Openness and foreign exchange exposure: A firm-level multi-country study

We examine the relation between economic openness and foreign exchange exposure for a sample of 3,788 companies from 23 developed countries. We find a strong positive relation between exchange exposure at the firm level and the country's economic openness (as measured by trade and FDI), and this relation holds after controlling for firm size.

Key words: Foreign exchange exposure, economic openness, openness to trade, FDI.

1. Introduction

Exposure to exchange rate movements is a critical risk management issue for firms in a globally integrated world economy. During the last couple of decades, as the world has seen massive growth in trade and investment flows, most countries have become more open and competitive pressures are increasingly international. While the benefits of economic openness are well established, the downside is that it may be associated with greater exposure to international economic shocks.[1] An important source of risk for economies overall and firms individually is exchange rate volatility. Do firms based in countries with open economies bear the disadvantage of higher levels of exposure to exchange rate changes than those in more closed economies?

A firm is subject to exchange exposure if unexpected changes in exchange rates affect expected future cash flows, and therefore firm value. An extensive literature has arisen examining the extent to which exchange rates affect firm value, and this research has mostly been operationalised via Adler and Dumas' (1984) and Jorion's (1990) technique of measuring the sensitivity of equity returns to exchange rate changes.[2] Counter to theory, most have found a weak relation between stock returns and exchange rate changes. Many reasons have been advanced to explain this common finding, including hedging activities and geographic diversification within the firm. An important explanation is that the US is not a particularly open economy, and most studies have been conducted using US data.

Bodnar and Gentry (1993) argued that their finding of higher exposure for Canadian and Japanese firms relative to US firms may be due to greater openness to trade. As

[1] See Calderon, Loayza and Schmidt-Hebbel, 2004, for a recent review.
[2] A less popular approach measures the impact of exchange rate changes on cash flows or earnings (Martin and Mauer, 2003; Walsh, 1994).

discussed in a recent review (Muller and Verschoor, 2006), several single-country studies point to the possibility that an economy's openness influences the degree of exchange exposure (for example, Donnelly and Sheehy, 1996; He and Ng, 1998; Chen, Naylor and Lu, 2004; Glaum, Brunner and Himmel, 2001). Using a large international data set of firms with high levels of international sales, Doidge, Griffin and Williamson (2006) show that exchange exposure is in fact statistically and economically significant. In the only study that we know of that specifically examines the issue of economic openness and exchange exposure, Friberg and Nydahl (1999) found a significant positive relation between market-level exchange exposure and openness. However, the literature to date lacks a systematic, large-sample study of the relation between economic openness and exchange exposure at the firm level. Are firms in open economies more exposed to exchange risk than those in relatively closed economies?

We address this critical gap in the literature by examining the relation between exchange exposure and economic openness for 3,788 companies in 23 developed countries over the 20-year period from 1984 to 2003.[3] Because exchange rate movements can affect any firm – not just those with international transactions or operations – we include all firms in each country for which price data are available for the full period. Such *indirect* exposure arises because suppliers and competitors can be directly exposed, or because firms operate in a competitive, globalised industry. In most studies of firm-level exchange exposure, samples are compiled on the basis of a certain minimum level of international transactions (see, for example, Jorion, 1990; Donnelly and Sheehy, 1996; Chow, Lee and Solt, 1997; He and Ng, 1998). In fact, not only does theory relating to exchange exposure suggest that it extends beyond international transactions, but as Dominguez and Tesar (2001a) argue, firms

[3] The period is shorter than 20 years for a few countries due to data constraints; the data periods for each country are detailed in Table 1.

with indirect exposure may be more exposed than those with direct exposure, since the latter are more likely to have natural hedges in place or to have access to other hedging strategies. It is well understood that transaction exposure is straightforward to measure (Chow, Lee and Solt, 1997), and several studies have shown that hedging using foreign currency derivatives mitigates foreign exchange exposure (Allayanis and Ofek, 2001; Allayanis and Weston, 2001; Nguyen and Faff, 2003). Most transaction exposure is routinely managed, certainly in developed countries (Batten, Mellor and Wan, 1993; Bodnar, Hayt and Marston, 1998; Prevost, Rose and Miller, 2000).

There is a substantial literature demonstrating a positive relation between openness and economic growth (see Frankel and Romer, 1999, and Calderon, Loayza and Schmidt-Hebbel, 2004, for reviews) in which economic openness is usually measured by trade flows. An alternative measure of openness is foreign direct investment (FDI). Although not as popular a measure of economic openness as trade, FDI has also been shown to be positively correlated with growth, particularly in developed countries (Borensztein, De Gregorio and Lee, 1998; Gao, 2004). In this study we use trade (exports plus imports as a percentage of GDP) as the main measure of openness, and we then repeat our analysis using FDI (inward plus outward FDI stock as a percentage of GDP).

In the first part of our study we demonstrate the existence of a significantly positive relation between economic openness and foreign exchange exposure at the market level. In the second and key stage of our research, we estimate firm-level exposure by regressing the change in the exchange rate against each firm's returns (while controlling for market effects) for all 3,788 firms. Using the exchange response coefficients estimated from these regressions as the dependent variable, we run a series of pooled cross-sectional regressions

to examine the extent to which the openness of the country in which a company is listed affects its exchange exposure. We find a highly significantly positive relation between the degree of trade openness and firm-level exchange exposure, and a similarly significant although smaller effect using FDI as the measure of openness.

It is well established that small firms tend to be more exposed to exchange rate movements than large firms (Chow, Lee and Solt, 1997; Bodnar and Wong, 2003; Hunter, 2005; Dominguez and Tesar, 2006), and there are at least two reasons why this might be the case. *First*, larger firms are more likely to hedge currency exposure because hedging activities exhibit economies of scale (Geczy, Minton and Schrand, 1997; Bodnar, Hayt and Marston, 1998; Allayanis and Ofek, 2001; Nance, Smith and Smithson, 1993; Hagelin and Pramborg, 2006). *Second*, large firms are more likely to be multinational (Agarwal and Ramaswami, 1992), and firms that operate across a greater number of countries are associated with less exchange exposure (Pantzalis, Simkins and Laux, 2001). When we control for firm size as measured by market value – which is significantly inversely related to exposure – the openness variables remain significant. Consistent with Dominguez and Tesar (2006), we go on to show that the inverse relation between size and exchange exposure is in fact nonlinear; it holds only for firms with a market value of less than US$150 million. After taking this nonlinearity into account, openness – as measured by both trade and FDI – remains a significant determinant of exchange exposure. The greater exposure to exchange rate movements of firms in open economies (relative to those in more closed economies) is an important and not very well-recognised downside of economic openness.

