INVESTMENT UNDER MONETARY UNCERTAINTY: A PANEL DATA INVESTIGATION

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Investment Under Monetary Uncertainty: A Panel Data Investigation[*]

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Abstract
There is a presumption in the literature that price or exchange rate uncertainty, or uncertainty in the monetary conditions underlying them, will have a negative effect on investment. Some argue that this negative effect will be extended by imperfect competition. However, models of "irreversible" investment show that the situation is more complicated than that. In these models, investment expenditures are affected by the scrapping price available on world markets; and also by the opportunity cost of waiting rather than investing. The impact of uncertainty is therefore going to depend on the type of industry, and hence on the industrial structure of the economy concerned. In addition, it may depend on the persistence of any price "misalignments" away from competitive equilibrium.

In this paper, we put these theoretical predictions to the test. We estimate investment equations for 13 different industries using data for 9 OECD countries over the period 1970-2000. We find the impact of price uncertainty is negative or insignificant in all but one case. But the impact of (nominal) exchange rate uncertainty is negative in only 6 cases. It is positive in 4 cases, and insignificant in 3 others. In addition, there are conflicting effects from the real exchange rate. The net effect depends on whether the source of the uncertainty is in domestic markets or in foreign markets.

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I. Introduction

In Darby et al. (1999) and Darby et al. (2002) we estimated investment equations for the major G7 countries including exchange rate volatility and misalignment terms. We found that, on average and for most countries in the sample, exchange rate volatility has had a negative and significant impact on the level of investment. That confirmed the conventional wisdom on the negative relationship between investment and exchange rate volatility. A second result was that, for some countries, the investment decision is affected by the degree of misalignment of the exchange rate in a measure depending on the degree of underlying volatility.

This type of aggregate empirical analysis, however, fails to capture differences at the industry level, which the theoretical analysis developed in those two papers proved could be important. In the present paper, we extend the empirical analysis of Darby et al. (1999, 2002) to the microlevel, using a panel data approach in order to capture cross-industry differences. We are also able to incorporate the effects of price uncertainty explicitly for the first time; and to distinguish the effects when price uncertainties arise at home from the case when they arise in foreign markets.

The structure of the paper is the following: in section II we briefly recall the theoretical analysis and its results as derived in Darby et al. (1999, 2002). In section III, we describe the methodology adopted to conduct the empirical analysis. In section IV, we discuss the results of such analysis. Section V concludes.

II. Theory: the impact of price and exchange rate volatility on the level of investment.

The theoretical analysis conducted in Darby et al. (1999, 2002) showed that the way in which individual investment programmes react to uncertainty will depend on that investment's scrapping value and on the opportunity cost of waiting. Specifically, if the scrapping price is low, then rising price or exchange rate volatility will tend to increase investment because extra volatility will reduce the chances of being stuck with an (ex-post) unwanted investment. Price uncertainty therefore reduces the potential for "hold up" problems.

Similarly, if the opportunity cost of waiting were low and the scrapping price high, producers would prefer to wait rather than invest. It would therefore take comparatively large or frequent increases in prices (or the exchange rate) to persuade producers to invest. Increases in price volatility would therefore provide exactly that situation; with the result that increasing price variability will increase investment. But if the opportunity cost of waiting were high, and the scrapping price also high, producers would be inclined to invest rather than to wait. In this case, an increase in either the possibility or the frequency of higher prices would fail to make them want to invest more at the upper end of the price distribution. But, at the same time, it would increase the risk of a mistaken investment at the bottom end of the price

distribution. So, in this case, an increase in price volatility would lead to a fall in investment expenditures.

II.1. The theoretical model.

The theoretical framework for this study is provided by the Dixit and Pindyck option value model of irreversible investment (Dixit and Pindyck, 1994). According to this model, taking an investment decision is analogous to buying an option. The decision is based on an evaluation of the expected future stream of revenues the investment project is going to produce over its lifetime (assumed to be infinite). Given sunk entry/exit costs and running costs, the decision to invest is taken only if the value of the project is "high enough" in terms of a certain threshold. The alternative is to wait until the entry condition is verified. The problem is symmetric: a firm currently investing will decide to disinvest if the value of the investment project becomes "too low". Otherwise it will wait to disinvest.

Note that the firms's optimisation problem is a genuine stochastic problem. The future value of the investment project is indeed uncertain because of the uncertainty concerning the future value of the exchange rate and, consequently, the producer price (used to evaluate the investment project)[1]. We maintain the same assumption as in the Dixit and Pindyck model that the exchange rate (and therefore the prices received in domestic currency) follows a Brownian motion specified as $de=\alpha \cdot edt+\sigma \cdot edz$, where e denotes the exchange rate, α and σ are parameters and dz is a random process, normally distributed with zero mean and variance dt (t being the time index). Notice that if $\alpha=0$, $de/e=\sigma\, dz$, and so, integrating between time 0 and 1, $\log (e/e_0)= \sigma$, which makes σ a measure of the exchange rate volatility. On the other hand, $\alpha>0$ means that the exchange rate is expected to rise ($E(de)= \alpha \cdot e \cdot dt>0$) and, conversely, it is expected to fall if $\alpha<0$. This makes α a measure of the current (or perceived) misalignment in the exchange rate[2].

The major implication of introducing uncertainty in the firm investment problem is that uncertainty makes waiting costly. If today the firm decides to wait and does not invest, then it might well end up loosing some profits should, at a later stage, prices become more favourable. This cost of waiting has therefore to be considered as an additional structural parameter/variable in the firm optimisation problem. Following Dixit and Pindyck, we denote the cost of waiting as δ and include it in the model as the discount rate for future prices.

The solution to the firm's optimisation problem (maximising the present discounted value of expected future revenues) now provides upper and lower trigger values for prices which are functions of sunk and running costs, the parameters defining the monetary uncertainty α and σ, and of the cost of waiting δ.[3] We denote these thresholds P_H and P_L, and note that the latter also represents the firm *scrapping* price.[4] The range of prices in between P_L and P_H is a zone of inactivity in the sense that when prices fall within this interval and the firm is not investing then it will remain out of the market. But if it is already investing it will stay in the market as originally planned.

To analyse the impact of exchange rate uncertainty on the level of investment, it is sufficient to analyse how the size of the inactivity zone changes as α and σ change. In other words, the conventional wisdom that increasing uncertainty reduces investment can be translated into *"increasing α and σ increases the size of the inactivity zone"*. Consequently, to answer the question *"how do investment decisions respond to monetary uncertainty?"* becomes an exercise in comparative statics to be resolved by assessing the signs of $\frac{\partial(P_H - P_L)}{\partial\sigma}$ and $\frac{\partial(P_H - P_L)}{\partial\alpha}$. In Darby et al. (1999, 2002) we derived the conditions under which each of these partial derivatives are either positive or negative.[5] We found that firms react differently to the exchange rate/price uncertainty, in the sense that as volatility is reduced and/or the currency becomes more aligned to its medium/long run value, some firms will invest more --but others won't. It depends on their opportunity cost of waiting, as well as on their scrapping price. In addition, the impact of a reduction in misalignment on investment also depends on the underlying degree of exchange rate/price volatility.

A formal derivation of these results follows from the conditions for investment to increase or decrease with price/exchange rate uncertainty in the Dixit-Pindyck model. These conditions are set out in Appendix A to this paper.

II.2. The Importance of Different Industrial Characteristics.

Based on the theoretical analysis conducted in Darby et al. (1999, 2002), it is possible to identify three classes of industries:

- Group 1: industries with a low scrapping price. These industries are characterised by having investments with a low resale value. If they invest, they stand a high chance of getting stuck with an (ex-post) unwanted investment. Consequently, they are likely to respond to a fall in uncertainty by waiting.
- Group 2: industries with a high scrapping price and high opportunity cost of waiting. Contrary to the industries in the previous group, industries in this group stand a low chance of getting stuck with an ex-post unwanted investment. However, as waiting is very costly for them, they are likely to respond even to a rise in volatility by continuing to invest. Similarly, in an environment characterised by a highly volatile and misaligned currency, they will respond to any increase in misalignment by investing more. But, if the underlying volatility is low, they will react to an increase in misalignment by waiting.
- Group 3: industries with a high scrapping price and low opportunity cost of waiting. For these industries waiting is not costly; and retooling, in the sense of adjusting their infrastructures to the production of a different product, is not expensive. Consequently, they are likely to respond to an increase in volatility by waiting and, conversely, to any fall in volatility by investing. The same type of decision (ie waiting) will appear in response to an increase in misalignment, in a high volatility environment. But if the underlying volatility is low, then these firms are likely to respond to a rise in misalignment by investing more.

To reiterate therefore, Group 1 includes industries where investment has a low scrapping price--such as power plants, mines, utilities -- or industries that involve high tech manufactures with high development costs. Here, price uncertainty should have a positive effect on investment. Group 2 includes those industries with high scrapping prices and a high opportunity cost of waiting, such as financial services; also those with high margins and which are cyclically sensitive or depend on patents or technical innovation. In these cases too, price volatility would have a positive effect on investment. Group 3 consists of the remaining industries, with high scrapping prices and low waiting costs. This group would consist mainly of conventional manufactures involving medium skills and technology, or service industries where retooling is relatively easy and the cycle is unimportant.

Table 1 summarises the differences in reaction across industries.

III. Empirical Tests.

In this section, we investigate if the theoretical intuitions set out in the previous section are confirmed by the data.

To do this, we estimate investment equations for 13 different industries (listed in table 2), using 13 panels of data obtained from 9 OECD countries over the period 1970-2000. The results of our panel estimations are summarised in tables 3-6: covering the pooled estimates of the long run (equilibrium) relations for each industry (tables 3, 4a and 4b and 5); and the short term, country specific, deviations from those equilibrium relationships (table 6). These tables report the signs of the coefficients. They are designed to be compared with the theoretical results quoted above.[6]

III.1 The Data.

Our data relate to 9 countries, and to 13 industries in each country. The countries we consider are Austria, Canada, Finland, France, Germany, Italy, Sweden, UK and US. The industrial sectors, defined according to the International Standard Industrial Classification, are reported in Table 2 (together with the terminology adopted in the tables and charts) The industries are organised in the three groups identified in the previous section; and correspond to data at the 2 digit level of industrial activity.

Second, our data are measured at an annual frequency and cover the period 1970-2000. For each sector and each country, the dataset includes time series of investment (gross fixed capital formation), production and measures of producer price volatility and misalignment. The latter are used as industry-specific proxies for exchange rate volatility and misalignment. However, alternative models directly involving nominal and real exchange rate volatility and misalignment measures are also examined. Our main data source is the OECD STAN database and the OECD Indicators for Industry and Services. However, producer prices for the sectors MACH, MIN, NEC, NMET, TRANS and UTIL are taken from the Eurostat database. The source of the nominal

effective exchange rate series is Bank of England FST. The real effective exchange rate series were provided by the OECD.

In Darby et al. (1999), and Darby et al. (2002), two different measures of exchange rate volatility were used. They both involved rolling estimates of the standard deviation of the variable in consideration, either in level terms or in the form of deviations from a time varying equilibrium path. That is, volatility was defined as

$$V = \left[\frac{1}{m} \sum_{i=1}^{m} \left(\ln(Z_{t-i}) - \ln(Z_{t-i-1}) \right)^2 \right]^{\frac{1}{2}} \quad (1)$$

with Z denoting the real exchange rate either in levels (Darby et al., 1999) or as deviation from a trend extracted using a HP filter (Darby et al., 2002). In this paper, we use both definitions of volatility: the Z variable being in turn producer prices, or the nominal or real effective exchange rate (either in levels, in the case of the first definition, or as a deviation from the HP trend in the case of the second definition).[7]

We then use three measures of misalignment. The first one, denoted in what follows as *p_mis*, *eer_mis* and *reer_mis* for producer prices, nominal and real effective exchange rate respectively, is simply defined as the deviation of the producer price (exchange rate) from its trend. The second, denoted *p_msp*, *eer_msp* and *reer_msp* for producer prices and nominal and real exchange rate, is a sign preserving measure of misalignment, defined as the squared deviation of producer price (exchange rate) from trend, with a positive (negative) sign when the producer price (exchange rate) is above (below) trend. This measure is used to test for the presence of effects of asymmetry in size. A third measure, denoted p_mis_{+ve}, eer_mis_{+ve} and $reer\_mis_{+ve}$ for producer prices and the nominal and real exchange rates, is a dummy variable assuming the value of the misalignment in the case of positive misalignments and zero otherwise. It is used to test for the presence of sign asymmetries in the impact of misalignment on investment spending.

Finally, our data are divided into 13 panels, one for each industry. Each panel pools together data for a specific industrial sector across a set or subset of the countries considered[8].

III.2. The empirical methodology.

In the investment model set up at the previous section, two error processes are being modelled: one in the prices or exchange rates upon which the investment decisions are conditioned, and one in the investment decisions themselves. The theoretical model also makes clear that $\alpha > 0$, for example, implies that markets expect prices to rise, which means that P_H would rise too and hence (under the conditions discussed above and formally derived in Appendix A) that investment will fall if the upper tail of the price/exchange rate distribution does not increase in size. And the results derived in Darby et al (1999, 2002) show that that will not happen. Consequently, the price/exchange rate disturbances necessarily create a negative feedback loop in this model. In other words, our investment model implies mean reverting (error

correction) behaviour in the investment decisions. Thus, to tie the empirical work to our theoretical model, we have to incorporate an error correction mechanism in the former and test it for mean reversion. This is what was done in Darby et al. (1999, 2002) using aggregate data. It is further developed here, using disaggregated data, in order to test the industrial structure implications which lie at the heart of our theory. Those implications were reported in Section II.2.

The main constraint faced when estimating an investment model at the industry level is the lack of disaggregated data covering all the variables of potential interest. For this reason, the model we estimate in the following section has to be simpler than those estimated in previous studies of investment under uncertainty. In contrast to Darby et al. (1999, 2002) for example, our investment model includes only industrial production and the measures of volatility and misalignment described above.[9]

However, as in Darby et al. (1999, 2002), the estimation methodology is still essentially an error correction model approach. In a panel context, this is implemented in the form of a Pooled Mean Group Estimation (PMGE) procedure for heterogeneous panels, as introduced by Pesaran et al. (1999). The choice of this methodology is dictated by the size of our panels. With a maximum time dimension of T=31 and maximum cross section dimension of N=9, the panels are too small for the application of more sophisticated methodologies. In fact, more elaborate techniques are usually designed for panels having at least one "large" dimension[10]. Hsiao et al. (1998) have shown that if at least one of the dimensions is small, the mean group estimator (MG) [which consists of the mean of the estimates obtained estimating separate equations for each group] although consistent, is not a good estimator. The next best approach is the PMGE estimator, which remains consistent for $T \rightarrow \infty$ (Pesaran et al., 1999)[11].

The main benefit of the PMGE procedure is that, for a given panel, it constrains only the long run coefficients to be identical. Intercepts, short run coefficients and error variances can vary across groups. In fact, Pesaran et al. (1999) have shown that this weak homogeneity assumption is preferable to the strong homogeneity assumption required by alternative estimation procedures such as fixed effects, IV or GMM – if only because the latter methods may provide very misleading estimates if the underlying coefficients are indeed different across groups. In the context of investment models, similarity between the technologies in use in a given industry across countries could justify having specified identical long run relationships across countries. Moreover, there are no strong priors suggesting that the adjustment dynamics in the investment equation for a specific industry should also be identical across countries. Indeed, the impact of uncertainty could still be very different, even if of the same sign, for a variety of institutional or structural reasons.

A final benefit of the PMGE methodology is that it does not require stationarity of the regressors. As Pesaran et al. (1999) demonstrate, pool mean group estimators are consistent and asymptotically normal (as T, and therefore T/N, tends to infinity) in the case of either stationary or non-stationary regressors.[12] Panel unit root tests of the variables involved in the estimations which follow, both in levels and first difference (available from the authors on request[13]), suggest that these variables are either I(0) or I(1). In particular, volatility and misalignment measures of both prices and exchange rate appear to be stationary. From a time series analysis perspective, their role in the error correction term is therefore to provide information on the adjustment process to

the long run value of the investment to production ratio. In other words, their insertion in the error correction term could be considered redundant and they could well be relegated to the short run dynamics only. However, the real reason for including them in the error correction term is to capture the fact that, in the continuous time space in which we locate our analysis, prices and exchange rate volatility and misalignments all affect the individual firm's probability of no action.

