587	-1.5288
Other industrial machinery t	(0.95)	(-0.09)	(0.29)	(-4.2)
Electrical machinery	2.1318	-0.2033	-1.4032	-1.8221
Electrical machinery t	(2.58)	(-3.32)	(-1.43)	(-9.76)
Wires and cables	1.6806	-0.0235	-1.3366	-1.295
Wires and cables t	(1.51)	(-0.27)	(-3.89)	(-4.24)
Domestic electrical appliances	2.5075	0.217	-0.86	-1.193
Domestic electrical appliances t	(2.39)	(1.65)	(-1.93)	(-3.74)
Air conditioners refrigerators	2.0041	-0.1615	-1.1953	-0.2572
Air conditioners refrigerators t	(2.02)	(-1.62)	(-3.12)	(-0.62)
Generators transformers switchgears	2.129	-0.2778	-1.6069	-2.0313
Generators transformers switchgears t	(2.66)	(-3.25)	(-4.3)	(-9.11)
Dry cells and storage batteries	2.0785	-0.7583	-2.495	-0.8645
Dry cells and storage batteries t	(2.17)	(-3.06)	(-3.41)	(-2.84)
electrical machinery	1.9992	-0.1781	-2.0074	-0.6853
electrical machinery t	(1.11)	(-1.73)	(-2.87)	(-2.67)
Electronics	2.835	-0.0359	-1.843	-2.8043
Electronics t	(2.72)	(-0.35)	(-3.98)	(-3.45)
Consumer	-0.5097	0.0255	-2.4891	-2.3479
Consumer t	(-0.84)	(0.17)	(-5.29)	(-1.88)
Computer hardware	1.1844	-0.0841	-0.9842	-1.2811
Computer hardware t	(0.67)	(-0.6)	(-2.2)	(-3.59)
Communications equipment	5.4143	-0.0898	-3.4438	-0.9645
Communications equipment t	(1.99)	(-0.64)	(-1.85)	(-4.78)
Other	0.8069	0.0227	-1.2787	-0.9525
Other t	(1.29)	(0.21)	(-3.28)	(-5.83)
Transport equipment	4.2014	-0.2024	-1.7437	-1.7662
Transport equipment t	(3.55)	(-3.88)	(-5.73)	(-13.54)
Automobile	4.7722	-0.2029	-1.3016	-1.9523
Automobile t	(3.38)	(-3.28)	(-4.96)	(-12.72)
Commercial vehicles	6.0497	-0.2112	-1.7678	-2.2152
Commercial vehicles t	(3.14)	(-1.85)	(-3.56)	(-9.53)
Passenger cars and MUV	3.8249	-0.2454	-2.7747	-2.4233
Passenger cars and MUV t	(3)	(-2.01)	(-3.9)	(-10.78)
Two and three wheelers	3.6155	-0.2157	-0.9825	-0.995
Two and three wheelers t	(2.44)	(-2.69)	(-3.13)	(-8.41)
Other transport equipment	1.4031	0.1301	-1.9393	-1.3649
Other transport equipment t	(1.08)	(0.45)	(-1.81)	(-5.93)
Automobile ancillaries	0.5972	-0.2179	-1.6658	-1.2413