The remainder of our paper is structured as follows. In the next section we present the data set and discuss how exposure is measured, and in section 3 we present our findings on exchange exposure at the market and at the firm level. Section 4 contains our findings on the relation between exchange exposure and trade openness, and section 5 presents the results of our analysis of the relation between exchange exposure and our alternative measure of exchange exposure – FDI. In section 6 we summarise and conclude.

2. Measuring exchange exposure

We use the approach pioneered by Jorion (1990) to estimate exchange exposure at the firm level:

$$r_t^{i,j} = \alpha_0^i + \alpha_1^i R_t^j + \alpha_2^i s_t^j + e_t^i \qquad [1]$$

Here, $r_t^{i,j}$ is the return on stock *i* in country *j* and R_t^j is the return on country *j*'s benchmark stock index for time period *t*. s_t^j is the change in country *j*'s trade-weighted exchange rate index over the same time period. This is a 2-factor model of equity returns in which the inclusion of a market index is designed to control for the macroeconomic effects of exchange rate movements; exchange rates and stock prices may move together simply because they are driven by the same shocks. The coefficient on the exchange rate variable α_2^i therefore measures 'residual' exchange exposure (Jorion, 1990). Thus a drawback of using this model to estimate firm-level exchange exposure is that if the firm's exchange exposure is close to average – that is, similar to the market's – then no firm-level exposure would be detected (Glaum, Brunner and Himmel, 2000). We examine market-level exchange exposure by replicating Friberg and Nydahl's (1999) study of exchange exposure at the market level, in which the following model is estimated for each market:

$$R_t^j = \beta_0^j + \beta_1^j s_t^j + \varepsilon_{j,t} \qquad [2]$$

Summary information on the data set is presented in Table 1. Our 23 sample countries are OECD members that have a national stock exchange. They all have liberalised economies and open stock markets, including Greece, Mexico, Portugal and Turkey, which according to Bekaert and Harvey (1998 and 2000) de-regulated their equity markets before the start date in our data set; respectively 12/87, 5/89, 7/86 and 8/89. As detailed in column [1], data are available for most countries from 1984 to 2003.[4] For 7 of the countries, the data period is shorter due to restricted availability of either stock market or exchange rate data (the specifics are detailed in note *a* of the table). Table 1 includes information on three proxies for country size: population, GDP and total stock market capitalisation (columns [2], [3] and [4] respectively), drawn from *The Economist's* World in Figures, 2003. The largest country by all three measures is the US, and the smallest is New Zealand.

The last two columns of Table 1 contain summary information on our sample of firms: number in each country (column [5]) and median firm market value (column [6]). Our firm-level data comprise all companies for which equity price data were available on Datastream at the end of December 2003 that were listed for the full period from the start date. The number of companies varies from 12 for Ireland to 794 for Japan and 1,156 for the US, and the range in the number of firms in each country is of course related to the size of the economy – the correlation between the number of companies in each country and its GDP is 0.98. There is a vast difference between the median size (market value) of firms across countries. Finland has the largest firms with a median market value of US$760 million, and Portugal has by far the smallest at US$22.8 million. The median firm size in the two largest economies – the US and Japan – is very similar at US$454 million and

[4] This long data period is comparable to the 20-year period used by Dominguez and Tesar (2001a, 2001b, and 2006) whose firm-level data set for 8 countries covered the period 1980-99.

US$473 million respectively. As there is growing evidence of an inverse relation between firm size and exchange exposure (see, for example, Bodnar and Wong, 2003; Hunter, 2005; Dominguez and Tesar, 2006), we control for size (as proxied by market value as at December 31, 2003) in our analysis of the relation between exchange exposure and economic openness.

In Table 2 we present summary statistics for the stock market and trade-weighted index data. The country stock indexes are monthly Datastream value-weighted indexes (our index and stock price data are in local currencies), and the exchange rates are Bank of England trade-weighted exchange rates. An increase in the exchange rate index indicates an appreciation of the currency. All of the stock markets show positive monthly returns on average, with a wide range of volatilities as measured by standard deviation.

Several of the countries in the sample experienced reductions in their trade-weighted exchange rates over the period; the biggest falls were experienced by Turkey and Mexico, with mean declines of 3 and 1 percent per month respectively. The Japanese yen saw a substantial increase in its value over the period – of 0.26 percent on average, which is more than 3 percent per year. Turkey and Greece have the greatest market volatility as measured by return standard deviation, with the US and Canada showing the lowest stock market return volatility. Despite appearances (Turkey's and Greece's stock markets have amongst the smallest firms on average; see column [6] in Table 1) there is in fact no significant relation between median firm size and stock market volatility; when Turkey and Greece are removed, the correlation is -0.08.

It is well understood that floating exchange rates tend to be more volatile than fixed or pegged systems (see Flood and Rose, 1999, and Canales-Kriljenko and Habermeier, 2004, for reviews). This tends to hold for our sample countries as shown in Table 3, which ranks the countries by exchange rate volatility from highest to lowest, and documents the exchange rate arrangements in place over the data period. Eleven countries (Australia, Canada, Japan, Mexico, New Zealand, Norway, Sweden, Switzerland, Turkey, UK and US) have independently floating exchange rate systems. Another 11 (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain) are in the Eurozone,[5] and lastly Denmark's currency is pegged to the euro. Generally speaking, the countries with floating currencies populate the upper part of the table having relatively high volatility, and the eurozone countries dominate the lower part. Turkey and Mexico exhibited the highest exchange rate volatility during the period; their declining currency values were accompanied by very high volatility of over 4 percent on a monthly basis. The lowest volatility floating exchange rates were those of Norway, Switzerland, Canada and Sweden. Finland, Italy and Spain had the highest volatility eurozone trade-weighted exchange rates.

3. Findings on foreign exchange exposure

3.1 Market-level exposure

Table 4 summarises the results for equation [2], in which we estimate the foreign exchange response coefficients β_1^j for each national stock market. For 15 out of the 23 countries in our study, we find that the foreign exchange response coefficient is significant at the 5 percent level or better, and another – Norway – is significant at the 10 percent level

[5] Our data set spans a major change in European exchange rate regimes with the introduction of the euro in 1999. Bartram and Karolyi (2006), however, find that although European firms' exchange exposure falls after the advent of the euro, this change is economically and statistically small.