III.3. The Estimating Equations

In this paper we compute PMGE estimators using the GAUSS program distributed by Pesaran and Shin. The starting point is the estimation of an ARDL(p,q) model in the form

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{it-j} + \sum_{j=0}^{q} \delta_{ij}' x_{it-j} + \mu_i + \varepsilon_{it} \qquad (2)$$

with x_{it} the vector of regressors for group i, μ_i the fixed effects, λ_{ij} scalars and δ_{ij} the vector of coefficients. By re-parameterising and stacking time series observations together, the model can be rewritten in the following error correction form

$$\Delta y_i = \varphi_i y_{i,-1} + X_{i,-1}\beta_i + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,-j} + \sum_{j=0}^{q-1} \Delta X_{i,-j} \delta_{ij}^{*} + \mu_i \iota + \varepsilon_i \qquad (3)$$

with $y_i=(y'_{i1}\ldots\ y'_{iT})'$ and $X_i=(X'_{i1}\ldots\ X'_{i1T})'$ are the stacked vector of dependent variables and the stacked matrix of regressors respectively; and where λ^{*} and δ^{*} are linear combinations of the parameters in (2) specified as follows

$$\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im} \qquad j = 1,2,...,p-1 \quad \text{and} \quad \delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im} \qquad j = 1,2,...,q-1 \qquad (4)$$

Assuming that there exists a long run relationship[14] between y_{it} and x_{it} with coefficients identical across groups, and assuming that disturbances ε_{it} are normally and independently distributed across countries, the parameters in eq. 3 are estimated using a Maximum Likelihood approach which involves maximising the log – likelihood function by means of the Newton-Raphson algorithm. Further details can be found in Pesaran et al. (1999).

Table 3 summarises our equilibrium specifications. For each industry, we estimate a suite of models and apply a general to specific approach to derive a parsimonious (but statistically significant) specification. Model (a) supposes the log of production (*ly*), producer price volatility (*p_vol*) and misalignment (*p_mis*) and exchange rate volatility (*eer_vol*) and misalignment (*eer_mis*) as the only determinants of (the log of) investment expenditures (*ly*). A term in positive misalignment (p_mis_{+ve} for prices and eer_mis_{+ve} for exchange rate) is also added to test for the presence of asymmetric responses of investment to prices or exchange rate misalignments. Model (b) then adds the sign preserving measure of misalignment (*p_msp* for prices, and *eer_msp* for the exchange rate).[15]

Models (c) and (d) are analogous to models (a) and (b), the difference being the use of real effective exchange rate volatility (*reer_vol*) and misalignment measures (denoted *reer_mis*, where $reer\_mis_{+ve}$ denotes as before the term in positive misalignment and *reer_msp* denotes the sign preserving measure of misalignment) in place of producer prices and nominal exchange rate volatility and misalignment.

For some panels, the estimation was conducted using data expressed as deviations from their respective cross-sectional means. This procedure allows us to eliminate or reduce the impact of common time-specific effects. In some cases, these effects appear indeed to be the predominant ones, overshadowing the effects of other variables. Therefore, they need to be netted out in order to be able to single out the impact of exchange rate/producer prices volatility and misalignment on the level of investment.

In each panel, we test for homogeneity of the long run coefficients and the error correction term using the Hausman test. Pesaran et al. (1999) argue that pooled mean group estimators are consistent and efficient only if homogeneity holds. Conversely, if the hypothesis of homogeneity is rejected, the PGME estimates are not efficient. In that case the mean group estimators would normally be preferred.

IV Results.

Tables 4a and 4b contain the general results from the long run pooled estimation (PMGE) procedure for each industry group in turn. These estimates correspond to the various equilibrium relationships summarised in table 3. Table 5 compares these results with the theoretical predictions outlined in section 2. Table 6 then sets out any country specific deviations in those coefficients in the short run – including any changes in sign – corresponding to the short term dynamic relationship given in equation (3). The numerical details which lie behind these qualitative results, including the coefficient values and their standard errors, are set out in Appendix B, tables B1 to B13.----[Editor: these may be dropped and replaced by a reference to our Bank of England Working paper if you prefer].

IV.1 The long run impact of price and exchange rate uncertainty.

Tables 4a and 4b show that the conventional wisdom – that the impact of price or exchange rate uncertainty on investment is likely to be negative in the long run – is *not* well supported in the data. As far as domestic price uncertainty is concerned, it has remarkably little impact on investment. Only 5 industries out of 13 actually show any significant effect: four of them negative and one positive. The majority (that is 8 out of 13 or 60%) shows no significant effect.

It is true that the negative impacts belong to the medium skills and technology category (Basic Metals, Mining/quarrying, and Non-Metal products) where retooling might be easy and the state of the economic cycle relatively unimportant. And the positive impact belongs to a technologically developed and high sunk costs industry (Chemical, Plastics and Fuels production and processing). To that extent, these results confirm our theoretical predictions exactly.

But the interesting finding is that the majority of industries show no systematic impact from price uncertainty; and, for those that do, the impact is relatively small and (mostly) less significant than the impacts of exchange rate uncertainty. There are two exceptions: the Mining sector and the Basic Metal sector. In the former, the impact of price volatility is larger than that of nominal exchange rate volatility. And the latter is the only industrial sector that shows a significant interaction between the price volatility and the exchange rate volatility. Furthermore, the two impacts are differently signed. Thus price uncertainties are clearly less important than exchange rate uncertainty, and it would be a mistake not to separate these two effects. In the past, few studies have done so.

Second, the exchange rate uncertainty results also confirm our theoretical intuition, irrespective of whether the exchange rate variability is in real, nominal or misalignment terms. Thus, Chemical Products and Fuels, Textiles and Footwear, Food Manufacturing, Transport and Paper/Printing/Publishing, all show evidence of a positive impact of exchange rate uncertainty on investment as we might expect from the theoretical analysis since these are high tech/ high skill industries; or those with substantial entry and development costs; or industries which are cyclically dependent.[16]

The interesting cases, however, are Chemicals, Food, Textiles and Transport which have a sign switch depending on whether the uncertainty is measured in real or nominal terms. Chemicals and Textiles are industries where uncertainty has a positive impact in the nominal case, but a negative impact for real exchange rates. But Food and Transport are industries which show the opposite result. In fact, it is possible to demonstrate[17] that such sign reversals can occur when the degree of price uncertainty in domestic and foreign prices is very different. In particular, having greater uncertainty in foreign prices will show the kind of sign reversal we see in the Chemical and Textile industries, while having greater uncertainty in domestic prices will produce the sign reversal we see in the Transport and Food results. In either case, the relative price uncertainty needs to exceed that in the nominal exchange rate. But that is exactly what we would expect: Chemicals and Textiles, being widely traded, will react more to “foreign” (i.e., rest of the world) price uncertainty -- but they are not large enough as industries to dominate the exchange rate in most OECD economies. Food and Transport, on the other hand, would respond more to domestic price uncertainty in most industrialised economies. For transport that is perhaps obvious. But for Food, it is important to bear in mind that processed foods are generally culture specific and not widely traded. This is in contrast to agricultural products (not analysed here), which include many primary commodities and which are widely traded internationally.[18]

IV.2 The long run impact of misalignment effects.

There are two aspects of the results to consider here: the fact that misalignments may affect (either reduce or encourage) investment expenditures; and that big misalignments may matter more (i.e., have a more than proportionate impact) than small misalignments. These two effects are captured by the terms "*-mis*" and "*-msp*" in each regression. From the results in tables 4a and 4b we can see that:

a) Misalignments do matter; departures from trend by exchange rates or prices affect investment in excess of any of the effects which volatility or other explanatory variables would cause on their own. Investment is either reduced or encouraged by such price or exchange rate misalignments in 10 out of 13 industries.
b) Price misalignments on their own do not matter; they show up only in the Food industry. Real exchange rate misalignments however affect investment in 10 industries, and are the only kind of misalignments that matter in 4 of them (Textiles, Transport, Utilities and Wood). And nominal exchange rate misalignments matter in another 6 cases. That leaves only 3 industries (Machinery, Mining and Manufacturing non-electronic components) which are unaffected by misalignments altogether. Thus, if misalignments matter, it is through exchange rates and competitiveness effects – not domestic pricing.
c) Departures from trend in the sense of a currency overvaluation (nominal exchange rate above trend, and hence *e* below it) enhance investment in only three cases (Chemicals, Financial and Non Metal products), and reduce it in 2 cases (Food and Paper). Conversely, an undervaluation increases investment in 2 cases and reduces it in 3. There are therefore 3 industries unaffected by real or nominal misalignments in exchange rates. And, in as far as we can allocate industries to the groups defined in section II.2, these results support the theoretical predictions for Chemicals or Financial products; but not those in the Food and Paper industries
d) More interesting perhaps, the non proportionality tests ("*-msp*") suggest large misalignments matter a lot in 4 industries – those with a plus sign in the "*_msp*" columns – but small misalignments are more important in 5 cases (those with a minus sign). Hence, the impact of uncertainty and misalignments is non linear in most cases. As a result, we have included an explicit asymmetry test: the "$\_mis_{+ve}$" variables in tables 4a and 4b. For 9 sectors out of 13 the impact coefficient of a plus misalignment (an overvaluation) appears to be quantitatively different from that of a minus misalignment (an undervaluation). Positive misalignments therefore appear to increase investment in the OECD's less widely traded products (Textiles, Food, Transport, Paper and Basic Metals); but to decrease it in the more widely traded goods (Chemicals, Financial Services, Non metal Products and Wood Products).

Given the results reported in section 2, these outcomes support or theoretical predictions pretty well for the traded goods which might belong to group 1 industries (e.g. Chemicals), or group 2 industries with volatile prices (eg, Financial services), or group 3 industries with stable prices (Non Metal and Wood products). Similarly, for the less traded goods in group 2 if prices tend to be stable (Food, Transport), or those in group 3 with unstable prices (Basic Metals). We have summarised the extent to

which our empirical results have confirmed our theoretical predictions in table 5. For volatility, the theory is confirmed in 12 out of 13 cases. For misalignments, confirmation comes in 9 out of 13 industries.

IV.3 Country Specific and Short Term Departures from the Equilibrium Relationships.

Table 6 summarises the various short term, country specific departures from the estimated equilibrium relationships in table 3, which we have used so far. These dynamic relationships take an error correction form, with an autoregressive distributed lag specification with up to 3 lags: see equation (3). The length of the lags were determined separately for each country in each industry by one of the information criteria available (Schwartz, Akaike or Hannan-Quinn Selection Criterion); and only the significant coefficients are retained in the final estimated relationship. The detailed numerical results which lie behind Table 6 are reported in full in Appendix B.

In the short term, a number of countries show deviations from the sign pattern established in tables 4a and 4b. There is a little more evidence of price uncertainty having some short term influence on investment – but positive this time in Finland and Sweden in the mining sector; and positive for France and the UK, but negative for Sweden, in non-metal manufactures. But only the French and British results are strong enough to produce a sign reversal for the impact of long run uncertainty on investment.

There are a larger number of short term deviations in the impact of nominal exchange rate uncertainty, although only in the case of the Food industry does that involve a majority of countries. Furthermore, only 17 out of the 117 possible country specific coefficients display a sign reversal in the short term impact of nominal exchange rate uncertainty. The industries most affected are Basic Metals/Machinery, Chemicals and Textiles, where the positive impact of exchange rate uncertainty would be overturned in one case each; and Food, Machinery, Non Metal manufactures and Paper, where the negative impact would be reversed in one case each.

In terms of real exchange rates, there are even fewer short term departures from the general sign pattern: 14 out of a total of 117 possible country specific coefficients. Taking all these results together, plus the fact that there seem to be no significant departures from the pattern of misalignment effects in tables 4a and 4b, our results appear to be remarkably robust across countries and across time periods.

Two further results are of interest in this context. First, one might suppose that a higher degree of openness would imply that industries try to diversify their input services and export markets. That would reduce the impact of volatility. However introducing an openness variable into our regressions yielded insignificant results in each case. So that turns out not to be an issue in practice.

Second, one might suppose that the nature of the shocks might affect the impact which volatility has on investment. But since the Dixit-Pindyck model just indicates

two trigger prices for any type of shock, it would not matter in this framework what kind of shock disturbed the output price. However, there is the possibility that industry specific vs economy wide shocks would make a difference. This has yet to be investigated because it depends on finding a satisfactory way of decomposing aggregate shocks into their (exclusive) industry and economy-wide components. That is a subject for further research.

V Conclusions

The results of the cross-industry empirical investigation conducted in this paper have provided six new conclusions about the impact of uncertainty on investment behaviour:

1) There can be no general presumption that increasing price or exchange rate uncertainties would reduce investment. For some industries the effect will be negative; but for others it will be positive. The overall effect, in a specific economy, will therefore depend on the exact industrial structure of that economy.
2) In the 13 industries studied here, price uncertainty played little role independently of exchange rate effects. That said, price uncertainty depressed investment in 4 cases and enhanced it in 1 case, leaving 8 industries unaffected. By contrast, nominal exchange rate uncertainty depressed investment in 7 cases, but enhanced it in 4. And real exchange rate uncertainty depressed it in 5 industries, but increased it in 5. So, while the negative impacts are in the majority, they are only in a small majority and several industries show a positive impact.
3) The sign pattern of these uncertainty effects supports our theoretical predictions rather well. Those industries with obviously low scrapping costs, or high development and entry costs, show a positive impact of price or exchange rate uncertainty on investment - as do those with higher scrapping costs, but a high opportunity cost of waiting. But those with lower waiting costs show a negative effect, as predicted.
4) Real and nominal exchange rate uncertainty can produce contrary effects, or the same effects, on investment depending on whether the underlying price uncertainties are at home or abroad.
5) Price or exchange rate misalignments are also important. But price misalignments alone are seldom significant. So it seems likely that the issue of imperfect competition, which has been so important in the literature, is in fact quantitatively unimportant in practice. Exchange rate misalignments, on the other hand, appear to be important in most cases; and to imply that undervaluations will encourage domestic investment. That is consistent with the theory for markets where group 1 industries, or group 2 with stable prices, predominate. But the effects are likely to be both asymmetric (undervaluations have more impact than overvaluations), and disproportionate (large misalignments are more important than small misalignments)
6) And finally, we have introduced an important a caveat to aggregate studies that conclude that greater exchange rate stability will, in itself, lead to increased investment expenditures (for instance Byrne and Davis (2003)). This

is a consequence of the disaggregated, industry level approach that we use here. There are several reasons for this conclusion. First exchange rates are seldom fixed against the rest of the world as a whole. This is an important qualification to the assumption that the nominal *effective* exchange rate will be less volatile than before. Second, even if the effective exchange rate is stabilised, some industries will see rising investment – but others falling investments, depending on their respective scrapping value and opportunity cost of waiting. So the net effect could go either way. Third, there are possible misalignments to take into account, as firms base their investment decisions not only on the underlying degree of volatility in the economy but also the current position of the exchange rate with respect to its long run value. And fourth, the sign of the nominal exchange rate uncertainty effect can easily get reversed by uncertainty in real exchange rates or in the degree of competitiveness. That effect therefore depends on whether the uncertainty is caused by events at home or events abroad.

Lastly, we have maintained the conventional assumption of the Dixit-Pindyck model, that the firm is a price taker in the product and foreign exchange markets, throughout this paper. There are no pricing decisions therefore. An interesting extension of this work would be to examine the impact of uncertainty on investment if the firm can decide between local and domestic currency pricing. Endogenous pricing decisions in the style of those recently analysed in Bacchetta and van Wincoop (2001) would be the natural next stage of this research.

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Tables

Table 1: Different industries have different investment reactions.

Industry type	Example	Reaction to a fall in volatility	Reaction to a fall in misalignment
Group 1: low scrapping price	Power plants/ utilities	Fall in investment (+ve)	Fall in invest. (+ve)
Group 2: high scrapping price /high opportunity cost of waiting	Financial services/cyclically sensitive industries	Fall in investment (+ve)	With high vol.: fall in invest.(+ve) With low vol.: rise in invest.(-ve)
Group 3: high scrapping price/low opportunity cost of waiting	Medium or low skills manufactures	Rise in investment (-ve)	With high vol.: rise in invest. (-ve) With low vol.: fall in invest.(+ve)

Table 2: Industrial sectors

Group 1	CHEM	Chemical, rubber, plastics and fuel products
	UTIL	Electricity, gas and water supply
Group 2	TEXT	Textiles, textile products, leather and footwear
	TRANS	Transport equipment
	PAP	Pulp, paper, paper products, printing and publishing
	FIN	Finance, insurance, real estate and business services
Group 3	BM	Basic metals, metal products, machinery and equipment
	FOOD	Food products, beverages and tobacco
	MACH	Machinery and equipment
	MIN	Mining and quarrying
	NEC	Manufacturing NEC (non electronic components)
	NMET	Other non-metallic mineral products
	WOOD	Wood and products of wood and cork

Table 3: The Long Run (Equilibrium) Relationships

Specification	*Model type*
Price and Nominal e/r volatility	
$linv=\alpha_0 ly+ \alpha_1 p\_vol + \alpha_2 p\_mis (+ \alpha_3 p\_mis_{+ve})$ $+\beta_1 eer\_vol + \beta_2 eer\_mis (+\beta_3 eer\_mis_{+ve})$	(a)
$linv=\alpha_0 ly+ \alpha_1 p\_vol+ \alpha_2 p\_mis+\alpha_4 p\_msp$ $+\beta_1 eer\_vol + \beta_2 eer\_mis+\beta_4 eer\_msp$	(b)
Real e/r volatility	
$linv=\gamma_0 ly+ \gamma_1 reer\_vol+ \gamma_2 reer\_mis (+ \gamma_4 reer\_mis_{+ve})$	(c)
$linv=\gamma_0 ly+ \gamma_1 reer\_vol+\gamma_2 reer\_mis+\gamma_4 reer\_msp$	(d)

Table 4a: Pooled Results – nominal exchange rates and producer prices

Industry	*eer_vol*	*p_vol*	*eer_mis*	*p_mis*	*eer_msp*	*p_msp*	eer_mis_{+ve}	p_mis_{+ve}
CHEM	+	+	+	none	-	none	none	none
UTILITIES	none	none	none	none	none	none	none	none
TEXT	+	none	none	none	none	none	none	none
TRANS	-	none	none	none	none	none	none	none
PAP	+	none	-	none	none	none	none	none
FIN	-	none	+	none	none	none	-	none
BM	+	-	+ / -	none	+	none	+	none
FOOD	-	-	-	-	+	+	+	+
MACH	-	none	none	none	none	none	none	none
MIN	-	-	none	none	-	none	none	none
NEC	-	none	none	none	+	none	none	none
NON-MET	-	-	+	none	-	none	none	none
WOOD	none	none	none	none	none	none	none	none

Table 4b: Pooled Results – real exchange rates

Industry	*reer_vol*	*reer_mis*	*reer_msp*	*reer_mis$_{+ve}$*
CHEM	+/-	+	-	-
UTILITIES	-	-	none	none
TEXT	-	+	-	+
TRANS	+	-	none	+
PAP	+	+	+	+
FIN	-	+	none	-
BM	+	-	+	none
FOOD	+	-	+	none
MACH	none	none	none	none
MIN	none	none	none	none
NEC	none	none	none	none
NON-MET	-	+	none	-
WOOD	-	+	-	-

Table 5: How the empirical results compare with the theoretical predictions.