Automobile ancillaries t	(1.18)	(-3.34)	(-4.5)	(-6.48)
Miscellaneous	2.2777	-0.1115	-1.4276	-0.7307
Miscellaneous t	(3.06)	(-1.25)	(-3.9)	(-1.83)
Paper and paper products	3.3998	-0.1157	-0.5015	-1.4011
Paper and paper products t	(3.31)	(-0.87)	(-1.16)	(-3.81)
Paper	1.2769	-0.122	-0.6181	-1.0421
Paper t	(1.75)	(-0.87)	(-1.45)	(-4.79)
Paper products	4.3978	0.0267	0.2007	-0.6707
Paper products t	(1.51)	(0.13)	(0.23)	(-0.62)
Leather products	0.8416	-0.1266	-0.5716	-1.9183
Leather products t	(0.42)	(-1)	(-1.71)	(-5.37)
Footwear	1.3989	-0.8583	0.4342	-2.6076
Footwear t	(0.53)	(-1.48)	(0.49)	(-4.67)
Other leather products	-2.1083	0.5065	-2.3775	-1.4069
Other leather products t	(-1.08)	(2.12)	(-1.35)	(-2.42)
Books and cards	1.16	-0.3504	-1.1866	-0.5725
Books and cards t	(1.11)	(-1.92)	(-3.13)	(-3.18)
Wood	-0.2056	-0.0042	-0.419	-0.4968
Wood t	(-0.2)	(-0.02)	(-0.44)	(-2.63)
Media print	-0.0273	0.0889	-0.8184	-0.5747
Media print t	(-0.26)	(0.16)	(-1.31)	(-2.38)
manufacturing	1.284	-0.0589	-1.7742	-0.1827
manufacturing t	(1.04)	(-0.58)	(-3.97)	(-0.22)
Diversified	2.6843	-0.1013	-2.076	-1.98
Diversified t	(4.98)	(-0.72)	(-5.43)	(-9.01)
Mining	2.5261	-0.401	-0.4592	-2.4557
Mining t	(2.02)	(-2.18)	(-0.88)	(-5.67)
Coal and lignite	-1.6223	-0.5057	-1.2808	-1.1753
Coal and lignite t	(-0.82)	(-2.5)	(-2.19)	(-4.71)
Crude oil and natural gas	6.3887	-0.9061	-0.4383	-2.4056
Crude oil and natural gas t	(2.53)	(-2.74)	(-0.82)	(-10.25)
Minerals	2.0652	-0.2596	-1.5789	-1.1136
Minerals t	(1.5)	(-1.36)	(-3.47)	(-3.07)
Electricity	4.5418	-0.1062	-0.7007	-1.8329
Electricity t	(4.96)	(-0.74)	(-1.8)	(-8.86)
generation	4.3733	-0.1062	-0.7006	-1.8595
generation t	(4.44)	(-0.74)	(-1.8)	(-8.77)
distribution	3.3403			-0.2605
distribution t	(2.55)	(NA)	(NA)	(-1.83)
Services	-1.024	-0.1895	-1.9138	-1.1544
Services t	(-1.07)	(-3.03)	(-4.37)	(-2.35)
Hotels and tourism	0.6929	0.1421	-2.2327	-0.7798
Hotels and tourism t	(0.5)	(0.89)	(-3.96)	(-5.96)
Hotels and restaurants	0.4842	-0.1305	-1.1074	-0.814
Hotels and restaurants t	(0.34)	(-1.75)	(-4.02)	(-6.08)
Tourism	1.011	-0.0898	-2.955	-0.2213
Tourism t	(0.54)	(-0.27)	(-3.03)	(-0.99)
Recreational services	1.4379	-0.2962	-2.5353	-1.6774
Recreational services t	(0.56)	(-2.27)	(-3.97)	(-7.03)
Production distribution exhibition of films	6.6661	0.027	-3.6464	-1.4699
Production distribution exhibition of films t	(1.78)	(0.08)	(-2.02)	(-6.19)