(p = 0.06). This is a higher proportion of significant effects than found by Friberg and Nydahl (1999) who used monthly data for the period 1973-1996; only 3 of their 11 countries had significant exposure at the 5 percent level. In common with Friberg and Nydahl, we find that Austria, Belgium and Denmark are significantly exposed at the market level, but Sweden, the US and the UK are not. France, Germany, Italy and Japan, significantly exposed in our findings, were not found to be significantly exposed by Friberg and Nydahl.

We find positive and negative response coefficients in equal measure. The countries with negative response coefficients – whose stock markets are adversely affected by a strengthening currency – are mostly Eurozone countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Netherlands and Portugal. Denmark, Switzerland and the UK also have negative response coefficients, although the UK's is not statistically significant. Other stock markets have positive response coefficients and are therefore adversely affected by a weakening currency, including Australia, Canada, Japan, Mexico, Norway and Sweden. Friberg and Nydahl (1999) find only 3 countries with positive exchange rate exposure – Japan, Italy and the UK – but none of these were significantly exposed. In contrast, for 7 of our countries there is a significant positive relation between the stock market and the exchange rate. For the commodity currencies – Australia, Canada, Norway and New Zealand – this is probably explained by the fact that both stock markets (which are heavily populated by commodity companies) and currency values are positively related to commodity prices. The significant positive for Japan is in contrast to Friberg and Nydahl's (1999) who found the relation between the yen and the Japanese stock market to be positive but insignificant. The response coefficient, however, at 0.269, is relatively small in absolute terms.

We include in Table 4 a decomposition of the exchange response coefficients into their two components – the covariance between the market returns and the change in the exchange rate (column [3]), and the variance of the change in the exchange rate (column [4]) – to provide insight into the composition of the exchange response coefficients. For example, the high negative response coefficient for the Netherlands (-2.775) results from a high covariance and a relatively small exchange rate variance. Clearly the Netherlands' stock market is very sensitive to exchange rate volatility. In contrast, Turkey and Mexico have highly volatile currencies, and this volatility is accompanied by high positive covariances between the exchange rate change and the market return, resulting in these countries' rather moderate response coefficients.

3.2 Firm-level exposure

Table 5 summarises our results for equation [1] on the full data set of 3,788 companies. It presents summary information on the exchange response coefficients (α_2^i): the mean (column [2]), the number negative and positive (columns [3] and [4]), and the number and proportion significant (columns [5] and [6]) for each country. We include the mean of the absolute value of the response coefficients in column [7], because our openness analysis uses absolute rather than actual response coefficient values. We find that 422 out of the 3,788 companies (11 percent) in our sample have significant exchange exposure.

For the US – the country that has attracted most research in the area of exchange rate exposure – we find that 134 out of 1,154 (11.6 percent) firms are significantly exposed. This is much higher than found by Jorion's (1990) 15 out of 287 firms (5 percent). Our figure for New Zealand firms – 12.5 percent – is comparable to that of Chen, Naylor and Lu (2004) who found that 10 to 14 percent of their sample firms were significantly exposed. In

contrast, we find that 12 percent of 69 Swedish firms are significantly exposed – considerably less than the quarter found by Nydahl (1999) for his sample of 47 companies. For Japan, He and Ng (1998) found significant exposure for 26 percent of their 171 sample firms, which is a much higher proportion that our 16 percent. Dominguez and Tesar's (2001a and 2006) data set includes firms from 8 countries, 6 of which we also examine – France, Germany, Italy, Japan, the Netherlands and the UK. They find that 8 percent of French firms are significantly exposed, with 14 percent for Germany and Italy, 26 percent for Japan, 15 percent for the Netherlands and 11 percent for the UK. We find lower proportions of significant response coefficients, with 5 percent for France, 6 percent for Germany, 9 percent for Italy, 16 percent for Japan, and 7 percent and 8 percent respectively for the Netherlands and the UK.

The country with the highest ratio of negative response coefficients to positives is Switzerland – about 80 percent of its companies' stock prices are adversely affected by a strengthening of the Swiss Franc – a relation that would be expected for net exporters or companies with assets denominated in other currencies. Countries similarly affected are Belgium, Denmark, Italy, Germany and Japan. At the other end of the spectrum, companies are more likely to be positively affected by a strengthening currency in Greece, Turkey, Australia, Spain, Norway and Austria.

4. Exchange exposure and openness

There is a substantial literature demonstrating a positive relation between openness and economic growth (Frankel and Romer, 1999; Calderon, Loayza and Schmidt-Hebbel, 2004), in which economic openness is usually measured by trade flows. Our trade measures

of openness were obtained from the Penn World Table Version 6.1[6], for the period 1984-2000, which is calculated as exports plus imports as a percentage of GDP at constant prices. We use the average of these annual figures from the year in which our daily price data begins for each country.

Figure 1 depicts the trade openness data. Panel A shows each country's trade openness ranked from highest to lowest. Belgium, Ireland and the Netherlands are the most open economies, and the US and Japan are the most closed. Generally speaking, small countries tend to trade more than large (see Wacziarg, Spolaore and Alesina, 2004, for a review), and this is apparent for the countries in our data set. Panel B of Figure 1 depicts trade openness versus country size as proxied by the log of GDP. It is clear from the figure that there is indeed a negative relation between the size of the economy and economic openness. The correlation between log GDP and trade openness is -0.55, and using population as an alternative measure of country size, the correlation between size and openness is -0.57.

In examining the relation between market level exchange exposure and economic openness, we use the exposure response coefficients (β_1^j) estimated via equation [2] at the market level and firm-level response coefficients (α_2^i) estimated from equation [1] as dependent variables in a series of cross-sectional regressions. Rather than using the actual exchange exposure response coefficients, we follow Dominguez and Tesar (2001a and 2001b) and first take the absolute values of α_2^i and β_1^j. This is because the impact of exchange rate changes will vary between markets and between firms, yielding both negative

[6] Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP). (http://pwt.econ.upenn.edu/php_site/pwt61_form.php).

and positive response coefficients. For net exporters, for example, a depreciation of the home currency (making exports more competitive) should increase firm, while for net importers a depreciation should reduce firm value. In addition, trade openness as we define it (exports plus imports over GDP) is a general measure of openness, rather than a measure that might be expected to have a unidirectional relation to exchange exposure.