Industry type	**Example**	**Reaction to a fall in volatility**	**Reaction to a fall in misalignment**
Group 1: low scrapping price	Power plants/ mines/utilities	Fall in invest.(+ve) CHEM*[+] ,UTIL[+]	Fall in invest. (+ve) CHEM[§+]
Group 2: high scrapping price /high opportunity cost of waiting	Financial services/cyclically sensitive industries	Fall in invest.(+ve) TEXT[§],PAP[§+], TRANS[+]	With high vol.: fall in invest.(+ve) FIN[§+],TEXT[+],PAP[+] With low vol.: rise in invest.(-ve) PAP[§],TRANSP[+]
Group 3: high scrapping price/low opportunity cost of waiting	Medium or low skills manufactures	Rise in invest.(-ve) BM*, FOOD*[§], MIN*[§], NON-MET*[§+],MACH[§], NEC[§],WOOD[+]	With high vol.: rise in invest. (-ve) BM[§+], FOOD*[§+] With low vol.: fall in invest.(+ve) NON-MET[§+], WOOD[+]

* Producer price; [§] Nominal exchange rate; [+] Real exchange rate

Table 6: Short Run Country Specific coefficients on volatility[a]

Industry	*eer_vol*	*p_vol*	*reer_vol*
CHEM	-UK;US -Sweden [19]	-France;US	+UK -Italy
UTIL	none	none	+Sweden
TEXT	-France;US;Italy	none	+Sweden [20]
TRANS	+France	none	-France;Finland;Sweden
PAP	-Italy	none	-France;US;Italy;Sweden
FIN	-Canada +France	none	none
BM	+UK -Finland/Sweden	none	-France;Austria;Sweden
FOOD	+Austria;Canada;Sweden -Italy ;Finland	none	-Italy
MACH	+UK	none	none
MIN	+Italy	+Finland; -Sweden	none
NEC	none	none	none
NON-MET	+Finland	+France;UK -Sweden	none
WOOD	none	none	+Finland;Italy

[a] The reported signs are those of the coefficients on the first difference of nominal exchange rate, price and real exchange rate volatility. They represent the short run impact multipliers, country by country, of an increase in price or exchange rate volatility on investment expenditures in each industry.

Appendix A.

The Dixit-Pindyck Investment Model.

Consider a firm evaluating an investment decision, which, if taken, will involve producing a certain amount of output forever. There is a sunk cost to the investment that the firm must pay once it decides to invest. The firm's inverse demand function may be written as

$$P = eD(Q) \tag{A.1}$$

where e is the exchange rate; and $D(Q)$ is the firm's revenue in units of a numeraire or foreign currency. Hence P is the output price received, measured in domestic currency units; while $P_f=P/e$ is the foreign currency price, or the price in a competing sector. The firm is a price taker in both the product and the currency markets.

For convenience we take P_f to be normalised at unity. That means e represents the price of domestic currency per unit of "foreign" currency; and that P and e are interchangeable as far as analysing the impacts of uncertainty are concerned while $D(Q)$ remains fixed. Now suppose domestic prices follow a Brownian motion

$$dP = \alpha P dt + \sigma P dz \tag{A.2}$$

where dz is normally distributed with zero mean and variance dt. That reduces the problem to one in price uncertainty, whether that uncertainty arises in the domestic market or through the foreign markets. The key parameters are: α, a measure of the predictable movements in prices away from their current values; and σ, a measure of their potential volatility.

Notice that the term in α implies some persistence in prices, but in the following sense. Because (A.2) ensures stochastic separability between time periods, first period certainty equivalence will apply to each output and each investment decision. That means the current state of a project's profitability will be known, but its future state and its future rate of return remain uncertain. Multiperiod certainty equivalence will be able to take care of that in due course. But, in the current period, $\alpha>0$ means that firms think that prices are more likely to go down than up in the next period (and vice versa if $\alpha<0$; Pindyck, 1988). That would be a market definition of a misalignment in prices: an overvaluation if $\alpha<0$, because prices are either falling or are expected to fall. Hence prices must be above trend. Conversely, we will have an undervaluation if $\alpha<0$. Only if we have no information on which way prices are more likely to move next, would we expect to have $\alpha=0$.

With exchange rates however, we get the opposite interpretation. Given that e is defined as the price of domestic currency per unit of foreign currency, $\alpha<0$ in the equivalent relationship for e would imply a predicted fall in e - and hence an appreciation. Hence $\alpha<0$ implies an undervaluation of the exchange rate, and $\alpha>0$ an overvaluation from the domestic stand point with e itself having been below trend.
The Dixit-Pindyck analysis now proceeds by maximising the expected discounted value of the project per unit of output

$$V(P)=P/\delta \qquad \text{where} \qquad \delta=\mu-\alpha$$

with μ the firm's discount rate, and δ the opportunity cost of waiting. The firm will only invest if the present value of the expected revenues is higher (by an amount equal to the value of waiting) than the sunk cost of entry *I*. And it will only disinvest if expected revenues fall below the exit cost, *E*. In other words, two threshold prices P_H and P_L have to be computed such that the decision becomes "invest if the price *P* rises above P_H, but abandon if *P* falls below P_L ". Between P_H and P_L, the investor should wait.

Model Solution.

Let $V_0(P)$ be the value of the option of waiting to invest, and $V_1(P)$the value of the active firm - i.e. the sum of the profits expected from being active plus the value of the option to abandon. The threshold values, P_H and P_L, can now be determined using the value matching and smooth pasting conditions:

$$V_0(P_H)=V_1(P_H)-I \quad V_0'(P_H)=V_1'(P_H) \tag{A.3}$$

$$V_1(P_L)=V_0(P_L)-E \quad V_1'(P_L)=V_0'(P_L) \tag{A.4}$$

Dixit and Pindyck show the solution to (A.3) and (A.4) can be obtained from

$$\left.\begin{aligned} -A_1P_H^{\beta_1}+B_2P_H^{\beta_2}+P_H/\delta-C/r&=I\\ -\beta_1A_1P_H^{\beta_1-1}+\beta_2B_2P_H^{\beta_2-1}+1/\delta&=0\\ -A_1P_L^{\beta_1}+B_2P_L^{\beta_2}+P_L/\delta-C/r&=\text{-}E\\ -\beta_1A_1P_L^{\beta_1-1}+\beta_2B_2P_L^{\beta_2-1}+1/\delta&=0 \end{aligned}\right\} \tag{A.5}$$

where i) $0<P_L<P_H$; ii) A_1 and B_2 are nonnegative variables; and iii) where

$$\beta_1=\frac{1}{2}-(\rho-\delta)/\sigma^2+\sqrt{\left[(\rho-\delta)/\sigma^2-\frac{1}{2}\right]^2+2\rho/\sigma^2}>1$$

$$\beta_2=\frac{1}{2}-(\rho-\delta)/\sigma^2-\sqrt{\left[(\rho-\delta)/\sigma^2-\frac{1}{2}\right]^2+2\rho/\sigma^2}<0 \tag{A.6}$$

In this we assume α and σ are known, but not necessarily constant, at each *t*; and that ρ is the private sector's discount rate: $\mu=r+\phi\rho\sigma$.

If increasing volatility or systematic misalignments were to reduce investment, we should expect to find that

$$\frac{\partial(P_H - P_L)}{\partial\sigma} > 0 \quad \text{and} \quad \frac{\partial(P_H - P_L)}{\partial\alpha} > 0 \tag{A.7}$$

These inequalities imply that the zone of inactivity, i.e. the range of prices over which there is no new investment, will widen with increasing values of α and σ. In practice, however, we have to check that the frequency with which the upper trigger price is exceeded does not also increase at the same time. If it did, a widening of the band in which no investment is undertaken might not lead to less investment overall. To do that we have to check that $\partial G(P_H)/\partial\sigma \leq 0$ holds, where G(.)=1-F(.) and F(.) is the probability distribution function of prices or the exchange rate. This condition is demonstrated in Darby et al. (1999). Similarly, the condition for the frequency with which P_H is exceeded, when the degree of misalignment increases, is not increased is $d\alpha \leq d\ log(P_H)$, ie that the proportional increase in any undervaluation must be no greater than the increase in P_H itself (Darby et al, 2002). These restrictions need to be incorporated to ensure that a widening of the zone of inactivity necessarily implies lower investment spending.

Conditions Under Which Increasing Price/Exchange Rate Volatility Reduces Investment Expenditures.

We can evaluate the partial derivatives for P_H - P_L with respect to σ using (A.5) to define the model's solution, plus the inequality constraints $P_H > P_L \geq 0$ and $(A_1, B_2) > 0$ from Dixit (1989). After some algebra we have

$$\frac{\partial P_H}{\partial\sigma} = \left[A_1 \frac{\partial\beta_1}{\partial\sigma} P_H^{\beta_1 - 1}(1 + \beta_1 log(P_H)) - B_2 \frac{\partial\beta_2}{\partial\sigma} P_H^{\beta_2 - 1}(1 + \beta_2 log(P_H)) \right.$$
$$\left. + \beta_1 P_H^{\beta_1 - 1} \frac{\partial A_1}{\partial\sigma} - \beta_2 P_H^{\beta_2 - 1} \frac{\partial B_2}{\partial\sigma} + \varphi\rho/\delta^2 \right] / C_1 \tag{A.8}$$

and

$$\frac{\partial P_L}{\partial\sigma} = \left[A_1 \frac{\partial\beta_1}{\partial\sigma} P_L^{\beta_1 - 1}(1 + \beta_1 log(P_L)) - B_2 \frac{\partial\beta_2}{\partial\sigma} P_L^{\beta_2 - 1}(1 + \beta_2 log(P_L)) \right.$$
$$\left. + \beta_1 P_L^{\beta_1 - 1} \frac{\partial A_1}{\partial\sigma} - \beta_2 P_L^{\beta_2 - 1} \frac{\partial B_2}{\partial\sigma} + \varphi\rho/\delta^2 \right] / C_2 \tag{A.9}$$

where

$$C_1 = -A_1\beta_1(\beta_1 - 1)P_H^{\beta_1 - 2} + B_2\beta_2(\beta_2 - 1)P_H^{\beta_2 - 2}$$

$$C_2 = -A_1\beta_1(\beta_1 - 1)P_L^{\beta_1 - 2} + B_2\beta_2(\beta_2 - 1)P_L^{\beta_2 - 2}$$

We can also deduce that $\partial\beta_1/\partial\sigma < 0$ and $\partial\beta_2/\partial\sigma > 0$ directly from (A.6). In addiction, $\partial A_1/\partial\sigma > 0$ and $\partial B_2/\partial\sigma > 0$ follows directly from (A.5) for smaller values of ϕ. The signs of $\partial P_H/\partial\sigma$ and $\partial P_L/\partial\sigma$ remain uncertain. However, we can determine sufficient conditions to guarantee $\partial(P_H - P_L)/\partial\sigma > 0$. They are:

$$P_H, P_L \geq e^{-1/\beta_2} > e^{-1/\beta_1} \tag{A.10}$$

to make $1+\beta_1 \log P_H>0$, $1+\beta_1 \log P_L<0$ and
$1+\beta_2 \log P_H<0$, $1+\beta_2 \log P_L<0$,

$$P_H, P_L > \left[\frac{B_2\beta_2(\beta_2-1)}{A_1\beta_1(\beta_1-1)}\right]^{1/(\beta_1-\beta_2)}, \tag{A.11}$$

to make C_1 and $C_2<0$.

$$B_2\beta_2(\beta_2-1) > A_1\beta_1(\beta_1-1), \tag{A.12}$$

$$P_H^x(1+\beta_2 \log P_H) - P_L^x(1+\beta_2 \log P_L) < P_H(1+\beta_1 \log P_H) - P_L(1+\beta_1 \log P_L), \tag{A.13}$$

where $\rho\leq\delta$ and $x=\beta_2-\beta_1+1\leq 0$. These are the simplest, but not necessarily the only conditions showing when price/exchange rate volatility is sure to depress investment. They can further be reduced to the condition that (A.10) shall hold. That is to say: if (A.10) holds, then (A.13) holds; as do (A.11) and (A.12) also provided $\rho\leq\delta$ and $P_L\geq 1$.

Sufficient conditions: Thus our sufficient condition boil down to $P_L > e^{-1/\beta_2}$: i.e.

$$\frac{1}{\sigma^2}\left[\frac{\rho(\log P_L+1)-\delta}{\log P_L}\right] > \frac{\log P_L+1}{2(\log P_L)^2}. \tag{A.14}$$

That leaves three cases to consider. Investment will fall with price or exchange rate uncertainty (but rise otherwise) if:

(i) $\log P_L>0$ and $\rho(\log P_L+1)>\delta$, which implies we need

$$\sigma^2 < 2\log P_L\left(\rho - \frac{\delta}{1+\log P_L}\right). \tag{A.15}$$

(ii) $\log P_L>0$ and $\rho(\log P_L+1)<\delta$, which will require (A.15) with the inequality reversed.

(iii) $\log P_L<0$, in which case those sufficient conditions will always be broken.

Necessary conditions: Following the same arguments, the corresponding necessary conditions for investment to fall as exchange rate volatility/uncertainty rises is

$$\frac{\sigma^2}{\rho-\delta} > 2logP_L \tag{A.16}$$

which is very similar to (A.15) but for the term in δ. Conversely, if $\rho > \delta$, the sufficient conditions will always be violated in cases (i) and (ii) and (A.16) shows investment will certainly rise with volatility if σ^2 is small or the scrapping price high.

Conditions Under Which A Misalignment Will Reduce Investment Expenditures.
The effects of a misalignment can likewise be computed from:

$$\frac{\partial P_H}{\partial \alpha} = \left[A_1 \frac{\partial \beta_1}{\partial \alpha} P_H^{\beta_1 - 1}(1 + \beta_1 logP_H) - B_2 \frac{\partial \beta_2}{\partial \alpha} P_H^{\beta_2 - 1}(1 + \beta_2 logP_H) \right.$$
$$\left. + \beta_1 P_H^{\beta_1 - 1} \frac{\partial A_1}{\partial \alpha} - \beta_2 P_H^{\beta_2 - 1} \frac{\partial B_2}{\partial \alpha} - 1/\delta^2 \right] / C_1 \tag{A.17}$$

and

$$\frac{\partial P_L}{\partial \alpha} = \left[A_1 \frac{\partial \beta_1}{\partial \alpha} P_L^{\beta_1 - 1}(1 + \beta_1 logP_L) - B_2 \frac{\partial \beta_2}{\partial \alpha} P_L^{\beta_2 - 1}(1 + \beta_2 logP_L) \right.$$
$$\left. + \beta_1 P_L^{\beta_1 - 1} \frac{\partial A_1}{\partial \alpha} - \beta_2 P_L^{\beta_2 - 1} \frac{\partial B_2}{\partial \alpha} - 1/\delta^2 \right] / C_2 \tag{A.18}$$

where C_1 and C_2 have been defined above; and where $\partial\beta_1 / \partial\alpha < 0$ and $\partial\beta_2 / \partial\alpha < 0$, and $\partial A_1 / \partial\alpha > 0$ and $\partial B_2 / \partial\alpha > 0$ all follow from (A.5), (A.6) and $\rho \leq \delta$. One set of sufficient conditions such that $\partial(P_H - P_L) / \partial\alpha > 0$ is that C_1 and C_2 should be negative; that $1+\beta_1 \log P_H$, $1+\beta_1 \log P_L$ are positive; and that $1+\beta_2 log P_H$ and $1+\beta_2 log P_L$ are negative. Hence, the zone of inactivity widens when

$$P_H, P_L \geq e^{-1/\beta_2} > e^{-1/\beta_1} \tag{A.19}$$

$$P_H, P_L > \left[\frac{B_2 \beta_2 (\beta_2 - 1)}{A_1 \beta_1 (\beta_1 - 1)} \right]^{1/(\beta_1 - \beta_2)}, \tag{A.20}$$

Since (A.19) implies (A.20), investment will fall with increasing undervaluations $(\alpha > 0)$ if $P_L > e^{-1/\beta_2}$, i.e. if

$$\frac{1}{\sigma^2} \left[\frac{\rho(logP_L + 1) - \delta}{logP_L} \right] > \frac{logP_L + 1}{2(logP_L)^2}. \tag{A.21}$$

That means we again face three possible outcomes:
(i) $log\ P_L > 0$ and $\rho(log\ P_L + 1) > \delta$, which implies we need

$$\sigma^2 < 2\log P_L\left(\rho - \frac{\delta}{1+\log P_L}\right). \qquad \text{(A.22)}$$

(ii) $\log P_L > 0$ and $\rho(\log P_L + 1) < \delta$, investment will rise if the inequality in (A.22) holds- but fall if it is reversed.