Media broadcasting	6.1476	-1.0257	-4.2084	-1.6347
Media broadcasting t	(2.29)	(-3.95)	(-2.59)	(-5.69)
Media content		9e-04	-3.2868	-1.9804
Media content t	(NA)	(0)	(-2.43)	(-5.72)
animation content	-3.7749	-0.2558	-1.709	-0.8974
animation content t	(-1.45)	(-1.64)	(-2.96)	(-3.56)
other	-2.8851	0.2135	-4.3107	-1.2366
other t	(-0.84)	(1.46)	(-1.99)	(-3.13)
Health services	2.5558	-0.0737	-0.0944	-0.832
Health services t	(0.74)	(-0.43)	(-0.15)	(-4.64)
Trading	0.8984	0.0399	-1.5617	1.5342
Trading t	(1.49)	(0.43)	(-3.39)	(0.49)
Transport services	2.5887	-0.0493	-0.9394	-1.4271
Transport services t	(1.66)	(-0.28)	(-2.18)	(-7.49)
Road	4.4742	0.1373	-0.9603	-0.7984
Road t	(2.4)	(0.64)	(-0.6)	(-2.81)
Railway		-5e-04	0.0961	-0.3284
Railway t	(NA)	(-0.01)	(1.28)	(-1.03)
Air	-0.8464	0.0292	-2.2379	-1.5915
Air t	(-0.48)	(0.08)	(-1.68)	(-3.68)
Shipping	2.5588	-0.1649	-0.4732	-1.5737
Shipping t	(1.55)	(-0.83)	(-0.89)	(-6.5)
Transport support services	3.7215	-1.2759	-0.8423	-1.5607
Transport support services t	(0.97)	(-2.3)	(-1.3)	(-4.31)
Communication services	-1.1513	-0.3166	-1.0918	-2.6727
Communication services t	(-0.69)	(-2.18)	(-2.54)	(-12.89)
Telecommunication services	-1.141	-0.3128	-1.0956	-2.6842
Telecommunication services t	(-0.71)	(-2.12)	(-2.51)	(-12.81)
Courier services	-0.8566	-0.4183	-3.7425	-0.338
Courier services t	(-0.41)	(-1.09)	(-3.46)	(-1.58)
Information technology	-0.1896	-0.1008	-3.3958	-0.7556
Information technology t	(-0.11)	(-1.04)	(-2.6)	(-1.79)
Computer software	-0.1896	-0.1008	-3.3978	-0.7555
Computer software t	(-0.11)	(-1.04)	(-2.59)	(-1.79)
ITES			-0.9662	-0.6885
ITES t	(NA)	(NA)	(-2.49)	(-3.5)
Misc services	0.4601	0.0534	-1.1213	-0.7185
Misc services t	(0.39)	(0.33)	(-3.13)	(-3.49)
Storage and distribution	1.2149	0.0261	-1.191	-1.3075
Storage and distribution t	(0.95)	(0.23)	(-2.89)	(-5.76)
Business consultancy	-0.7959	-0.0395	1.6097	-1.3253
Business consultancy t	(-0.5)	(-0.19)	(1.1)	(-5.19)
Other misc services	-2.9625	0.0633	3.4193	-1.7673
Other misc services t	(-1)	(0.12)	(1.27)	(-3.54)
Construction	0.8585	0.0357	-1.9572	-2.3795
Construction t	(1.36)	(0.18)	(-2.66)	(-2.64)
Real estate	2.8932	-0.0986	-0.1095	-1.0452
Real estate t	(1.97)	(-0.6)	(-0.24)	(-2.07)
Housing construction	3.1581	-0.1157	0.2364	-1.4783
Housing construction t	(1.86)	(-0.68)	(0.31)	(-3.07)
Commercial complexes	-1.1965	0.0791	-0.4413	-1.2431

Commercial complexes t	(-0.73)	(0.35)	(-0.77)	(-3.32)
Industrial and infrastructural construction	0.8266	0.0429	-1.9357	-1.2142
Industrial and infrastructural construction t	(1.24)	(0.21)	(-3.17)	(-2.96)
Industrial	-0.3111	-0.2947	-1.7655	-4.8186
Industrial t	(-0.57)	(-1.58)	(-2.62)	(-1.73)
Infrastructure construction	4.571	-0.2298	-1.6894	-2.729
Infrastructure construction t	(1.47)	(-1.25)	(-2.67)	(-7.14)
Other construction and allied activities	2.3609	0.6506	-1.0926	-0.4905
Other construction and allied activities t	(2.36)	(1.4)	(-1.9)	(-1.78)
Financial services	2.7802	-0.3202	-3.8574	-1.1996
Financial services t	(2.54)	(-5.99)	(-2.64)	(-3.09)
Banking services	0.1526	-0.3335	-2.1943	-2.4855
Banking services t	(0.14)	(-4.19)	(-4.69)	(-11.37)
Financial institutions	3.5858	-0.3959	-1.8457	-3.2112
Financial institutions t	(2.75)	(-3.48)	(-2.93)	(-7.45)
nbfc	1.4034	-0.0257	-0.7271	-1.4793
nbfc t	(1.1)	(-0.38)	(-2.06)	(-7)
Housing finance	1.4282	-0.4233	-0.4561	-1.6494
Housing finance t	(1.58)	(-2.11)	(-1.01)	(-6.01)
Securities	2.3892	-0.3167	-0.532	-1.005
Securities t	(2.04)	(-2.76)	(-1.4)	(-1.67)
Securities and stock traders	2.3405	-0.3204	-0.3816	-0.9506
Securities and stock traders t	(1.52)	(-2.74)	(-0.94)	(-1.43)
Brokers	0.596	0.3234	-3.7427	-2.2132
Brokers t	(0.18)	(0.64)	(-2.73)	(-4.5)
Other financial services	6.8882	0.0887	0.2407	1.0589
Other financial services t	(4.24)	(0.73)	(0.15)	(0.38)

Table 7: Currency exposure of all industries

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