4.1 Market-level exposure and openness

We estimate a cross-sectional model is as follows:

$$\omega_j = \delta_0 + \delta_1 OPEN_j + \mu_j \qquad [3]$$

where *OPEN* is the log of trade openness for country *j*, and $\omega_j = \left|\beta_1^j\right|$, with β_1^j estimated via equation [2].

Figure 2 depicts the relation between the market-level absolute exchange exposure response coefficients and the log of trade openness. A positive relation is apparent in the figure, and estimating equation [3] using robust regressions with Newey-West standard errors yields a slope coefficient (δ_1) of 0.798. This is significant at the 1 percent level (p = 0.00), and the adjusted R-squared for the regression is 0.24. This finding is consistent with Friberg and Nydahl (1999); stock markets in countries with greater openness are more exposed to exchange rate movements than markets in countries with relatively closed economies.

4.2 Firm-level exchange exposure and openness

For the firm-level analysis, we examine the extent of the relation between economic openness and exchange exposure via a series of pooled cross-sectional regressions. We begin by estimating the following equation:

$$\omega_i = \gamma_0 + \gamma_1 OPEN_{j,i} + \nu_i \qquad [4]$$

Here, $\omega_i = \sqrt{\left|\alpha_2^i\right|}$, with α_2^i estimated via equation [1], and $OPEN_{j,i}$ is the log of trade openness for the country (*j*) in which firm *i* is listed. Following Dominguez and Tesar (2006), we transform the firm-specific absolute exchange response coefficients, $\left|\alpha_2^i\right|$, by taking their square root. This transformation is necessary because taking the absolute value of the response coefficients causes truncation bias, resulting in a non-normal error term. In a second pooled regression we control for firm size (*SIZE*), proxied by market value in US dollars as at December 2003:

$$\omega_i = \gamma_0 + \gamma_1 OPEN_{j,i} + SIZE_i + \nu_i \qquad [4']$$

The results for estimating [4] and [4'] appear in Panels A and B respectively of Table 6. The openness variable is highly significant (at the 1 percent level) in both equations. Without the size control (Panel A) the openness coefficient is a significant 0.155, and when controlling for firm size (Panel B) which is negative and highly significant, the openness coefficient falls slightly to 0.139. The explanatory power of the model as given by the adjusted R-sq increases substantially when size is included – from 7 percent to 11 percent.

4.3 Firm size and exchange exposure – a nonlinear relation?

A closer examination of the evidence on exchange exposure and firm size suggests the possibility that the relation is not linear. Dominguez and Tesar (2006), for example, show that the smallest third of firms in each country are more strongly exposed to exchange rate changes than the largest two thirds. To check for possible nonlinearity in the relation between exposure and firm size, we divide our sample into deciles by market capitalisation and then take an average of the square root of the absolute response coefficients for each decile. The mean, median and standard deviation for each size decile are depicted in 3. It can clearly be seen in the figure that the response coefficients are essentially the same for the largest 6 deciles (deciles 5–10), with the mean and median of each decile varying within a narrow band between 0.50 and 0.60. Below decile 4 – which has a median firm size of US$112 million – the mean response coefficient rises monotonically as the size deciles become smaller. Exchange exposure is at its maximum for the smallest decile, which contains firms with a market value of less than US$10 million. Amongst the smaller firms there is also greater variability in the response coefficient as measured by within-decile standard deviation.

We therefore define small firms as those below US$150 million, as the 4th decile's largest firm has a market value of just over US$150 million. According to this definition, there are 1507 small firms (40 percent) and 2,281 large firms. Table 7 summarises the number and proportion of small and large firms for the sample overall and for each country, ranked on the proportion of small firms in each country from highest to lowest. Not surprisingly given the small median size of its firms as reported in Table 1, Portugal has the greatest proportion of small firms (85 percent), with Greece close behind at 80 percent. Our largest countries – Germany, the UK, the US and Japan – differ considerably in their

proportions of small firms; 58, 45, 36 and 22 percent of firms in each country (respectively) have less than US$150 million in market value. The combined number small firms in these countries – 895 of them – comprise over a third of the small firm subsample. Our technique for defining firms as small contrasts with the approach used by Dominguez and Tesar (2006), who define size within the country – that is, they classify the smallest third of firms in each country as small. As is clear from Table 7, a small firm in Japan, for example, would be considerably larger than one in Denmark or Greece.

Panel C of Table 6 reports the findings of re-estimating the pooled regression of equation [4'] with a 0-1 dummy variable as an additional variable, with 1 representing small firms. In this version of the model the size coefficient becomes insignificant ($p = 0.61$) and the size dummy is highly significantly positive ($p = 0.00$). It appears to be the case that rather than a size effect per se, the smallest firms are driving the inverse relation between exchange exposure and size. To confirm this finding, we re-run equation [4'] separately for small firms ($n = 1507$) and large firms ($n = 2,281$); the results are presented in Panels D and E respectively of Table 6. For both small and large firms, the openness variables are highly significant, and importantly, their coefficients have a similar magnitude; 0.004 for small firms and 0.005 for large. On this estimate, economic openness as measured by trade affects small and large firms to a similar degree. The size variable for small firms is significantly negative ($p = 0.00$), whereas the size variable for large firms, although negative, is not significant ($p = 0.47$).

Our findings on firm size and exchange exposure are clear. Once a firm has a market value of more than US$150 million, size no longer matters. There is essentially no difference in exchange exposure between a firm with a market value of US$200 million

versus one with a market value of US$4 billion (ceteris paribus). In contrast, for firms with a market value of less than US$150 million, the smaller the firm, the greater the exchange exposure.

5. An alternative measure of economic openness – FDI

Although not as popular a measure of openness as trade, FDI also tends to be positively correlated with economic growth, particularly in developed countries (Borensztein, De Gregorio and Lee, 1998; Gao, 2004). For FDI openness, we use inward plus outward stock of FDI[7] as at 2003 from UNCTAD's 2005 World Investment Report, standardised by dividing by GDP. Figure 4 depicts the FDI openness data along with trade openness, ranked (left to right) on trade openness. It is clear from the figure that there is a strong correlation between the two measures of openness; the correlation is in fact 0.75. The relation between FDI openness and country size is, as for trade openness, inverse; the correlation is -0.32, and using population as a proxy for size, the correlation is -0.50. The three countries with greatest trade openness – Belgium, Ireland and the Netherlands – have very high FDI penetration. The most closed countries as defined by trade openness – Japan and the US – are also relatively closed in FDI terms. Some countries, however, are much more open to FDI than to trade, such as the Netherlands, Switzerland, Sweden and the UK, and for others – Austria, Mexico, Turkey and Greece – trade openness exceeds openness to FDI.