(iii) $\log P_L < 0$, in which case investment will always rise since (A.22) is always violated ($\beta_2 < 0$).

These conditions depend on both the trigger prices and the level of price (or exchange rate) volatility.

Appendix B: Results of PMGE estimation.

Table B1(a)

Germany and Austria omitted (data have been de-meaned)

Industry type: Chem (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.083 (6.884)				2.87 (0.09)		
p_vol	0.399 (6.134)				3.49 (0.06)		
Error correction coefficient	-0.340 (-6.972)						
Joint Hausman test (p value):	10.30 (0.01)						
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (2,2,2)	**Canada** ARDL (2,0,0)	**UK** ARDL (2,2,0)	**US** ARDL (2,1,2)	**Finland** ARDL (2,0,0)	**Italy** ARDL (1,2,0)	**Sweden** ARDL (1,2,0)
Error correction	-0.4847 (-7.1470)	-0.2844 (-2.5054)	-0.4772 (-5.2519)	-0.1417 (-1.6589)	-0.4337 (-3.5499)	-0.2481 (-2.9714)	-0.3131 (-1.6889)
dlinv(-1)	0.5347 (4.8067)	0.3839 (1.9094)	0.4426 (3.7378)	0.6379 (3.4407)	-0.3614 (-2.3462)		
dly			-0.7080 (-4.6076)	0.9164 (2.4461)			0.8040 (2.0120)
dly(-1)	-0.5475 (-4.2299)						
dp_vol	-0.1553 (-5.3780)			-0.1540 (-4.0006)			
dp_vol(-1)	-0.1026 (-4.6245)						
Intercept	0.2150 (1.9714)					0.0544 (2.9807)	
Diagnostic statistics							
	France	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.044	0.202	0.067	0.080	0.177	0.076	0.150
SC	0.28	0.44	0.18	0.26	0.11	4.05	0.83
FF	0.74	3.15	0.09	0.11	0.54	2.65	0.00
NO	1.01	29.47	0.44	6.50	0.28	0.61	0.18
HE	0.45	0.00	2.81	0.61	0.87	3.49	0.41
$\overline{R}^2$	0.76	0.07	0.66	0.26	0.38	0.12	0.09
LL	38.62	6.84	28.81	22.39	9.67	21.29	12.75

Table B1(b)

France omitted (data have been de-meaned)

Industry type: Chem (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
ly	0.117 (3.132)					1.28 (0.26)		
eer_vol	0.252 (4.613)					2.47 (0.12)		
eer_mis	18.306 (9.917)					0.58 (0.45)		
eer_msp	-6.223 (-15.114)					2.29 (0.13)		
Error correction coefficient				-0.597 (-3.315)				
Joint Hausman test (p value):				8.41 (0.08)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	Germany ARDL (2,2,2,2,2)	**Austria** ARDL (1,0,2,0,1)	**Canada** ARDL (2,0,2,0,0)	**UK** ARDL (2,2,2,2,2)	**US** ARDL (1,0,1,2,2)	**Finland** ARDL (0,2,1,1,0)	**Italy** ARDL (0,2,0,0,0)	**Sweden** ARDL (2,2,2,2,2)
Error correction	-1.2518 (-5.6505)	-0.3678 (-3.3352)	-0.2451 (-2.0872)	-0.9261 (-18.5944	-0.1517 (-3.3707)	-1.0000	-1.0000	0.1653 (1.8973)
dlinv(-1)				-0.1644 (-3.9957)				
dly				-1.6786 (-18.3527)		1.7798 (2.6143)	-5.5653 (-2.2882)	4.5682 (4.5961)
dly(-1)				-1.2349 (-9.3060)		-6.4841 (-1.9261)		
deer_vol				-0.2911 (-8.1885)				0.1771 (2.5005)
deer_vol(-1)				-0.3449 (-15.9672)				
deer_mis	-22.1248 (-4.1078)			-12.4015 (-9.0170)		16.1279 (3.1589)		5.8492 (2.3721)
deer_mis(-1)	-17.2696 (-3.3120)			-7.9663 (-11.0325)				
deer_msp	6.3629 (4.9798)	0.6730 (2.3643)		3.9313 (14.7080)	0.9509 (2.5322)			
deer_msp(-1)	4.7573 (3.8872)			2.1550 (16.7713)				
Intercept	1.5879 (5.4834)		-0.2399 (-2.0275)	-0.6715 (-12.8013)	0.1847 (3.1358)	-0.9784 (-6.8883)		
Diagnostic statistics								
	Germany	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.176	0.142	0.266	0.019	0.112	0.762	0.521	0.287
SC	208.36	8.49	0.59	6.96	1.93	0.73	0.26	4.89
FF	0.57	0.29	1.15	0.08	1.19	22.64	24.33	1.87
NO	2.18	0.59	15.48	9.78	1.13	19.58	16.84	0.60
HE	0.01	0.01	0.03	1.13	0.85	17.55	17.92	2.59
$\bar{R}^2$	-0.16	-0.11	-0.40	0.96	-0.14	-3.03	-67.74	-2.29
LL	21.84	16.18	4.28	61.83	22.92	-16.95	-9.37	19.42

Table B1(c)

Results without France and Finland

Chem (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.889 (43.595)				0.31 (0.58)		
eer_vol	0.270 (7.496)				2.28 (0.13)		
eer_mis	3.271 (4.488)				0.13 (0.72)		
Error correction coefficient	-0.485 (-2.631)						
Joint Hausman test (p value):	6.96 (0.07)						
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	Germany ARDL(1,2,2,1)	**Austria** ARDL(2,1,0,2)	**Canada** ARDL(2,0,0,0)	**UK** ARDL(1,2,0,2)	**US** ARDL(2,0,1,2)	**Italy** ARDL(2,2,0,2)	**Sweden** ARDL(2,1,1,2)
Error correction	-0.2346 (1.7576)	-0.3022 (-3.4606)	-0.3150 (-2.3215)	-0.0622 (-0.7458)	-0.9674 (-8.6935)	-0.1472 (-2.1221)	-1.3660 (-5.3455)
dlinv(-1)		0.3599 (2.3855)	0.4568 (2.2446)		0.6766 (6.1380)	0.6029 (3.0242)	0.3207 (1.9460)
dly		-0.9895 (-2.2372)					-1.2457 (-2.6693)
dly(-1)				1.0937 (2.9715)			
deer_vol					-0.2428 (-5.6640)		-0.2401 (-2.5607)
deer_mis	-3.7541 (-2.3033)	-3.8668 (-1.9037)			-2.7951 (-4.6468)		-3.7414 (-3.1540)
deer_mis(-1)		-5.5716 (-3.0267)			-2.0125 (-4.8422)	-1.3468 (-2.0792)	-1.6602 (-2.3439)
Intercept		-4.0748 (-3.4014)	-4.0482 (-2.2967)		-14.4983 (-9.1273)	-1.9525 (-2.0747)	-17.9022 (-5.3710)
Diagnostic statistics							
	Germany	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.212	0.124	0.266	0.121	0.053	0.083	0.124
SC	2.89	14.32	0.64	24.49	0.21	1.59	0.22
FF	0.46	3.07	10.43	8.89	0.37	0.08	0.05
NO	0.39	2.23	15.59	0.29	0.39	1.22	0.73
HE	0.86	0.18	1.28	0.24	0.11	0.61	0.74
$\overline{R}^2$	-0.35	0.31	0.02	-0.17	0.74	-0.02	0.35
LL	9.69	18.81	1.78	18.64	34.82	26.59	18.52

Table B1(d)

France excluded (data have been de-meaned)

Industry type: Chem (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
ly	-0.168(-2.096)					0.74 (0.39)		
reer_vol	0.201(5.079)					0.03 (0.86)		
reer_mis	10.897(3.266)					2.35 (0.13)		
reer_msp	-2.741(-5.043)					1.80 (0.18)		
Error correction coefficient				-0.252(-2.297)				
Joint Hausman test (p value):				4.71 (0.32)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[1]								
	Germany ARDL (3,3,3,3,3)	**Austria** ARDL (3,3,0,1,3)	**Canada** ARDL (1,0,0,3,3)	**UK** ARDL (3,3,3,3,2)	**US** ARDL (2,3,0,3,3)	**Finland** ARDL (1,3,2,3,3)	**Italy** ARDL (1,1,3,1,2)	**Sweden** ARDL (1,0,3,0,0)
Error correction	-0.9379 (-5.6595)	-0.0217 (-0.1078)	-0.0470 (-0.5132)	-0.4766 (-14.511)	-0.1271 (-1.5179)	-0.1517 (-1.2994)	-0.1013 (-1.7825)	-0.1532 (-1.4415)
dlinv(-1)	0.6223 (4.2660)				0.5216 (2.8200)			
dlinv(-2)	0.3953 (2.6922)			0.2472 (4.8394)				
dly						1.4088 (8.5972)	-1.1348 (-2.6769)	
dly(-1)				-0.6409 (-4.4608)				
dly(-2)	2.765 (5.2764)			0.4421 (4.5538)		-1.3561 (-2.2381)		
dreer_vol							-0.0605 (-2.0545)	
dreer_vol(-1)	0.1355 (2.4029)						-0.1135 (-2.9216)	
dreer_vol(-2)	0.1289 (3.0765)			-0.1308 (-9.5379)			-0.0564 (-2.0482)	
dreer_mis	-14.9679 (-4.2087)			-9.0229 (-6.5451)			-5.5251 (-4.8366)	
dreer_mis(-1)				-2.8339 (-3.0982)				
dreer_mis(-2)	10.4783 (4.3501)			-3.0502 (-8.3082)		8.4062 (2.5214)		
dreer_msp	3.3451 (4.1944)			1.5632 (7.0342)			0.8863 (4.1959)	
dreer_msp(-1)		-1.0819 (-2.2573)	-0.8979 (-2.6106)	0.3501 (2.2062)				
dreer_msp(-2)	-2.2622 (-4.7364)		-1.2803 (-3.7133)			-1.2994 (-2.5561)		
Intercept	1.7086 (5.6450)			-0.4835 (-9.9319)			0.0624 (3.5534)	
Diagnostic statistics								
	Germany	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.126	0.173	0.202	0.0307	0.111	0.242	0.0701	0.174
SC	16.17	9.43	0.76	11.49	7.34	9.88	0.05	1.36
FF	2.23	0.25	1.13	3.99	7.32	0.05	0.04	0.32
NO	1.28	4.15	2.00	2.26	1.02	0.30	0.18	0.36
HE	0.00	1.73	9.01	1.76	0.81	0.38	0.17	0.10
$\bar{R}^2$	0.27	-0.72	0.08	0.89	-0.38	0.58	0.15	-0.29
LL	37.13	19.78	12.63	64.19	32.26	13.78	38.77	13.06

[1] The number of lags has been selected using the Hannan & Quinn selection criterion

Table B1(e)

France excluded (data have been de-meaned)

Industry type: Chem (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
ly	0.773 (7.293)					0.86 (0.35)		
reer_vol	-0.169 (-3.691)					0.28 (0.60)		
reer_mis	4.996 (2.199)					1.76 (0.18)		
reer_mis+ve	-23.873 (-6.783)					1.39 (0.24)		
Error correction coefficient				-0.549 (-4.410)				
Joint Hausman test (p value):				5.08 (0.28)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	Germany ARDL (1,0,0,2,0)	**Austria** ARDL (3,2,0,2,0)	**Canada** ARDL (1,0,0,0,1)	**UK** ARDL (2,1,3,1,3)	**US** ARDL (0,0,0,3,3)	**Finland** ARDL (1,0,0,0,1)	**Italy** ARDL (3,2,2,2,3)	**Sweden** ARDL (0,2,3,3,3)
Error correction	-0.3875 (-3.4397)	-0.5442 (-4.5325)	-0.1674 (-1.9032)	-0.3978 (-7.5203)	-1.0000[16]	-0.8003 (-6.0310)	-0.0971 (-1.1649)	-1.0000[2]
dlinv(-1)		0.5120 (3.5702)						
dlinv(-2)		0.5304 (3.5004)						
dly(-1)		-1.4550 (-2.8342)						
dreer_vol				0.0730 (2.4469)				
dreer_vol(-1)							-0.1151 (-2.8094)	0.4131 (2.8543)
dreer_mis				-2.0354 (-2.4990)	-6.7193 (-2.6763)		-1.9872 (-1.9720)	
dreer_mis(-1)	1.6569 (2.0589)	-4.7387 (-4.0094)						
dreer_mis+ve				6.9954 (3.9656)	24.0755 (5.4836)	9.1485 (3.0262	5.3877 (2.4098)	16.6987 (2.7348)
dreer_mis+ve (-1)				2.2972 (2.1446)	15.6956 (3.5723)		6.5848 (3.2596)	
dreer_mis+ve (-2)				-1.5753 (-2.0211)	6.8239 (1.9517)		3.3540 (3.8780)	
Intercept		-0.0741 (-3.1464)					0.0378 (2.2049)	
Diagnostic statistics								
	Germany	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.139	0.106	0.223	0.065	0.127	0.276	0.090	0.293
SC	1.88	0.01	4.62	0.63	18.68	0.97	1.26	164.35
FF	0.10	0.00	1.51	0.62	0.84	11.38	3.60	2.46
NO	1.67	0.37	2.48	0.11	2.73	0.00	5.24	2.07
HE	4.76	0.23	0.07	1.36	7.01	1.59	0.78	0.18
$\bar{R}^2$	0.12	0.36	-0.13	0.66	-0.82	0.48	-0.37	-2.66
LL	18.73	28.77	6.30	43.50	23.28	0.38	38.42	10.06

[2] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than -1

Table B2

Data have been de-meaned

Industry type: Utilities (dependent variable linv)				
	Long run coefficients (t ratio)		**H-test (p value)**	
ly	-0.864 (-3.350)		0.65 (0.42)	
reer_vol	-0.512 (-4.404)		0.51 (0.48)	
reer_mis[3]	-2.588 (-3.134)		1.22 (0.27)	
Error correction coefficient		-0.274 (-2.045)		
Joint Hausman test (p value):		na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[4]				
	France ARDL(2,2,1,2)	**Finland** ARDL(2,1,0,1)	**Italy** ARDL(1,1,0,1)	**Sweden** ARDL(1,2,2,2)
Error correction	-0.1021 (-1.2921)	-0.2905 (-3.6080)	-0.0573 (-1.8410)	-0.6468 (-5.5019)
dly				-0.9001 (-2.0983)
dreer_vol				0.2429 (4.9114)
dreer_vol(-1)				0.1364 (4.3079)
dreer_mis				1.3731 (3.8377)
dreer_mis(-1)	2.1843 (2.5119)			0.7017 (1.9592)
Intercept		-0.6639 (-3.5741)		-0.0524 (-2.2658)
Diagnostic statistics				
	France	**Finland**	**Italy**	**Sweden**
Sigma	0.093	0.130	0.081	0.046
SC	3.00	0.00	2.74	0.02
FF	4.82	2.06	0.58	0.26
NO	3.81	0.93	0.69	0.08
HE	4.71	0.69	0.35	2.49
$\overline{R}^2$	-0.15	0.11	-0.04	0.68
LL	27.88	18.62	32.42	34.77

[3] Results relative to the model including the term in positive misalignments are not reported. When such term is added, its coefficient is significant and positive, but the coefficient on the volatility term becomes insignificant.
[4] AIC (Akaike Information Criterion) has been used to select the lag orders for each group.