Figure 5 depicts the relation between the absolute market-level exchange response coefficients (β_1^j from equation [2]) and the log of FDI openness for each country. As for

[7] We also conducted the FDI openness analysis with outward FDI only, and the findings are similar. These results are available from the authors on request.

trade openness, a positive relation between market exchange exposure and FDI openness is apparent in the figure. Estimating equation [3] with FDI as the measure for openness and using robust regressions with Newey-West standard errors yields a slope (δ_1) of 0.381. This is about half the size of the coefficient for trade openness reported in section 4.1, but it is significant at standard levels (p = 0.04). The adjusted R-squared for the regression is also lower, at 0.13 compared to 0.24 when using trade as the measure for openness.

Table 8 reports the results of the pooled firm-level regressions, repeating the estimates reported in Table 6, but with $OPEN_{j,i}$ in equations [4] and [4'] and being the log of FDI openness instead of the log of trade openness. Except for the small firm-only specification (Panel D) in which FDI openness is significant at the 10 percent level, openness is highly significant. Similarly to the findings using trade openness, the coefficients on the FDI openness variable in Panels A and B (FDI openness as the sole independent variable, and FDI with market value respectively) are almost identical for both specifications. Again as with the findings for trade openness, when the sample is divided into small and large firms (Panels D and E), size is significantly negative for small firms (p = 0.00) but not for large (p = 0.21).

Comparing our findings on trade and FDI openness, it is apparent that at both the market and at the firm level, the magnitude of the sensitivity of firms to exchange rate changes is about twice as great for openness to trade as it is for FDI openness. This holds across all specifications used in our firm-level analysis. Clearly trade openness has a substantially greater effect on stock market and firm-level exchange exposure than FDI openness. A potential explanation for this is that the geographic diversification that is associated with multinationalisation to some extent ameliorates the drawback of openness

that we have demonstrated in this paper. FDI assists in managing economic foreign exchange exposure, and its usefulness was confirmed by Miller and Reuer (1998) who found an inverse relation between FDI and exchange exposure at the firm level. Further, Pantzalis, Simkins and Laux (2001) found that multinational firms with high levels 'network breadth' – that is, firms that operate across a greater number of foreign countries – have lower levels of exchange exposure. We are reluctant to make very strong conclusions on this point because our FDI data are country-level rather than firm-specific, but it is certainly the case that firms in countries that are open to trade are more sensitive to exchange rate fluctuations than those in countries that are open to FDI.

6. Summary and conclusions

In this paper we have investigated the extent of foreign exchange exposure at the market and at the firm level in 23 developed countries, in an attempt to address the question, is economic openness associated with enhanced exposure to exchange rate movements? We find a strongly significant positive relation between exchange exposure and openness as measured by both trade (exports plus imports) and FDI (inward plus outward FDI stock). We confirm the findings of Friberg and Nydahl (1999) and demonstrate that this relation holds at the market level. For our analysis of the exchange exposure of 3,788 companies, we find a strong positive relation between economic openness and firm-level or 'residual' exchange exposure. This holds after controlling for firm size (as proxied by market value) which is inversely related to exposure. The relation remains significant when we take into account the fact that the relation between size and exposure is non-linear and driven by the smallest firms. For large firms (those with a market capitalisation of more than US$150 million) there is no significant relation between size and exposure, and this is consistent

with prior research findings that hedging exhibits economies of scale, and that multinationality – more likely amongst larger firms – mitigates exchange exposure.

Our surprisingly strong finding that exchange exposure and economic openness are positively related is a critical and not very well-recognised drawback for firms operating in open economies. We have found that openness magnifies exchange exposure for large and small firms alike; being large does not protect against its effect. Future research might compare firms with different degrees and types of internationalisation in an attempt to ascertain what sorts of strategies best reduce this effect. In the meantime, firms in open economies should be aware that they face greater levels of exchange exposure than those in more closed economies such as the US and Japan.

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Table 1 Summary information – countries and firms

		Country data			Firm-level information	
	[1]	[2]	[3]	[4]	[5]	[6]
	Data start date[a]	Pop'n (millions)	GDP (US$ bn)	Total market cap (US$ m)	number of firms	Median market cap (US$ m)
Australia	1984-01	19.1	390	372,794	52	437.19
Austria	1984-01	8.1	189	29,935	33	54.43
Belgium	1984-01	10.2	227	182,481	42	182.41
Canada	1984-01	30.8	688	841,385	134	193.70
Denmark	1984-01	5.3	162	107,666	76	58.37
Finland	1988-04	5.2	122	293,635	30	760.07
France	1984-01	59.2	1294	1,446,634	217	213.27
Germany	1984-01	82	1873	1,270,243	283	98.57
Greece	1988-02	10.6	113	110,839	80	35.89
Ireland	1984-01	3.8	93.9	81,882	12	683.00
Italy	1984-01	57.5	1074	768,364	93	193.19
Japan	1984-01	127.1	4842	3,157,222	794	472.84
Mexico	1994-07	98.9	575	125,203	23	247.83
Netherlands	1984-01	15.9	365	640,456	74	290.15
New Zealand	1988-02	3.8	49.9	18,613	24	104.40
Norway	1984-01	4.5	162	65,034	32	225.28
Portugal	1990-02	10	105	60,681	39	22.80
Spain	1987-03	39.9	559	504,219	51	433.70
Sweden	1984-01	8.8	227	328,339	69	384.30
Switzerland	1984-01	7.2	240	792,316	102	217.60
Turkey	1994-07	66.7	200	69,659	60	49.78
UK	1984-01	59.4	1415	2,576,992	312	186.05
US	1984-01	283.2	9837	15,104,037	1156	454.05

Notes. The sample includes all companies with stock price data available on Datastream at the end of December 2003 that had existed for the full period (as specified in column [1]). This yielded 20 years of data for most of the countries. Population, GDP and overall market capitalisation (columns [2] – [4]) are drawn from the Pocket World in Figures, published by *The Economist*, 2003.

[a]The start dates for some countries is later due to restricted data availability. The start dates for Finland, Greece, Portugal and Spain are defined by the availability of country stock market index data; and for Mexico and Turkey, the start date is when the trade-weighted exchange rate index becomes available. For New Zealand, company price data are not available before 1988.

Table 2 Exchange rates and national stock markets

	Stock market index returns (monthly)				Trade-weighted exchange rate (monthly change)			
	mean	Standard deviation	skewness	kurtosis	mean	Standard deviation	skewness	kurtosis
Australia	0.68	5.21	-2.79	23.47	-0.23	3.17	-0.66	1.13
Austria	0.90	6.60	0.49	3.45	0.04	0.46	0.47	1.14
Belgium	0.71	5.17	-0.92	4.46	0.05	0.67	-0.01	3.01
Canada	0.62	4.32	-1.09	5.88	-0.05	1.45	-0.13	0.20
Denmark	0.68	5.42	-0.43	0.32	0.07	0.77	0.18	1.70
Finland	0.83	9.63	-0.11	0.78	-0.10	1.58	-3.14	21.74
France	0.84	6.05	-0.47	1.12	0.03	0.82	0.32	4.36
Germany	0.84	5.54	-1.09	3.74	0.11	0.97	0.30	0.04
Greece	1.29	10.38	1.26	3.92	-0.39	1.03	-4.21	38.16
Ireland	1.00	6.59	-1.08	4.65	-0.02	1.19	-1.12	5.57
Italy	0.80	6.96	0.31	0.67	-0.16	1.53	-3.24	25.88
Japan	0.19	6.00	-0.23	1.34	0.26	3.00	0.80	3.49
Mexico	1.05	7.48	-0.68	1.31	-1.02	4.89	-3.78	26.36
Netherlands	0.65	5.22	-1.22	4.41	0.05	0.72	0.43	0.41
New Zealand	0.39	5.52	0.22	2.10	-0.04	2.23	-0.41	0.63
Norway	0.83	7.23	-1.11	3.22	-0.07	1.22	-1.17	6.23
Portugal	0.27	5.70	0.20	3.53	-0.07	0.92	-2.02	14.44
Spain	0.64	6.42	-0.69	2.12	-0.08	1.24	-2.35	14.17
Sweden	0.83	7.32	-0.43	1.03	-0.10	1.58	-1.93	17.26
Switzerland	0.81	5.17	-1.31	5.22	0.07	1.36	0.33	1.00
Turkey	4.03	16.45	-0.12	2.22	-3.23	4.81	-1.22	10.58
UK	0.70	4.98	-1.42	7.22	-0.06	2.04	-0.57	3.59
US	0.82	4.45	-0.99	3.93	-0.15	2.21	0.04	-0.08

Notes. This table reports summary statistics for each country's monthly stock market index returns and the monthly change in the trade-weighted exchange rate index.

Table 3 Exchange rate volatility and exchange rate arrangements

	Mean	Standard deviation	Exchange rate arrangements
Mexico	-1.02	4.89	Independent float (1994)
Turkey	-3.23	4.81	Independent float (2001) (previous systems: managed float, crawling peg)
Australia	-0.23	3.17	Independent float (1983)
Japan	0.26	3.00	Independent float (1973)
New Zealand	-0.04	2.23	Independent float (1985)
US	-0.15	2.21	Independent float
UK	-0.06	2.04	Independent float (managed float to 1990, ERM 1990-92)
Finland	-0.10	1.58	Eurozone (ERM 1996, Euro 1999)
Sweden	-0.10	1.58	Independent float (fixed to 1991; ERM 1991-92)
Italy	-0.16	1.53	Eurozone (ERM 1979 to 1992, Euro 1999)
Canada	-0.05	1.45	Independent float (1970)
Switzerland	0.07	1.36	Independent float (1973)
Spain	-0.08	1.24	Eurozone (ERM 1989)
Norway	-0.07	1.22	Independent float (fixed to 1992; managed float 1992 to 2001)
Ireland	-0.02	1.19	Eurozone[a]
Greece	-0.39	1.03	Eurozone (2001; previous system: managed float)
Germany	0.11	0.97	Eurozone[a]
Portugal	-0.07	0.92	Eurozone (ERM 1992, Euro 1999)
France	0.03	0.82	Eurozone[a]
Denmark	0.07	0.77	Pegged to Euro, ±2.25% band (ERM 1979)
Netherlands	0.05	0.72	Eurozone[a]
Belgium	0.05	0.67	Eurozone[a]
Austria	0.04	0.46	Eurozone (linked to Deutschemark 1981, ERM 1996, Euro 1999)

Notes. This table summarises the exchange rate arrangements of each country during the sample period. The countries are ranked highest to lowest by the standard deviation of monthly exchange rate changes.

[a] Belgium, France, Germany, Ireland and the Netherlands joined the Exchange Rate Mechanism (ERM) in 1979 where they remained until they joined the Eurozone in 1999.

Table 4 Exchange rate response coefficients, market level

	[1] β_1^j	[2] p-value	[3] Covar (s_t^j, R_t^j)	[4] Var (s_t^j)
Australia	0.440	0.00	4.41	10.07
Austria	-2.182	0.02	-0.46	0.21
Belgium	-1.632	0.00	-0.74	0.45
Canada	0.973	0.00	2.04	2.10
Denmark	-1.957	0.00	-1.15	0.59
Finland	-0.716	0.11	-1.77	2.48
France	-1.762	0.00	-1.17	0.66
Germany	-1.492	0.00	-1.40	0.94
Greece	-1.153	0.12	-1.21	1.06
Ireland	-1.139	0.00	-1.61	1.42
Italy	0.723	0.01	1.68	2.34
Japan	0.269	0.04	2.42	9.02
Mexico	0.461	0.01	10.92	23.87
Netherlands	-2.775	0.00	-1.42	0.51
New Zealand	0.456	0.01	2.26	4.98
Norway	0.730	0.06	1.08	1.48
Portugal	-1.080	0.03	-0.90	0.84
Spain	-0.227	0.54	-0.35	1.54
Sweden	0.221	0.46	0.55	2.50
Switzerland	-1.270	0.00	-2.34	1.85
Turkey	0.446	0.17	10.21	23.09
UK	-0.210	0.19	-0.87	4.16
US	0.085	0.52	0.41	4.86

Notes. This table presents the findings for the relation between each country's monthly stock market return (R_t^j) and the change in its trade-weighted exchange rate (s_t^j). β_1^j (column [1]) is the exchange response coefficient for country *j* estimated via equation [2]. In this table we separate β_1^j into its constituent parts Covar (s_t^j, R_t^j) and Var (s_t^j) in columns [3] and [4].