Table B3(a)

Results excluding Finland

Industry type: Text (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.618 (35.030)				0.61 (0.43)		
eer_vol[5]	0.167 (4.372)				0.16 (0.69)		
Error correction coefficient	-0.550 (-2.514)						
Joint Hausman test (p value):				0.64 (0.72)			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (3,3,3)	**Austria** ARDL (3,0,3)	**Canada** ARDL (3,3,0)	**UK** ARDL (1,3,2)	**US** ARDL (1,1,3)	**Italy** ARDL (1,1,1)	**Sweden** ARDL (3,3,2)
Error correction	-0.2726 (2.2855)	-0.4813 (-2.4786)	0.2143 (0.889)	-1.0612 (-3.9443)	-1.5428 (-8.9745)	-0.2537 (-4.7482)	-0.4522 (-3.2603)
dlinvest(-1)	0.3268 (2.4756)	0.7043 (4.0028)	-1.1605 (-3.6028)				0.3745 (2.8469)
dlinvest(-2)			-0.9009 (-2.9783)				0.3192 (2.2059)
dly	2.3270 (6.0326)				-2.7294 (-4.9169)	2.0780 (7.0789)	1.8721 (4.4391)
dly(-1)	-1.7992 (-3.2377)		2.3173 (3.0005)	2.1007 (3.9180)			-2.1531 (-3.8836)
dly(-2)			1.3093 (2.0229)				
deer_vol	-0.1398 (-3.6682)				-0.2109 (-4.2001)	-0.0677 (-1.9046)	
deer_vol(-1)	0.1164 (2.2365)				-0.2271 (-4.8842)		
					-0.1246 (-3.6649)		
Intercept	-3.0570 (-2.2642)	-4.8443 (-2.4512)		-10.2769 (-3.8291)	-17.1228 (-9.6216)	-2.7235 (-4.8784)	-4.0975 (-3.2632)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.079	0.134	0.161	0.105	0.046	0.077	0.125
SC	13.77	18.45	1.17	5.67	5.56	0.02	2.77
FF	0.29	12.44	1.11	3.46	4.65	0.27	0.02
NO	0.07	0.63	0.34	0.60	1.01	1.65	2.56
HE	1.03	2.04	0.95	0.00	0.64	2.14	0.64
$\overline{R}^2$	0.72	0.21	0.26	0.48	0.81	0.63	19.87
LL	29.48	16.94	13.15	20.63	35.25	25.31	0.64

[5] Adding a misalignment term and a term in positive misalignment makes the volatility term insignificant. They are both significant and with a positive and negative coefficient, respectively.

Table B3(b)

Results excluding Finland

Industry type: Text (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.534 (33.262)				0.55 (0.46)		
reer_vol	-0.075 (-1.315)				1.03 (0.31)		
reer_mis	2.907 (2.007)				0.28 (0.59)		
reer_msp	-1.216 (-4.975)				0.03 (0.86)		
Error correction coefficient				-0.525 (-4.296)			
Joint Hausman test (p value):				1.99 (0.74)			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (3,0,3,3,3)	**Austria** ARDL (2,2,3,3,2)	**Canada** ARDL (3,3,3,3,3)	**UK** ARDL (2,2,3,3,0)	**US** ARDL (3,1,2,0,0)	**Italy** ARDL (1,1,0,0,0)	**Sweden** ARDL (3,2,3,3,3)
Error correction	-0.6708 (-5.0575)	-0.3593 (-2.9761)	-0.6126 (-5.2402)	-1.1282 (-10.8373)	-0.3296 (-3.2432)	-0.1179 (-3.1499)	-0.4598 (-4.4280)
dlinvest(-1)		0.3917 (2.6518)	-0.5121 (-4.0538)	0.3287 (3.2018)			
dlinvest(-2)			-0.6243 (-3.1905)		-0.3586 (-3.1477)		0.6073 (4.5537)
dly		1.1272 (2.2257)	-1.9476 (-3.9822)	0.5906 (2.2536)		1.7995 (6.8724)	1.0095 (2.8628)
dly(-1)				1.4853 (5.9584)			
dreer_vol							0.1651 (3.6379)
dreer_vol(-1)				0.1329 (2.7895)			
dreer_vol(-2)				0.1708 (5.5089)			-0.0757 (-1.9386)
dreer_mis			-5.8641 (-3.8383)	4.6710 (3.4775)			-11.3705 (-7.3931)
dreer_mis(-1)	-5.9828 (-2.2803)		-8.8090 (-5.9685)	5.3984 (4.5426)			-7.8507 (-4.4162)
dreer_mis(-2)		-5.2060 (-2.8244)	20.4044 (4.2295)	4.1021 (5.2886)			-9.8543 (-5.6076)
dreer_msp			-7.9723 (-5.5258)				2.0111 (8.4341)
dreer_msp(-1)			-3.5209 (-6.5093)				1.9024 (6.3386)
dreer_msp(-2)			-1.2720 (-4.2672)				1.5547 (5.5755)
Intercept	-6.7180 (-4.8815)	-3.1973 (-2.9305)	-5.2342 (-5.2032)	-9.8620 (-10.6106)	-3.2460 (-3.2977)	-1.1545 (-3.2553)	-3.7152 (-4.4239)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.130	0.123	0.289	0.071	0.071	0.100	0.138
SC	58.40	1.66	0.66	0.21	2.94	1.59	0.41
FF	4.76	0.86	44.43	0.37	2.03	0.16	2.74
NO	0.72	0.51	1.75	4.11	0.65	1.19	1.73
HE	0.03	1.05	0.01	0.00	1.99	0.03	0.16
$\bar{R}^2$	0.33	0.26	-1.09	0.81	0.53	0.56	0.52
LL	29.64	31.12	28.20	41.05	37.93	27.12	34.30

Table B3(c)

Results excluding Finland

Industry type: Text (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	2.030 (61.208)				2.09 (0.15)		
reer_vol	-0.184 (-11.839)				0.00 (0.96)		
reer_mis	7.391 (14.944)				3.22 (0.07)		
reer_mis+ve	15.957 (8.219)				1.68 (0.20)		
Error correction coefficient				-0.363 (-2.675)			
Joint Hausman test (p value):				36.00 (0.00)			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (3,2,3,3,2)	**Austria** ARDL (1,1,0,1,3)	**Canada** ARDL (2,3,3,3,3)	**UK** ARDL (1,2,2,0,2)	**US** ARDL (3,3,3,0,2)	**Italy** ARDL (1,1,0,2,0)	**Sweden** ARDL (3,3,3,3,3)
Error correction	-0.4014 (4.0930)	-0.2507 (-2.0961)	-0.3106 (-4.7033)	-0.1957 (-2.1548)	-0.1529 (-3.0716)	-0.0862 (-2.9310)	-1.1423 (-38.3372)
dlinvest(-1)					0.5747 (2.5562)	1.9452 (5.5719)	1.4248 (39.9297)
dlinvest(-2)					-0.7073 (-3.7795)		1.2875 (38.2605)
dly	2.0554 (6.1862)	1.943 (4.0329)			1.5128 (4.5336)		0.7446 (9.8135)
dly(-1)					-0.9371 (-1.9559)		
dly(-2)							0.9410 (10.5168)
dreer_vol							-0.2382 (-10.3985)
dreer_vol(-1)			-0.2783 (-2.6853)				-0.7057 (-22.1797)
dreer_vol(-2)					0.0541 (2.0255)		-0.1545 (-13.7065)
dreer_mis			-12.0310 (-3.3040)				-10.2270 (-25.6215)
dreer_mis(-1)							-21.2766 (-43.9572)
dreer_mis(-2)	-2.4884 (-2.6403)						-24.2972 (-40.6838)
dreer_mis+ve			14.3852 (2.6624)	-5.6754 (-2.6403)	-3.7556 (-2.9148)		
dreer_mis+ve (-1)			-12.7814 (-2.2610)	-4.2893 (-2.6711)	-3.1599 (-3.2700)		24.2305 (38.2682)
dreer_mis+ve (-2)		-7.4335 (-2.1548)					26.2880 (44.3870)
Intercept	-6.4696 (-4.0912)	-3.5961 (-2.1014)	-4.1475 (-4.6832)	-2.6606 (-2.1497)	-2.4042 (-3.0834)	-1.3771 (-2.9918)	-14.7257 (-60.4293)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.122	0.122	0.204	0.161	0.082	0.103	0.024
SC	44.70	3.19	0.06	0.20	1.02	0.35	31.93
FF	3.24	0.37	1.98	7.15	14.38	0.01	3.42
NO	0.47	1.05	11.66	1.52	1.64	0.33	0.70
HE	0.41	0.00	1.32	1.91	0.18	0.99	0.02
$\overline{R}^2$	0.41	0.27	0.04	0.03	0.37	0.44	0.99
LL	33.01	24.33	23.99	18.32	39.69	26.86	77.42

Table B4(a)

Finland excluded

Industry type: Food (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.172 (34.870)				0.93 (0.34)		
p_vol	-0.059 (-2.089)				0.97 (0.33)		
p_mis	-19.112 (-5.237)				1.03 (0.31)		
p_msp	7.499 (5.199)				1.37 (0.24)		
Error correction coefficient	-0.594 (-3.932)						
Joint Hausman test (p value):				na			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (1,0,0,1,0)	**Austria** ARDL (1,0,0,1,0)	**Canada** ARDL (0,0,0,0,0)	**UK** ARDL (0,0,0,1,1)	**US** ARDL (1,1,0,1,0)	**Italy** ARDL (1,1,0,0,0)	**Sweden** ARDL (0,1,0,1,1)
Error correction	-0.3353 (-1.4513)	-0.2405 (-3.2314)	-1.0000[6]	-1.0000[7]	-0.0795 (-2.5243)	-0.5045 (-4.5270)	-1.0000[18]
dly					1.3424 (3.3414)	0.9458 (4.0142)	
dp_mis	6.1384 (2.3419)	1.1577 (2.3279)			-1.2617 (-2.3901)		
dp_msp				-3.0917 (-2.0747)			
Intercept		-1.1770 (-3.0571)	-5.3950 (-15.2334)	-5.1409 (-14.5181)	-0.4645 (-2.5441)	-2.5264 (-4.1741)	-5.0207 (-12.8253)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.142	0.061	0.102	0.131	0.057	0.060	0.127
SC	12.21	0.25	0.04	59.36	1.42	0.26	21.42
FF	0.13	3.27	0.07	71.19	0.26	0.76	22.27
NO	3.86	0.79	1.06	1.34	0.02	0.07	0.62
HE	0.09	0.50	0.93	4.59	0.62	0.33	0.29
$\overline{R}^2$	-0.24	0.26	0.33	-0.78	0.25	0.66	-0.20
LL	12.75	22.28	21.74	18.22	38.36	33.71	18.62

[6] Single equation ARDL estimates show that adding a dummy for 1997 produces an error correction coefficient greater than -1

[7] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than -1

Table B4(b)

Industry type: Food (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.253 (46.144)				0.00 (0.98)		
p_vol	-0.075 (-3.048)				0.27 (0.61)		
p_mis	-6.858 (-3.706)				0.62 (0.43)		
p_mis+ve	13.466 (4.251)				0.73 (0.39)		
Error correction coefficient				-0.668 (-4.798)			
Joint Hausman test (p value):				na			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (1,1,1,1,1)	**Austria** ARDL (1,0,1,1,1)	**Canada** ARDL (0,0,0,1,1)	**UK** ARDL (0,0,0,1,1)	**US** ARDL (1,0,0,1,1)	**Italy** ARDL (0,1,1,0,1)	**Sweden** ARDL (0,1,1,0,1)
Error correction	-0.3199 (-1.2069)	-0.0870 (-0.3630)	-1.0000[8]	-1.0000[9]	-0.7395 (-5.6892)	-0.5286 (-3.0158)	-1.0000[20]
dly	1.5437 (2.5322)					1.0831 (4.3649)	
dp_mis					2.8447 (2.3335)		
dp_mis+ve				-11.2562 (-2.5423)	-6.8790 (-3.3227)		
Intercept			-6.2642 (-21.4085)	-6.0052 (-20.5057)	-5.0597 (-5.0275)	-3.1659 (-2.9383)	-6.0055 (-18.6238)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.148	0.087	0.112	0.125	0.041	0.076	-0.147
SC	13.80	3.31	0.00	33.79	0.52	0.38	156.71
FF	1.95	5.64	0.82	33.32	0.00	0.20	39.40
NO	6.39	0.25	0.16	0.68	0.19	0.22	0.69
HE	0.29	0.06	2.95	0.01	2.82	0.09	0.73
$\bar{R}^2$	-0.36	-0.49	0.19	-0.61	0.60	0.45	-0.61
LL	15.58	20.96	21.12	19.35	45.70	29.49	15.52

[8] Single equation ARDL estimates show that adding a dummy for 1997 produces an error correction coefficient greater than -1

[9] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than -1

Table B4(c)

Industry type: Food (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
ly	1.889 (11.601)					1.09 (0.30)		
eer_vol	-0.118 (-3.908)					2.89 (0.09)		
eer_mis	-4.388 (-3.038)					0.10 (0.75)		
eer_msp	0.862 (3.608)					0.61 (0.44)		
Error correction coefficient				-0.504 (-3.290)				
Joint Hausman test (p value):				4.47 (0.35)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	France ARDL (1,0,1,1,0)	**Austria** ARDL (2,2,2,2,2)	**Canada** ARDL (2,2,2,2,2)	**UK** ARDL (1,1,0,0,0)	**US** ARDL (1,2,1,2,2)	**Finland** ARDL (0,1,0,1,0)	**Italy** ARDL (2,0,2,2,2)	**Sweden** ARDL (2,2,2,2,2)
Error correction	0.1015 (0.6052)	-0.1654 (-1.2552)	-0.7488 (-4.7467)	-0.4085 (-2.3688)	-0.7683 (-3.6251)	-1.0000[10]	-0.0478 (-0.3774)	-0.9924 (-7.4308)
dlinv(-1)			-0.4238 (-2.6898)					
dly		1.6632 (3.4539)	1.0987 (2.2647)	1.8702 (2.9080)		-0.7359 (-4.5889)		-1.4622 (-3.1604)
dly(-1)			-2.0933 (-4.1449)					
deer_vol		0.1038 (1.9775)	0.1087 (4.6403)				-0.1260 (-2.1785)	0.1490 (4.8348)
deer_vol(-1)			0.0986 (5.4393)					0.2152 (7.5310)
deer_mis					-3.9830 (-2.7284)			5.3102 (3.5025)
deer_mis(-1)	-3.0591 (-3.4864)		2.0878 (2.3945)					
deer_msp								-1.2417 (-4.8372)
deer_msp(-1)					0.5882 (2.4662)			
Intercept			0.3632 (3.2262)	0.3064 (2.2144)	-1.1281 (-3.2175)	0.8394 (5.4272)		0.2404 (5.4551)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.108	0.127	0.070	0.075	0.101	0.153	0.122	0.123
SC	0.47	0.85	301.64	0.28	0.47	0.64	0.10	76.92
FF	0.28	17.58	19.35	0.05	29.90	0.64	0.87	671.33
NO	1.45	0.39	0.71	1.48	0.45	0.52	1.17	0.35
HE	0.15	0.02	0.14	1.21	0.38	0.60	0.53	1.97
$\overline{R}^2$	0.03	-0.25	0.43	0.16	0.03	0.85	-0.81	-0.07
LL	21.30	27.03	39.30	26.50	27.52	13.93	23.83	33.06

Data have been de-meaned

[10] Single equation ARDL estimates show that reducing the sample size produces an error correction coefficient greater than -1

Table B4(d)

Industry type: Food (dependent variable linv)								
			Long run coefficients (t ratio)			**H-test (p value)**		
ly			1.617 (61.978)			0.79 (0.38)		
eer_vol			-0.163 (-13.254)			2.45 (0.12)		
eer_mis			-3.935 (-16.818)			0.23 (0.63)		
eer_mis+ve			8.184 (13.723)			0.10 (0.75)		
Error correction coefficient				-0.708 (-3.489)				
Joint Hausman test (p value):				13.00 (0.01)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	France ARDL (1,0,0,2,2)	**Austria** ARDL (0,1,0,2,1)	**Canada** ARDL (1,2,2,2,2)	**UK** ARDL (2,2,2,2,2)	**US** ARDL (1,2,1,2,2)	**Finland** ARDL (2,2,1,1,2)	**Italy** ARDL (2,0,2,1,0)	**Sweden** ARDL (2,2,2,2,1)
Error correction	0.0659 (0.4360)	-1.0000[11]	-1.5180 (-24.4414)	-0.6854 (-2.9400)	-0.4043 (-1.7380)	-1.4232 (-5.2063)	-0.1167 (-0.8179)	-0.5856 (-3.5727)
dlinv(-1)				0.7540 (2.7144)				
dly			-0.4790 (-4.3324)	5.5787 (3.6613)				
dly(-1)			-2.3773 (-23.2888)	-3.3332 (-1.9977)		1.7964 (2.1998)		
deer_vol			0.2061 (18.1598)			-0.1095 (-2.1869)		
deer_vol(-1)			0.1296 (21.2752)	-0.0963 (-2.4420)				0.2919 (2.9148)
deer_mis	-3.9273 (-2.1982)		3.9491 (11.8778)	6.2612 (4.0587)		8.6314 (3.5127)	-1.1658 (-1.9966)	
deer_mis(-1)			2.4056 (12.3138)	2.4901 (2.7952)				
deer_mis+ve			-10.7056 (-10.5750)	-2.9230 (-2.0565)		-19.7120 (-4.3930)		
deer_mis+ve (-1)			-5.0137 (-8.8699)	-4.0515 (-2.7801)				
Intercept		0.0763 (2.1236)	0.4315 (9.9493)	0.3089 (2.7944)		0.8083 (4.9820)		0.1039 (3.2405)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.111	0.175	0.013	0.163	0.151	0.151	0.103	0.165
SC	2.17	10.80	1.57	60.74	9.15	0.45	0.38	11.50
FF	3.82	3.78	0.16	1.06	16.30	0.04	5.71	2.07
NO	0.22	0.01	0.87	0.37	0.96	0.06	2.43	0.43
HE	0.03	0.07	0.07	0.07	0.70	0.52	0.00	1.27
$\overline{R}^2$	0.02	-1.37	0.98	-3.38	-1.16	0.86	-0.29	-0.95
LL	21.90	12.28	63.88	28.45	19.90	19.88	22.60	22.75

Data have been de-meaned

[11] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than -1

Table B4(e)

Industry type: Food (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
ly	1.332 (2.694)				0.23 (0.63)		
reer_vol	0.117 (.214)				2.81 (0.09)		
reer_mis	-4.883 (-2.496)				0.01 (0.93)		
reer_msp	0.943 (2.866)				0.89 (0.35)		
Error correction coefficient				-0.442 (-4.424)			
Joint Hausman test (p value):				na			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (1,0,0,1,2)	**Austria** ARDL (1,0,0,0,0)	**UK** ARDL (3,3,2,3,3)	**US** ARDL (2,0,0,0,0)	**Finland** ARDL (1,0,0,0,0)	**Italy** ARDL (3,3,2,2,3)	**Sweden** ARDL (3,3,2,1,0)
Error correction	-0.1560 (-1.2153)	-0.7166 (-6.0782)	-0.1552 (-1.2558)	-0.3702 (-3.7848)	-0.7892 (-13.3523)	-0.6190 (-6.3231)	-0.2897 (-1.2263)
dlinv(-1)						0.2596 (2.1190)	
dlinv(-2)						0.3413 (3.1852)	
dly(-2)						1.3762 (3.9944)	
dreer_vol						-0.0600 (-2.4318)	
dreer_vol(-1)						-0.0734 (-2.6755)	0.1064 (2.2760)
dreer_mis						2.7659 (2.5734)	
dreer_mis(-1)						4.7004 (5.0966)	
dreer_msp						-0.4334 (-2.4069)	
dreer_msp(-1)						-0.7386 (-4.4648)	
dreer_msp(-2)						0.1648 (2.9906)	
Intercept				-0.3136 (-3.9078)	0.3133 (6.6414)	0.0977 (4.2316)	
Diagnostic statistics							
	France	**Austria**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.097	0.080	0.116	0.070	0.128	0.053	0.122
SC	1.33	3.23	2.78	0.02	0.09	0.09	0.02
FF	0.57	2.02	0.10	0.70	0.02	2.77	18.36
NO	3.54	1.31	0.76	0.82	0.23	1.73	1.92
HE	0.11	2.51	0.21	0.39	0.75	0.00	1.34
$\overline{R}^2$	-0.15	0.53	-1.38	0.18	0.87	0.48	-0.33
LL	29.42	33.28	36.54	36.42	21.16	53.27	26.16

Data have been de-meaned

Table B5(a)

Industry type: Transp (dependent variable linv)				
	Long run coefficients (t ratio)		**H-test (p value)**	
ly	1.186 (15.788)		0.28 (0.59)	
eer_vol	-0.626 (-5.429)		1.12 (0.29)	
Error correction coefficient	-0.557 (-3.041)			
Joint Hausman test (p value):		2.23 (0.33)		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)				
	France ARDL(3,2,3)	**UK** ARDL(1,2,0)	**Finland** ARDL(0,0,0)	**Sweden** ARDL(3,3,3)
Error correction	-0.6325 (-6.0012)	-0.4806 (-3.9867)	-1.0000[12]	-0.1154 (-1.5520)
dlinv (-1)	0.3657 (2.7805)			
dlinv(-2)	0.2357 (2.3606)			-0.6387 (-5.0535)
dly	0.8456 (2.7040)			1.8347 (4.5043)
dly(-1)	-1.3653 (-3.9585)	1.3752 (2.3581)		
dly(-2)				2.5225 (5.8147)
deer_vol	0.1907 (2.9954)			
deer_vol(-1)	0.2959 (5.2411)			
deer_vol(-2)	0.1559 (3.0154)			0.2629 (5.3197)
Intercept	-3.2375 (-4.1913)	-2.1371 (-4.1318)	-4.5087 (-6.5540)	
Diagnostic statistics				
	France	**UK**	**Finland**	**Sweden**
Sigma	0.077	0.131	0.452	0.144
SC	0.02	1.62	0.01	7.87
FF	2.27	0.82	44.97	3.53
NO	2.10	0.70	14.37	1.32
HE	0.45	0.33	17.65	0.79
$\bar{R}^2$	0.64	0.60	-1.49	0.59
LL	29.17	14.74	-11.49	19.83

[12] Single equation ARDL estimates show that adding a dummy for 1988 and 1992 produces an error correction coefficient greater than -1

Table B5(b)

Data have been de-meaned

Industry type: Transp (dependent variable linv)				
	Long run coefficients (t ratio)		**H-test (p value)**	
ly	1.743 (10.641)		0.56 (0.45)	
reer_vol	1.189 (12.089)		0.79 (0.37)	
reer_mis	-8.238 (-3.312)		0.22 (0.64)	
reer_mis+ve	19.224 (5.006)		0.55 (0.46)	
Error correction coefficient		-0.699 (-4.030)		
Joint Hausman test (p value):		na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[13]				
	France ARDL(0,2,3,1,0)	**UK** ARDL(1,2,2,2,0)	**Finland** ARDL(1,0,2,3,3)	**Sweden** ARDL(2,2,2,1,1)
Error correction	-1.0000[14]	-0.2549 (-2.2168)	-0.5933 (-10.6530)	-0.9484 (-7.4738)
dlinv (-1)				0.5626 (4.7086)
dly(-1)				1.1354 (3.8282)
dreer_vol	-0.7872 (-6.2399)		-0.7567 (-6.2856)	-0.5671 (-5.8522)
dreer_vol(-1)	-0.6055 (-5.0677)		-0.5124 (-4.9619)	-0.4598 (-6.7615)
dreer_vol(-2)	-0.2679 (-2.9753)			
dreer_mis				-7.9509 (-3.0626)
dreer_mis(-2)			8.5078 (3.7863)	
dreer_mis+ve				9.1692 (2.3778)
dreer_mis+ve (-1)			-12.7024 (-2.4674)	
dreer_mis+ve (-2)			-13.3137 (-3.8469)	
Intercept	-1.4483 (-4.5154)		0.7513 (6.2339)	
Diagnostic statistics				
	France	**UK**	**Finland**	**Sweden**
Sigma	0.199	0.249	0.195	0.093
SC	21.19	0.09	2.58	1.00
FF	7.35	4.19	0.36	4.19
NO	0.15	0.90	0.04	1.31
HE	2.36	0.11	0.45	0.00
$\overline{R}^2$	-0.05	-0.26	0.84	0.71
LL	12.11	7.47	15.70	31.67

[13] HQ (Hannan & Quinn) selection criterion has been used to select the lag orders for each group.

[14] Single equation ARDL estimates show that reducing the sample size produces an error correction coefficient greater than -1

Table B6(a)

Industry type: PAP (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
ly	0.501 (47.210)					0.30 (0.58)		
eer_vol	0.235 (4.758)					0.10 (0.75)		
eer_mis	-2.334 (-12.290)					0.47 (0.49)		
Error correction coefficient				-0.621 (-3.514)				
Joint Hausman test (p value):				1.03 (0.79)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[15]								
	France ARDL (1,0,0,0)	**Austria** ARDL (1,2,2,2)	**Canada** ARDL (2,1,0,2)	**UK** ARDL (2,2,2,2)	**US** ARDL (2,2,2,0)	**Finland** ARDL (2,2,2,2)	**Italy** ARDL (2,2,2,2)	**Sweden** ARDL (2,2,2,1)
Error correction	-0.2966 (-1.5246)	-0.9286 (-3.1250)	-0.9920 (-4.0077)	-0.8685 (-3.8905)	-0.3851 (-3.3663)	-0.6652 (-2.8361)	-1.1902 (-61.3124)	0.3620 (0.9667)
dlinv(-1)			0.5405 (2.6965)	0.6160 (2.6322)			0.8790 (36.7491)	
dly							-1.9519 (-22.7382)	2.2261 (2.2746)
dly(-1)				2.0846 (2.5571)			-1.0594 (-8.3923)	
deer_vol							-0.1080 (-3.2171)	
deer_vol(-1)							0.0462 (4.4420)	
deer_mis							-1.7713 (-6.4707)	
deer_mis(-1)				2.6232 (2.4340)			-1.4978 (-6.8756)	
Intercept		0.2587 (2.6925)	-0.2806 (-3.1953)	-0.8508 (-3.8841)	0.1135 (2.7327)	0.2286 (2.2174)	-0.5431 (-37.7875)	
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.155	0.381	0.254	0.235	0.111	0.219	0.015	0.258
SC	0.15	19.46	8.75	74.20	0.07	2377.89	18.70	32.14
FF	0.56	73.34	0.39	8.08	3.50	70.01	14.43	3.91
NO	1.46	1.54	0.91	0.37	0.70	1.38	1.90	0.56
HE	1.50	0.29	0.97	0.29	5.36	2.44	0.30	0.64
$\overline{R}^2$	-0.24	-0.40	0.00	-0.74	-0.93	-3.75	0.98	-1.66
LL	9.37	6.25	7.04	17.04	19.64	18.00	52.62	11.32

Results excluding Germany (data have been de-meaned)

[15] The number of lags has been selected using the Hannan & Quinn selection criterion

Table B6(b)

Industry type: PAP (dependent variable linv)								
	Long run coefficients (t ratio)						**H-test (p value)**	
ly	1.455 (44.132)						0.09 (0.76)	
reer_vol	0.285 (7.075)						0.00 (0.95)	
reer_mis	5.698 (5.550)						0.31(0.58)	
reer_msp	0.626 (4.153)						0.39 (0.53)	
Error correction coefficient	-0.344 (-3.687)							
Joint Hausman test (p value):						2.81(0.59)		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[16]								
	France ARDL (1,2,0,0,0)	**Austria** ARDL (1,0,1,1,0)	**Canada** ARDL (2,2,2,0,0)	**UK** ARDL (2,2,2,2,2)	**US** ARDL (1,2,2,2,2)	**Finland** ARDL (2,2,0,2,2)	**Italy** ARDL (2,2,2,2,2)	**Sweden** ARDL (2,2,2,2,2)
Error correction	-0.2748 (-2.1879)	-0.3654 (-2.0766)	-0.3415 (-2.4326)	-0.3782 (-1.9338)	-0.4510 (-7.1688)	0.0865 (1.1910)	-0.1759 (-0.7629)	-0.8492 (-14.2281)
dlinv(-1)								0.1812 (3.1692)
dly			1.2556 (2.0289)	2.9034 (2.5443)	1.0313 (3.8170)	1.0394 (2.2468)		0.3458 (2.1596)
dly(-1)	1.5466 (2.1767)				1.2797 (4.1789)	2.4025 (4.9601)		2.0929 (9.8507)
dreer_vol					-0.0545 (-2.3821)			-0.2338 (-5.3687)
dreer_vol (-1)					-0.0672 (-3.8388)			
dreer_mis					-1.3113 (-3.0107)	3.7522 (3.0819)		
dreer_mis (-1)					-1.3048 (-3.1045)			
dreer_msp							-0.2943 (-2.2989)	-0.6128 (-6.5860)
dreer_msp (-1)					0.0894 (2.0202)			-0.2921 (-6.5949)
Intercept	-2.4369 (-2.2132)	-2.8372 (-2.0335)	-2.6849 (-2.5429)	-3.1578 (-2.0503)	-4.1274 (-7.2507)			-6.9155 (-15.5182)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.174	0.288	0.215	0.235	0.063	0.174	0.162	0.083
SC	11.07	0.04	0.61	0.16	0.07	0.12	0.01	39.69
FF	7.29	2.39	0.00	3.61	1.60	0.37	24.66	110.73
NO	0.40	1.34	0.08	0.50	0.84	0.56	0.25	5.93
HE	1.56	2.61	0.13	1.12	0.06	1.01	0.25	0.83
$\overline{R}^2$	-0.02	-0.01	0.47	-0.65	0.58	0.35	-0.69	0.87
LL	11.23	1.63	10.42	16.68	38.11	17.12	23.39	39.35

Results excluding Germany

[16] The number of lags has been selected using the Hannan & Quinn selection criterion

Table B6(c)

Industry type: PAP (dependent variable linv)								
			Long run coefficients (t ratio)				**H-test (p value)**	
ly			0.995 (26.043)				0.05 (0.82)	
reer_vol			0.831 (8.050)				0.03 (0.87)	
reer_mis			6.165 (1.945)				2.16 (0.14)	
reer_mis+ve			7.496 (2.084)				1.28 (0.26)	
Error correction coefficient			-0.273 (-3.053)					
Joint Hausman test (p value):						na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)[17]								
	France ARDL (3,3,3,3,3)	**Austria** ARDL (1,1,3,3,1)	**Canada** ARDL (3,2,0,3,3)	**UK** ARDL (3,2,2,3,3)	**US** ARDL (2,3,2,3,0)	**Finland** ARDL (3,2,1,0,3)	**Italy** ARDL (3,2,3,3,3)	**Sweden** ARDL (3,3,1,2,3)
Error correction	-0.0905 (-0.7259)	-0.4742 (-3.1295)	-0.3054 (-2.7504)	-0.0812 (-1.0035)	-0.1658 (-2.2245)	0.0546 (0.4874)	-0.3997 (-3.8045)	-0.7215 (-8.8108)
dlinv(-1)								0.6024 (7.7151)
dlinv(-2)							-0.2676 (-3.3969)	0.1491 (2.0317)
dly	2.3284 (3.0154)		1.3649 (3.2447)	2.0009 (2.6356)				
dly(-1)			1.2732 (2.5590)		1.1106 (3.2294)	1.8767 (4.4740)		0.5410 (2.3315)
dly(-2)								-1.7035 (-6.0843)
dreer_vol	-0.2484 (-2.6703)				-0.0937 (-2.1818)		-0.2118 (-2.5774)	-0.4410 (-12.2197)
dreer_vol(-1)				0.1432 (2.4698)	-0.0807 (-2.5481)			
dreer_vol(-2)		-0.2226 (-2.1042)						
dreer_mis	-14.4782 (-2.3460)							
dreer_mis(-1)	-26.4096 (-4.0806)				-1.5517 (-2.6354)		2.3033 (2.1839)	6.4186 (4.1862)
dreer_mis+ve							-6.3392 (-3.2165)	-8.2018 (-2.3616)
dreer_mis+ve (-1)	43.8333 (3.5322)			10.4132 (2.2597)		5.4498 (2.1164)	-6.1153 (-2.9842)	-17.0553 (-4.6289)
dreer_mis+ve (-2)						6.2185 (2.6096)	-4.2100 (-2.6943)	-11.3391 (-6.7189)
Intercept		-1.5804 (-3.0362)	-1.1872 (-2.9869)		-0.6691 (-2.2316)		-1.2254 (-3.0176)	-2.1344 (-6.1959)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.241	0.233	0.182	0.176	0.097	0.245	0.102	0.087
SC	0.64	0.83	7.53	8.15	0.31	0.34	1.73	0.43
FF	6.49	4.18	0.81	0.46	0.72	8.93	4.90	0.97
NO	3.08	2.07	2.53	1.13	0.34	8.75	1.15	0.05
HE	0.36	1.04	0.77	3.46	2.19	0.12	2.46	1.95
$\overline{R}^2$	-1.10	0.33	0.55	-0.02	-0.07	0.20	0.52	0.86
LL	21.61	11.16	19.93	24.29	34.31	9.70	39.63	38.81

Results excluding Germany

[17] The number of lags has been selected using the Hannan & Quinn selection criterion

Table B7(a)