Table 5 Summary of individual firm estimates

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	N	mean coefficient	no. neg	no. pos	number significant	proportion significant	mean of the absolute value
Australia	52	0.09	15	37	7	13.5	0.25
Austria	33	0.07	13	20	2	6.1	1.28
Belgium	42	-0.45	32	10	2	4.8	0.72
Canada	134	0.07	65	70	9	6.7	0.45
Denmark	76	-0.40	52	24	9	11.8	0.90
Finland	30	-0.13	17	13	6	20.0	0.50
France	217	-0.14	117	100	11	5.1	0.79
Germany	283	-0.11	163	120	17	6.0	0.69
Greece	80	1.07	17	63	19	23.8	1.44
Ireland	12	-0.02	7	5	2	16.7	0.47
Italy	93	-0.06	54	39	8	8.6	0.37
Japan	794	-0.06	446	348	125	15.7	0.23
Mexico	23	0.10	8	15	3	13.0	0.24
Netherlands	74	-0.05	35	39	5	6.8	0.78
New Zealand	24	0.06	10	14	3	12.5	0.33
Norway	32	0.20	12	20	2	6.3	0.63
Portugal	39	-0.20	19	20	5	12.8	1.19
Spain	51	0.25	17	34	6	11.8	0.73
Sweden	69	0.00	32	37	8	11.6	0.43
Switzerland	102	-0.35	79	23	8	7.8	0.47
Turkey	60	0.14	17	43	6	10.0	0.29
UK	312	0.08	134	178	25	8.0	0.29
US	1156	0.21	385	771	134	11.6	0.41
	3788		**1746**	**2043**	**422**	**11.1**	

Notes. This table summarises information on the exchange rate response coefficients α_2^i from estimating equation (1) on 3,788 companies from 23 countries. (The data period for each country can be found in Table 1.) For each country we present the number of companies in the sample, *N* (column [1]), the mean α_2^i for each country [2], the number negative [3] and the number positive [4], and the number significant [5] and the proportion significant [6]. Because our subsequent estimations involve the absolute value of the firm-level exchange response coefficients, we include the mean of these for each country in column [7].

Table 6 Pooled firm-level regression results

	coefficient	t-stat	p-value	adj. R-sq
Panel A Openness only (equation [4])				
Constant	0.061	1.89	0.06	0.07
Openness	0.155	16.79	0.00	
Panel B Openness and size (equation [4'])				
Constant	0.261	7.25	0.00	0.11
Openness	0.139	15.20	0.00	
Size	-0.026	-12.57	0.00	
Panel C Openness, size and size dummy (small = 1)				
Constant	0.429	40.43	0.00	0.10
Openness	0.003	13.20	0.00	
Size	0.000	-0.52	0.61	
Size dummy (1 = small)	0.139	12.95	0.00	
Panel D Openness, size – small firms (< US$150m market value)				
Constant	0.593	13.87	0.00	0.05
Openness	0.004	5.023	0.00	
Size	-0.003	-7.00	0.00	
Panel E Openness, size – large firms (> US$150m market value)				
Constant	0.202	13.25	0.00	0.07
Openness	0.005	12.68	0.00	
Size	0.000	-0.719	0.47	

Notes. This table presents the results for our pooled regression analysis, in which the dependent variable is $\sqrt{\left|\alpha_2^i\right|}$, with α_2^1 estimated via equation (1), for the full sample of 3,788 firms. In Panel A we present the results for our pooled regression equations with explanatory variable openness (log of trade openness) only (equation [4]). In Panel B we include in the regressions the log of firm market value (*size*) in US dollars (equation [4'], and in Panel C we extend equation [4'] by including a zero-one size dummy, with 1 representing small firms; that is, those with a market capitalisation of less than US$150 million. In Panels D and E respectively we repeat the estimation of equation [4'] on small firm small firm (n = 1507) and large firm (n = 2,281) subsamples.

Table 7 Proportion of small firms in the data set (<US$150m market value)

	Number of small firms in the sample	Total number of firms in the sample	Proportion of small firms in the sample (%)
Portugal	33	39	84.6
Greece	64	80	80.0
Denmark	52	76	68.4
Austria	22	33	66.7
Turkey	40	60	66.7
New Zealand	14	24	58.3
Germany	165	283	58.3
Canada	65	134	48.5
Belgium	20	42	47.6
France	97	217	44.7
UK	139	312	44.6
Italy	41	93	44.1
Netherlands	31	74	41.9
Norway	13	32	40.6
Australia	21	52	40.4
Switzerland	41	102	40.2
Spain	19	51	37.3
Sweden	25	69	36.2
US	415	1156	35.9
Mexico	6	23	26.1
Ireland	3	12	25.0
Japan	176	794	22.2
Finland	5	30	16.7
Total	**1507**	**3788**	**39.8**

Notes. This table presents the number and proportion of small firms – that is, those with a market capitalisation of less than US$150 million as at December 2003 – in each country, ranked from highest to lowest proportion of small firms.

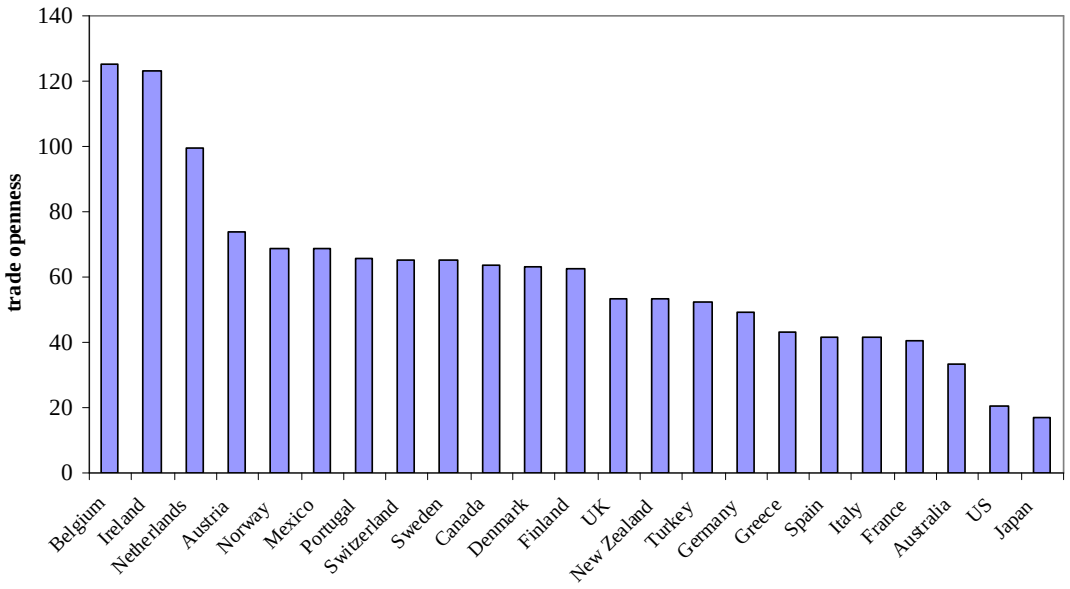
Table 8 Pooled firm-level regression results – FDI openness