Industry type: Fin (dependent variable linv)						
	Long run coefficients (t ratio)			**H-test (p value)**		
ly	0.581 (5.089)			0.02 (0.89)		
eer_vol	-0.425 (-5.103)			0.11 (0.74)		
eer_mis	18.971 (8.467)			0.00 (0.97)		
eer_mis+ve	-31.951 (-8.782)			0.01 (0.90)		
Error correction coefficient	-0.239 (-3.843)					
Joint Hausman test (p value):				2.73 (0.60)		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)						
	Austria ARDL (2,0,0,0,0)	**Canada** ARDL (2,2,2,2,2)	**Finland** ARDL (2,0,1,0,2)	**France** ARDL (1,2,2,1,2)	**Italy** ARDL (2,2,1,0,1)	**Sweden** ARDL (2,2,1,2,2)
Error correction	-0.0999 (-1.7445)	-0.1815 (-2.5372)	-0.3779 (-4.2163)	-0.3056 (-8.8688)	-0.0477 (-1.0996)	-0.4201 (-8.2703)
dlinvest(-1)	0.6775 (4.5124)	1.0251 (4.0370)	0.3855 (1.9444)		0.7838 (5.0107)	0.4346 (3.7448)
dly				-0.6066 (-5.0895)		
dly(-1)				-0.3542 (-2.6695)		2.9958 (3.8890)
deer_vol		-0.1955 (-2.40080)		0.1234 (8.1544)		
deer_vol(-1)		-0.1705 (-2.9795)		0.1493 (11.4308)		
deer_mis		6.3702 (2.0139)		-3.3546 (-8.0275)		-6.6719 (-5.7198)
deer_mis(-1)						-4.0831 (-4.9303)
deer_mis+ve				4.3233 (6.3364)		10.0116 (5.2597)
deer_mis+ve(-1)				-1.8210 (-4.5908)		6.4867 (4.2925)
Intercept		-0.2680 (-2.6275)		0.2184 (3.0303)		
Diagnostic statistics						
	Austria	**Canada**	**Finland**	**France**	**Italy**	**Sweden**
Sigma	0.073	0.219	0.126	0.019	0.064	0.072
SC	0.36	2.92	1.47	6.02	1.60	6.87
FF	2.01	230.76	13.78	4.52	6.75	5.33
NO	1.88	0.19	4.00	2.89	1.54	0.10
HE	0.58	6.84	1.91	0.04	0.00	1.30
$\overline{R}^2$	0.35	-1.12	0.32	0.86	0.31	0.44
LL	27.09	19.88	20.03	59.80	33.43	35.25

UK and US have been excluded (data have been de-meaned)

Table B7(b)

Industry type: Fin (dependent variable linv)						
	Long run coefficients (t ratio)			**H-test (p value)**		
ly	0.772 (15.955)			0.03 (0.85)		
reer_vol	-0.189 (-3.197)			1.44 (0.23)		
reer_mis	13.025 (4.946)			0.14 (0.71)		
reer_mis+ve	-26.319 (-5.034)			0.06 (0.81)		
Error correction coefficient	-0.170 (-3.917)					
Joint Hausman test (p value):				na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)						
	Austria ARDL (1,0,0,0,0)	**Canada** ARDL (2,0,0,0,0)	**Finland** ARDL (2,1,0,0,0)	**France** ARDL (1,1,0,0,0)	**Italy** ARDL (2,2,0,0,0)	**Sweden** ARDL (2,2,0,2,2)
Error correction	-0.0343 (-0.6018)	-0.2558 (-2.8204)	-0.2248 (-4.8473)	-0.0688 (-1.0322)	-0.1375 (-3.6599)	-0.2978 (-13.6728)
dlinv(-1)		0.4719 (2.8964)	0.3689 (3.3234)		0.3394 (2.1347)	0.4254 (6.7491)
dly			1.7781 (4.4280)	1.0264 (6.9949)	1.0404 (6.0354)	0.6077 (3.0064)
dly(-1)					-0.4080 (-2.1538)	1.1286 (4.5306)
dreer_mis						-2.9113 (-5.5078)
dreer_mis(-1)						-2.5032 (-6.5275)
dreer_mis+ve						6.4074 (5.9775)
dreer_mis+ve(-1)						3.4926 (4.8257)
Intercept					0.2235 (2.1558)	
Diagnostic statistics						
	Austria	**Canada**	**Finland**	**France**	**Italy**	**Sweden**
Sigma	0.042	0.160	0.092	0.031	0.036	0.035
SC	3.30	2.89	0.11	5.06	1.69	77.41
FF	0.20	0.22	5.67	0.30	0.52	9.75
NO	0.82	3.91	17.58	0.56	1.33	1.97
HE	0.00	1.94	0.01	1.43	0.07	0.81
$\overline{R}^2$	-0.27	0.17	0.71	0.58	0.79	0.95
LL	43.86	14.10	27.98	49.24	55.20	45.10

UK and US have been excluded

Table B8(a)

Germany has been excluded (Data have been de-meaned)

Industry type: BM (dependent variable linv)								
	Long run coefficients (t ratio)			**H-test (p value)**				
Ly	1.062 (11.155)			0.86 (0.35)				
eer_vol	0.102 (4.219)			0.37 (0.54)				
eer_mis	-2.097 (-2.065)			0.02 (0.89)				
eer_msp	0.508 (3.486)			0.07 (0.80)				
Error correction coefficient	-0.531 (-4.670)							
Joint Hausman test (p-value):				7.55 (0.11)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	France ARDL (2,0,0,1,0)	**Austria** ARDL (1,0,0,0,1)	**Canada** ARDL (2,0,0,2,2)	**UK** ARDL (1,2,2,2,2)	**US** ARDL (2,2,1,2,2)	**Finland** ARDL (1,0,1,0,0)	**Italy** ARDL (2,1,0,0,0)	**Sweden** ARDL (2,2,0,0,0)
Error correction	-0.6409 (-3.5848)	-0.5724 (-2.8099)	-0.5804 (-3.5766)	0.0106 (0.0517)	-0.1656 (-1.4582)	-0.6560 (-5.4945)	-0.5993 (-3.5607)	-1.0405 (-9.6022)
dlinv(-1)			0.4508 (2.1489)		0.7030 (3.3335)		0.4714 (2.7186)	0.3439 (3.5818)
dly				2.2438 (2.3294)	1.0470 (3.6640)			
dly(-1)					-1.4762 (-3.0767)			-0.5273 (-4.6563)
deer_vol				0.2945 (2.4344)		-0.1270 (-2.3388)		
deer_mis	2.7496 (2.3623)				4.6098 (2.1785)			
deer_mis(-1)					6.9063 (3.6716)			
deer_msp(-1)					-1.1267 (-3.7561)			
Intercept							0.1854 (2.9580)	
Diagnostic statistics[18]								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.138	0.185	0.220	0.212	0.114	0.187	0.117	0.051
SC	0.33	0.47	0.53	34.04	0.71	8.37	0.24	2.89
FF	0.89	0.47	8.41	0.04	0.17	0.25	14.19	0.35
NO	0.85	0.90	0.24	0.65	1.50	0.01	0.40	0.35
HE	0.07	0.93	0.08	0.47	1.12	0.41	2.63	2.63
$\overline{R}^2$	0.15	-0.03	-0.22	-1.03	0.24	0.43	0.20	0.89
LL	15.35	9.93	10.01	15.88	27.11	9.67	19.05	32.84

[18] The statistics reported follow a χ-square distribution. Sigma: standard error; SC: Serial Correlation test; FF: functional form test; NO: normality test; HE: hetheroskedasticity; LL: loglikelihood

Table B8(b)

Germany has been excluded (data have been de-meaned)

Industry type: BM (dependent variable linv)								
	Long run coefficients (t ratio)			**H-test (p value)**				
Ly	1.388 (67.608)			1.33 (0.25)				
eer_vol	0.084 (12.270)			1.09 (0.30)				
eer_mis	7.666 (28.161)			0.00 (0.95)				
eer_mis+ve	7.079 (16.880)			1.52 (0.22)				
Error correction coefficient	-0.533 (-2.999)							
Joint Hausman test (p-value):				4.10 (0.39)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	France ARDL (2,1,1,2,2)	**Austria** ARDL (1,0,0,1,0)	**Canada** ARDL (2,0,0,0,2)	**UK** ARDL (2,2,2,1,0)	**US** ARDL (2,2,2,2,2)	**Finland** ARDL (1,0,1,0,0)	**Italy** ARDL (2,1,0,0,0)	**Sweden** ARDL (2,2,2,2,2)
Error Correction	-0.2343 (-1.6290)	-0.2954 (-1.2568)	-0.5935 (-4.7342)	-0.3348 (-1.8187)	-0.3072 (-2.7343)	-0.4331 (-3.9092)	-0.3200 (-3.5027)	-1.7477 (-33.0572)
dlinvest(-1)			0.5095 (2.8703)					1.1156 (32.4060)
Dly					0.9418 (2.6588)		0.6993 (2.4658)	-0.4446 (-6.8437)
dly(-1)								-0.3688 (-7.4468)
deer_vol								-0.2559 (-17.4808)
deer_vol(-1)								0.0575 (7.3296)
deer_mis								-9.7694 (-18.7513)
deer_mis(-1)				-2.3434 (-2.3724)				-8.0416 (-23.6231)
deer_mis+ve			-7.1208 (-2.2923)					-7.1954 (-10.1405)
deer_mis+ve (-1)			-5.9647 (-2.1171)					-5.8575 (-12.9721)
Intercept					-0.3371 (-2.7047)	0.3911 (4.0423)	0.0567 (1.9246)	-0.3680 (-13.3408)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.157	0.209	0.178	0.169	0.158	0.222	0.118	0.023
SC	7.98	0.22	4.87	5.98	0.42	0.39	0.09	14.31
FF	1.75	1.07	12.74	0.16	1.76	0.31	16.58	23.69
NO	7.95	1.09	0.56	1.83	0.64	0.59	0.24	0.04
HE	0.55	0.05	0.25	0.49	2.02	0.86	0.45	1.96
$\overline{R}^2$	-0.10	-0.33	0.20	-0.78	-0.46	0.19	0.18	0.97
LL	19.30	7.32	11.92	16.85	22.40	6.04	18.80	60.08

Table B8(c)

Industry type: BM (dependent variable linv)								
	Long run coefficients (t ratio)					**H-test (p value)**		
Ly	0.876 (8.739)					0.67 (0.41)		
eer_vol	0.104 (3.545)					0.10 (0.75)		
eer_mis	1.786 (3.639)					0.47 (0.49)		
eer_mis+ve	1.507 (2.204)					0.00 (0.98)		
p_vol	-0.199 (-3.744)					1.51 (0.22)		
Error correction coefficient				-0.537 (-4.315)				
Joint Hausman test (p-value):				1.64 (0.90)				
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)								
	France ARDL (1,1,0,0,0,0)	**Austria** ARDL (1,0,1,1,0,0)	**Canada** ARDL (1,0,1,1,0,0)	**UK** ARDL (1,0,1,1,1,0)	**US** ARDL (1,1,1,0,0,0)	**Finland** ARDL (0,0,0,0,1,1)	**Italy** ARDL (1,1,0,0,1,0)	**Sweden** ARDL (1,1,0,0,0,1)
Error correction	-0.3412 (-1.4019)	-0.5394 (-2.5882)	-0.4478 (-3.1748)	-0.2684 (-1.6290)	-0.1887 (-1.7081)	-1.0000	-0.3579 (-2.1863)	-1.1554 (-7.7542)
dly	2.0962 (2.1868)				1.1617 (3.1363)			-0.6451 (-2.0035)
deer_mis			-4.0416 (-2.1731)					
Intercept							0.1213 (1.9408)	0.2791 (2.7626)
Diagnostic statistics								
	France	**Austria**	**Canada**	**UK**	**US**	**Finland**	**Italy**	**Sweden**
Sigma	0.171	0.213	0.209	0.167	0.126	0.258	0.150	0.068
SC	1.99	0.77	6.45	0.03	1.33	17.39	5.50	0.60
FF	3.42	0.01	0.79	7.33	0.40	6.13	12.45	4.21
NO	0.92	0.73	1.22	2.27	0.68	0.35	0.32	0.28
HE	1.71	1.10	0.25	0.76	2.04	0.94	0.07	0.18
$\overline{R}^2$	0.01	-0.35	-0.08	-0.87	0.12	-0.25	-0.26	0.81
LL	11.12	8.51	8.90	13.80	18.44	3.94	14.81	27.89

Germany has been excluded (data have been de-meaned)

Table B8(d)

Industry type: BM (dependent variable linv)							
	Long run coefficients (t ratio)				**H-test (p value)**		
Ly	1.014 (15.154)				0.56 (0.45)		
reer_vol	0.099 (3.379)				0.82 (0.36)		
reer_mis[19]	-6.833 (-4.863)				1.56 (0.21)		
reer_msp	0.799 (2.814)				1.07 (0.30)		
Error correction coefficient				-0.436 (-3.147)			
Joint Hausman test (p value):				4.05 (0.40)			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)							
	France ARDL (1,2,2,2,1)	**Austria** ARDL (1,0,2,0,2)	**Canada** ARDL (1,1,0,2,0)	**UK** ARDL (2,2,2,0,0)	**US** ARDL (1,1,2,2,0)	**Italy** ARDL (2,2,1,2,2)	**Sweden** ARDL (2,1,2,2,2)
Error correction	-0.2004 (-2.5926)	-0.6395 (-4.1563)	-0.4256 (-2.7124)	-0.1090 (-0.6709)	-0.1098 (-0.7511)	-0.4297 (-1.7786)	-1.1415 (-10.9731)
dlinv(-1)							0.5083 (10.3199)
Dly	2.8356 (7.4053)				1.4409 (3.2584)		-0.7883 (-6.5382)
dly(-1)	2.5078 (8.5493)						
dreer_vol	-0.0952 (-3.7280)	-0.2047 (-3.0278)					-0.2793 (-12.3369)
dreer_vol(-1)	0.0630 (2.4532)						-0.1268 (-8.7441)
dreer_mis	6.6779 (6.0456)				2.0534 (2.2128)		
dreer_mis(-1)	6.0260 (8.6521)						-6.7267 (-8.0402)
dreer_msp	-1.6822 (-7.9983)						
dreer_msp(-1)	-1.6822 (-7.9983)						1.0681 (7.4918)
Intercept	0.0845 (7.6277)						0.1600 (2.9694)
Diagnostic statistics							
	France	**Austria**	**Canada**	**UK**	**US**	**Italy**	**Sweden**
Sigma	0.041	0.108	0.124	0.084	0.079	0.046	0.032
SC	5.47	0.01	6.15	11.47	0.66	1.16	6.84
FF	0.08	0.23	0.31	0.89	4.78	0.64	14.65
NO	1.19	0.41	0.53	0.77	0.49	0.16	0.01
HE	0.76	2.11	0.00	0.45	0.71	0.51	0.78
$\overline{R}^2$	0.91	0.60	0.62	0.67	0.66	0.87	0.94
LL	43.68	23.06	18.80	27.59	30.45	44.06	49.12

Germany and Finland have been excluded (data have been de-meaned)

[19] When adding a term in positive misalignment, the volatility term becomes insignificant. The coefficient on the term in positive misalignment itself is significant and negative.

Table B9

Industry type: Mach (dependent variable linv)			
	Long run coefficients (t ratio)		**H-test (p value)**
ly	1.106 (62.676)		0.01 (0.91)
eer_vol	-0.358 (-6.455)		0.87 (0.35)
Error correction coefficient	-0.856 (-2.423)		
Joint Hausman test (p value):		453 (0.10)	
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)			
	France ARDL(1,2,0)	**UK** ARDL(3,1,3)	**Finland** ARDL(0,3,3)
Error correction	-0.1851 (-1.1460)	-1.3830 (-7.2066)	-1.0000[20]
dlinv(-1)		0.5874 (6.0281)	
dlinv(-2)		0.3765 (4.6758)	
dly		0.6681 (2.0862)	
dly(-1)	1.7217 (2.3492)		
deer_vol		0.4416 (4.5152)	
deer_vol(-1)		0.3192 (4.7014)	
deer_vol(-2)		0.1781 (5.4514)	
Intercept		-5.8751 (-7.7894)	-3.9964 (-17.3252)
Diagnostic statistics			
	France	**UK**	**Finland**
Sigma	0.143	0.040	0.373
SC	3.52	0.35	96.06
FF	0.67	6.79	36.21
NO	1.56	8.76	1.35
HE	1.86	0.14	13.01
$\bar{R}^2$	0.19	0.92	-3.17
LL	13.15	38.32	-2.11

[20] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than -1

Table B10(a)

Industry type: Min (dependent variable linv)			
	Long run coefficients (t ratio)		**H-test (p value)**
ly*	2.815 (10.972)		4.15 (0.04)
p_vol	-1.096 (-3.760)		0.52 (0.47)
Error correction coefficient		-0.662 (-2.130)	
Joint Hausman test (p value):		na	
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)			
	Finland ARDL (0,01)	**Italy** ARDL(1,10)	**Sweden** ARDL(1,0,1)
Error correction	-1.0000[21]	-0.0412 (0.5313)	-0.9463 (-8.0672)
dp_vol	0.7727 (4.0304)		0.7419 (6.5042)
Intercept	-16.5474 (-7.5045)		-16.9316 (-5.1477)
Diagnostic statistics			
	Finland	**Italy**	**Sweden**
Sigma	0.214	0.150	0.127
SC	0.40	4.86	0.01
FF	0.52	0.02	6.82
NO	0.09	1.18	0.65
HE	1.95	2.07	2.75
$\bar{R}^2$	0.01	-0.29	0.88
LL	3.78	11.12	9.06

*MG estimator and t-statistics 2.147 (5.158)

[21] Single equation ARDL estimates show that shortening the sample size produces an error correction coefficient greater than -1

Table B10(b)

Industry type: Min (dependent variable linv)			
	Long run coefficients (t ratio)		**H-test (p value)**
ly	1.816 (11.513)		0.06(0.80)
eer_vol	-0.498 (-2.255)		2.32 (0.13)
eer_msp	-0.937 (-2.322)		4.44 (0.04)
Error correction coefficient		-0.357 (-2.358)	
Joint Hausman test (p value):		na	
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)			
	Finland ARDL(2,0,0,0)	**Italy** ARDL(2,2,1,2)	**Sweden** ARDL(1,0,0,1)
Error correction	-0.1442 (-0.9216)	-0.6504 (-3.7115)	-0.2771 (-2.1840)
dlinv(-1)		1.0197 (-3.6483)	
dly		-0.7887 (-3.6483)	
dly(-1)		0.5823 (2.4051)	
deer_vol		0.3077 (3.0809)	
deer_msp(-1)		0.2628 (2.0197)	
Intercept		-5.8065 (-2.9093)	-2.5717 (-2.0773)
Diagnostic statistics			
	Finland	**Italy**	**Sweden**
Sigma	0.296	0.100	0.270
SC	0.24	0.24	1.04
FF	3.42	0.19	0.02
NO	0.81	2.18	0.56
HE	0.02	0.77	0.11
$\bar{R}^2$	-0.29	0.41	0.15
LL	-0.49	24.43	1.67

Table B11

Industry type: NEC (dependent variable linv)			
	Long run coefficients (t ratio)		**H-test (p value)**
ly	1.021 (16.899)		na
eer_vol	-0.372 (-2.859)		na
eer_msp	0.408 (2.093)		na
Error correction coefficient	-0.733 (-2.751)		
Joint Hausman test (p value):		na	
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)			
	France ARDL(1,2,0,0)	**UK** ARDL(0,1,2,0)	**Finland** ARDL(0,0,0,0)
Error correction	-0.2002 (-1.3476)	-1.0000[22]	-1.0000[19]
dly(-1)	1.3894 (2.2974)		
Intercept		-3.4029 (-5.9659)	-3.0189 (-5.3766)
Diagnostic statistics			
	France	**UK**	**Finland**
Sigma	0.132	0.141	0.388
SC	0.97	8.40	1.52
FF	3.78	12.43	3.08
NO	1.46	0.96	10.54
HE	0.81	0.54	0.04
$\bar{R}^2$	0.17	0.41	0.44
LL	15.40	14.16	-7.67

[22] Single equation ARDL estimates show that the choice of a different lag structure produces an error correction coefficient greater than –1. Note that eliminating Finland from the sample does not improve results

Table B12(a)

Industry type: NON MET (dependent variable linv)			
	Long run coefficients (t ratio)		**H-test (p value)**
ly	0.459 (4.134)		2.85 (0.09)
p_vol	-0340 (-3.706)		0.38 (0.54)
Error correction coefficient	-0.765 (-7.562)		
Joint Hausman test (p value):		2.85 (0.24)	
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)			
	France ARDL(3,2,3)	**UK** ARDL(2,2,3)	**Sweden** ARDL(2,0,3)
Error correction	-0.9655 (-4.2322)	-0.6845 (-7.6060)	-0.6439 (-5.6932)
dlinv (-1)	1.2263 (3.7540)	-0.2913 (-2.3661)	0.8920 (6.3881)
dlinv (-2)	0.7502 (2.5161)		
dly	-4.9841 (-3.4407)	1.4230 (4.0296)	
dly(-1)		2.4151 (4.3859)	
dp_vol	0.4279 (2.5997)	0.3269 (5.0815)	-0.1843 (-2.2748)
dp_vol(-1)	0.3562 (3.5115)	0.4151 (6.9511)	
dp_vol(-2)	0.4445 (2.9111)	0.3045 (5.7777)	
Intercept	3.9015 (2.7699)	1.6200 (2.1832)	1.7150 (2.3290)
Diagnostic statistics			
	France	**UK**	**Sweden**
Sigma	0.173	0.103	0.186
SC	0.79	0.32	0.00
FF	0.48	0.72	1.20
NO	1.08	0.54	0.86
HE	0.02	1.26	8.00
$\bar{R}^2$	-0.05	0.85	0.59
LL	14.58	21.52	9.63

Results excluding Finland

Table B12(b)

Industry type: NON MET (dependent variable linv)				
	Long run coefficients (t ratio)		**H-test (p value)**	
ly	0.661 (5.144)		0.59 (0.44)	
eer_vol	-0.598 (-4.552)		0.03 (0.86)	
eer_mis	13.838 (3.373)		0.65 (0.42)	
eer_msp	-1.970 (-3.472)		0.09 (0.76)	
Error correction coefficient		-0.409 (-2.030)		
Joint Hausman test (p value):		na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)				
	France ARDL(1,0,0,0,0)	**UK** ARDL(1,2,2,2,2)	**Finland** ARDL(0,2,2,0,0)	**Sweden** ARDL(2,0,2,2,2)
Error correction	-0.1074 (-0.8515)	-0.3153 (-2.0787)	-1.0000[23]	-0.2133 (-1.9989)
dlinv (-1)				0.7708 (3.8779)
dly		1.7377 (2.6749)	1.5107 (3.0806)	
dly(-1)			1.8042 (3.5222)	
deer_vol			0.6148 (5.3640)	
deer_vol(-1)			0.3491 (4.6803)	
deer_mis		-8.2119 (-2.1156)		
deer_msp		1.3125 (2.0000)		
Diagnostic statistics				
	France	**UK**	**Finland**	**Sweden**
Sigma	0.190	0.283	0.185	0.380
SC	1.55	1.73	0.57	4.69
FF	2.57	4.17	1.58	7.15
NO	2.10	2.12	0.86	0.54
HE	0.06	0.21	0.02	0.55
$\overline{R}^2$	-0.31	-0.06	0.64	-0.87
LL	8.44	10.71	11.34	6.16

[23] Single equation ARDL estimates show that adding a dummy for 1988 produces an error correction coefficient greater than -1

Table B12(c)

Industry type: NON MET (dependent variable linv)				
	Long run coefficients (t ratio)		**H-test (p value)**	
ly	0.917 (18.325)		0.41 (0.52)	
reer_vol	-0.203 (-2.331)		0.02 (0.90)	
reer_mis	9.316 (3.707)		1.90 (0.17)	
reer_mis+ve	-47.880 (-7.048)		0.75 (0.39)	
Error correction coefficient		-0.520 (-3.148)		
Joint Hausman test (p value):		na		
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)				
	France ARDL(3,3,3,3,1)	**UK** ARDL(2,1,3,0,0)	**Finland** ARDL(3,1,0,0,3)	**Sweden** ARDL(3,3,0,3,2)
Error correction	-0.3568 (-3.1098)	-0.2547 (-3.7944)	-0.9972 (-6.1333)	-0.4705 (-2.7879)
dlinv (-1)		0.2865 (2.4257)	0.3657 (3.2285)	
dlinv (-2)			-0.3259 (-2.8536)	
dly		1.1632 (3.0304)		
dreer_mis+ve	13.5199 (2.1854)		25.3065 (4.7037)	
dreer_mis+ve(-1)			13.2029 (3.1780)	
dreer_mis+ve(-2)			9.9244 (4.1205)	
Intercept		-0.3696 (-2.4539)	-1.2950 (-2.6227)	-0.6588 (-2.1139)
Diagnostic statistics				
	France	**UK**	**Finland**	**Sweden**
Sigma	0.045	0.139	0.153	0.146
SC	0.96	1.24	0.18	5.32
FF	0.09	3.84	5.89	0.00
NO	0.48	1.10	2.61	0.71
HE	1.43	0.06	0.11	0.15
$\overline{R}^2$	0.94	0.71	0.77	0.74
LL	57.82	20.59	19.94	25.37

Table B13(a)

Industry type: Wood (dependent variable linv)					
	Long run coefficients (t ratio)			**H-test (p value)**	
ly	1.247 (23.401)			0.03 (0.85)	
reer_vol	-0.156 (-3.199)			0.59 (0.44)	
reer_mis	8.458 (1.822)			1.26 (0.26)	
reer_msp	-3.473 (-4.328)			0.20 (0.66)	
Error correction coefficient		-0.446 (-2.430)			
Joint Hausman test (p value):		na			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)					
	Austria ARDL(1,1,0,1,0)	**UK** ARDL(2,0,0,3,1)	**US** ARDL(1,3,1,0,1)	**Finland** ARDL(1,3,1,3,3)	**Italy** ARDL (3,3,3,3,1)
Error correction	-0.4479 (-4.5884)	-1.1492 (-8.5115)	-0.1159 (-2.0824)	-0.2805 (-3.7244)	-0.2376 (-2.9510)
dlinv(-1)		0.5759 (4.1238)			
dly	1.5504 (4.8573)			0.6846 (2.8218)	2.2674 (4.2354)
dly(-1)			1.1002 (4.6638)		
dly(-2)				1.1185 (5.2225)	
dreer_vol				0.1637 (2.2404)	0.1313 (2.2432)
dreer_mis(-1)	-4.2624 (-2.7096)	8.3976 (4.8102)			
dreer_mis(-2)		3.7935 (3.4190)		5.6176 (2.1351)	
dreer_msp		1.2282 (2.2530)			
dreer_msp(-2)				-1.1349 (-2.9937)	
Intercept	-2.3831 (-4.5741)	-6.3611 (-6.8620)	-0.7740 (-2.3305)	-1.5890 (-3.9599)	-1.2876 (-2.8572)
Diagnostic statistics					
	Austria	**UK**	**US**	**Finland**	**Italy**
Sigma	0.109	0.135	0.124	0.204	0.191
SC	0.01	1.26	0.09	6.02	5.72
FF	1.95	7.26	0.32	1.59	4.13
NO	2.17	0.79	1.73	3.13	0.10
HE	4.65	0.00	0.37	0.06	0.85
$\overline{R}^2$	0.57	0.71	0.44	0.37	-0.49
LL	26.28	21.42	24.05	16.90	22.29

Table B13(b)

Data have been de-meaned

Industry type: Wood (dependent variable linv)						
	Long run coefficients (t ratio)				**H-test (p value)**	
ly	0.669 (8.495)				0.02 (0.90)	
reer_vol	-0.305 (-4.004)				0.60 (0.44)	
reer_mis	6.997 (2.647)				0.02 (0.88)	
reer_mis+ve	-46.781 (-8.381)				0.05 (0.82)	
Error correction coefficient			-0.397 (-4.360)			
Joint Hausman test (p value):			na			
Country specific error correction coefficients and short run coefficients (t ratios in parenthesis)						
	Austria ARDL (1,1,3,2,3)	**Canada** ARDL (1,2,0,0,3)	**UK** ARDL (2,1,2,3,1)	**US** ARDL (1,0,1,0,0)	**Finland** ARDL (1,0,0,0,1)	**Italy** ARDL (1,3,1,1,3)
Error correction	-0.2520 (-2.1684)	-0.4384 (-3.8941)	-0.6550 (-2.3078)	-0.0642 (-0.9181)	-0.3579 (-4.5450)	-0.6135 (-9.2976)
dlinv(-1)			0.7329 (2.1559)			
dly	0.7365 (3.3584)					
dly(-1)		0.9384 (3.1786)				0.4307 (2.9428)
dly(-2)						0.8807 (5.5025)
dreer_vol						0.1930 (4.5748)
dreer_vol(-2)	0.2064 (3.9850)					
dreer_mis						-3.1855 (-2.5409)
dreer_mis(-1)	7.5333 (3.4612)					
dreer_mis+ve			17.9426 (2.3699)		7.8975 (3.4419)	22.7134 (7.1104)
dreer_mis+ve(-1)	-10.6774 (-2.3421)					9.4655 (5.4911)
dreer_mis+ve(-2)	-7.1969 (-2.7597)					4.3414 (4.1852)
Intercept	0.1094 (1.9667)	-0.1349 (-3.5821)	-0.5459 (-1.9250)			0.3217 (8.3260)
Diagnostic statistics						
	Austria	**Canada**	**UK**	**US**	**Finland**	**Italy**
Sigma	0.119	0.146	0.224	0.176	0.195	0.067
SC	0.46	3.19	1.48	0.41	0.70	1.83
FF	0.19	1.24	0.44	1.65	0.36	5.01
NO	1.58	1.09	1.27	0.46	1.26	1.07
HE	0.22	0.33	0.53	0.04	0.17	1.88
$\overline{R}^2$	0.47	0.59	-0.28	-0.26	0.31	0.74
LL	29.29	19.90	12.36	12.68	10.07	41.35

Footnotes:

[1] Notice that exchange rate uncertainty would affect not only decisions to invest in a foreign country, but also domestic investment decisions, because for example the presence of vertical integration or because firms might be able to switch between producing for (or in) the domestic or the foreign market.

[2] Note that including α and σ as separate parameters means that our model treats pure volatility (σ) and predictable variations (α) as separate components in the overall degree of variability of prices or the exchange rate.

[3] Notice that in this paper we adopt a similar definition of mean preserving price (exchange rate) uncertainty to Caballero (see Caballero, 1991). Specifically, we focus solely on the type of uncertainty originated by a volatile and misaligned currency. Nonetheless, there might be a range of different sources of uncertainty affecting investment decisions. Carruth et al. (2000) review some of approaches used in the literature to proxy the uncertainty affecting investment decisions (eg, stock market volatility, real wages volatility, long and short bond risk premia). However, they also point out "*a lack of consensus about best practice*" and that each measure bears a number of shortcomings. Importantly, they also stress that "*correlation with a volatility measure… may reveal more about correlation with some omitted underlying "fundamentals"*". Nevertheless, this kind of risk should be significantly reduced in the type of disaggregated empirical analysis conducted in this paper. Moreover, our results are generated by an extensive general to specific search which means the final specification is more dependent on the significance (t-ratios) of individual coefficients, than by general error diagnostic

tests which get averaged across the panel. The latter might allow omitted variables because the existence of cointegrated relationships does not mean they are unique. But by concentrating on the individual variables, we can at least identify if exchange rate volatilities and misalignments are important driving variables for investment expenditures, and in which direction they drive them.

[4] Details of the optimisation problem and its solution can be found in the Appendix of the paper.

[5] This was shown in Darby et al. (1999) for changes in σ; and in Darby et al. (2002) for changes in α. In each case we had to show that an increase in the width of the inactivity zone was not matched by an increase in the area of the price distribution above P_L. If that had happened a wider range of conditions with no investment could have been offset by a higher frequency of prices which trigger investment.

[6] See Appendix B for detailed numerical estimates of these coefficients, standard error and all the regression diagnostics. Note that these results are derived from an extensive specification search within the general framework defined by equations (2)-(4) below. However we only report the final results: where only coefficients which are significant at the 5% level have been retained, and where the standard diagnostic tests are satisfied. Estimates for the remaining models and coefficients are available from the authors on request; as also are the model estimates obtained when the volatility measures are computed as in Darby et al. (1999).

[7] To compute these volatility measures we start from monthly data, which are then rolled over according to equation (1) using a five month window (m=5). Finally, annualised measures of volatility are computed by averaging the result over the year.

[8] In some panels, countries with only a limited number of observations available were excluded from the sample.

[9] Admittedly, the STAN database contains data on other variables which could be included in the investment model. However, these data are not available for all the countries and all the sectors in consideration. Including those extra variables would mean severely reducing the already small size of the panels in use, thus undermining the validity of the empirical analysis performed.

[10] Given the possibility that industrial production and price volatility are endogenous with respect to investment, a GMM approach would, for example, be more appropriate. Also, notice that a cross section dimension of 9 is usually considered too large for SUR or other system estimations techniques to be applicable.

[11] Although large values of T are not a feature of our data, it is however true that the time series dimension of our panels is at least three times as large as the cross sectional one.

[12] Pesaran et al. (1999) contains an extensive comparison of the PMGE with other dynamic panel estimation procedures.

[13] We have conducted Levin-Lin and IPS tests.

[14] In the paper we follow the convention, usually adopted when conducting PMGE estimations, of not testing for the existence of such long run relationship. However panel unit root tests of the residuals of the long run relationships for each sector, available from the authors on request, suggest that this hypothesis cannot be rejected.

[15] Producer price volatility and misalignment are included alongside nominal exchange rate volatility and misalignment to account for any possible interaction

effect. However, the interaction is not rejected by the data only in one sector (Basic Metals).

[16] Only the results for the Basic Metal sector contravene out theoretical intuition.

[17] A formal proof can be found in Hughes Hallett et al. (2003a).

[18] According to the ISIC classification, the Chemical sector includes factories attending "the transformation of organic and inorganic raw materials by a chemical process and the formulation of products". The Textiles sector includes "preparation and spinning of textile fibres as well as textile weaving, finishing of textiles and wearing apparel, manufacture of made-up textile articles, except apparel (e.g. household linen, blankets, rugs, cordage, etc.) and manufacture of knitted and crocheted fabrics and articles thereof (e.g. socks and pullovers)". The Food industry "processes the products of agriculture, animal husbandry and fishing into food and drink for humans or animals, and includes the production of various intermediate products, which are not directly food products". The Transport sector includes "activities related to providing passenger or freight transport, whether scheduled or not, by rail, pipeline, road, water or air; supporting activities such as terminal and parking facilities, cargo handling, storage, etc.; postal activities and telecommunication ; renting of transport equipment with driver or operator." (ISIC rev. 3.1, Detailed structure and explanatory notes).

[19] The sign of the effect turns positive if the sign preserving measure of misalignment is added to the long run relationship.

[20] The sign of the effect turns negative if a term in positive misalignments is added to the long run relationship.