	coefficient	t-stat	p-value	adj. R-sq
Panel A Openness only (equation [4])				
Constant	0.292	12.99	0.00	0.05
Openness	0.086	13.97	0.00	
Panel B Openness and size (equation [4'])				
Constant	0.485	18.63	0.00	0.10
Openness	0.076	12.71	0.00	
Size	-0.029	-13.82	0.00	
Panel C Openness, size and size dummy (small = 1)				
Constant	0.483	53.43	0.00	0.08
Openness	0.001	8.90	0.00	
Size	0.000	-0.96	0.34	
Size dummy (1 = small)	0.151	13.94	0.00	
Panel D Openness, size – small firms (< US$150m market value)				
Constant	0.723	20.36	0.00	0.03
Openness	0.001	1.66	0.10	
Size	-0.003	-7.11	0.00	
Panel E Openness, size – large firms (> US$150m market value)				
Constant	0.279	22.38	0.00	0.04
Openness	0.002	9.35	0.00	
Size	0.000	-1.26	0.21	

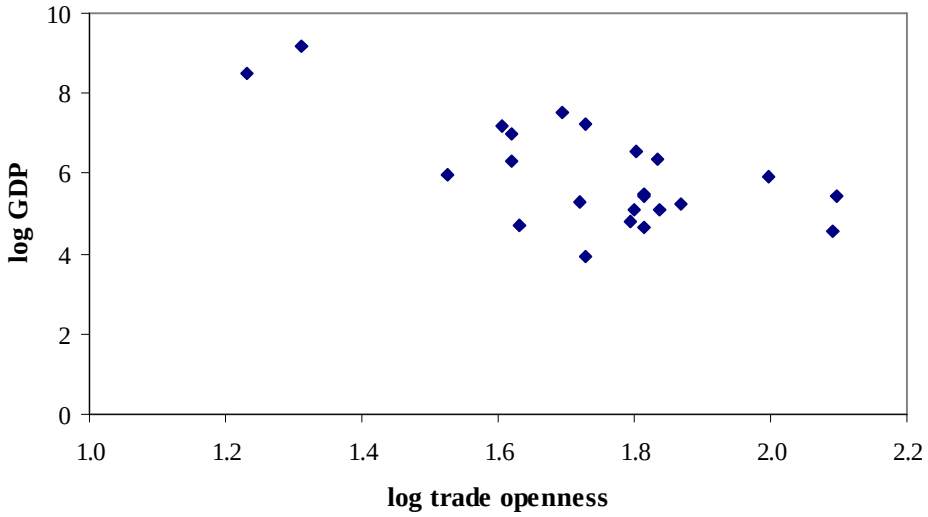
Notes. This table repeats Table 6, substituting FDI openness for trade openness. It presents the results for the pooled regression analysis, in which the dependent variable is $\sqrt{\left|\alpha_2^i\right|}$, with α_2^1 estimated via equation (1), for the full sample of 3,788 firms. In Panel A we present the results for our pooled regression equations with explanatory variable openness (log of FDI openness) only (equation [4]). In Panel B we include in the regressions the log of firm market value (*size*) in US dollars (equation [4'], and in Panel C we extend equation [4'] by including a zero-one size dummy, with 1 representing small firms; that is, those with a market capitalisation of less than US$150 million. In Panels D and E respectively we repeat the estimation of equation [4'] on small firm small firm (n = 1507) and large firm (n = 2,281) subsamples.

Figure 1 Trade openness

Panel A: Trade as a percentage of GDP

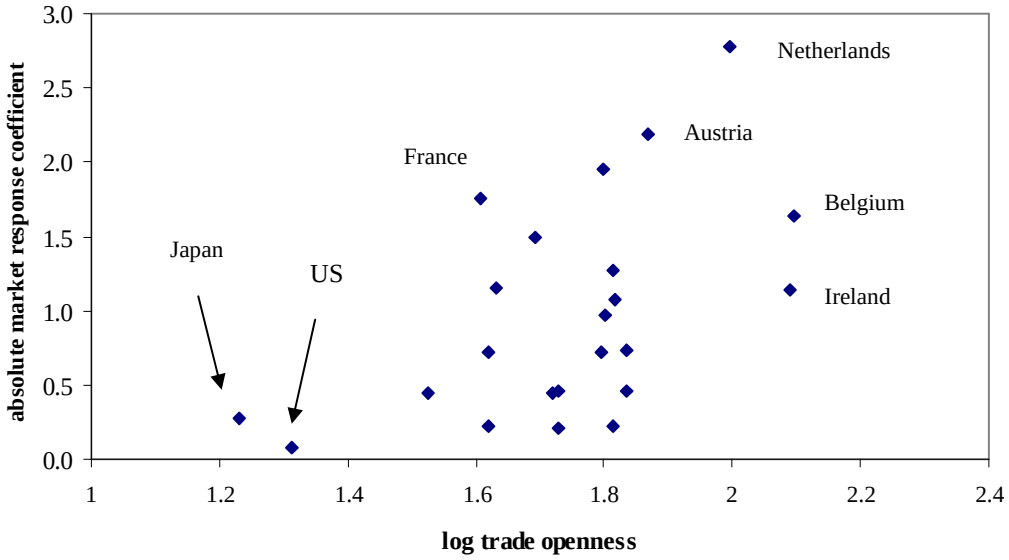


Panel B**:** Trade openness versus country size (as measured by GDP)



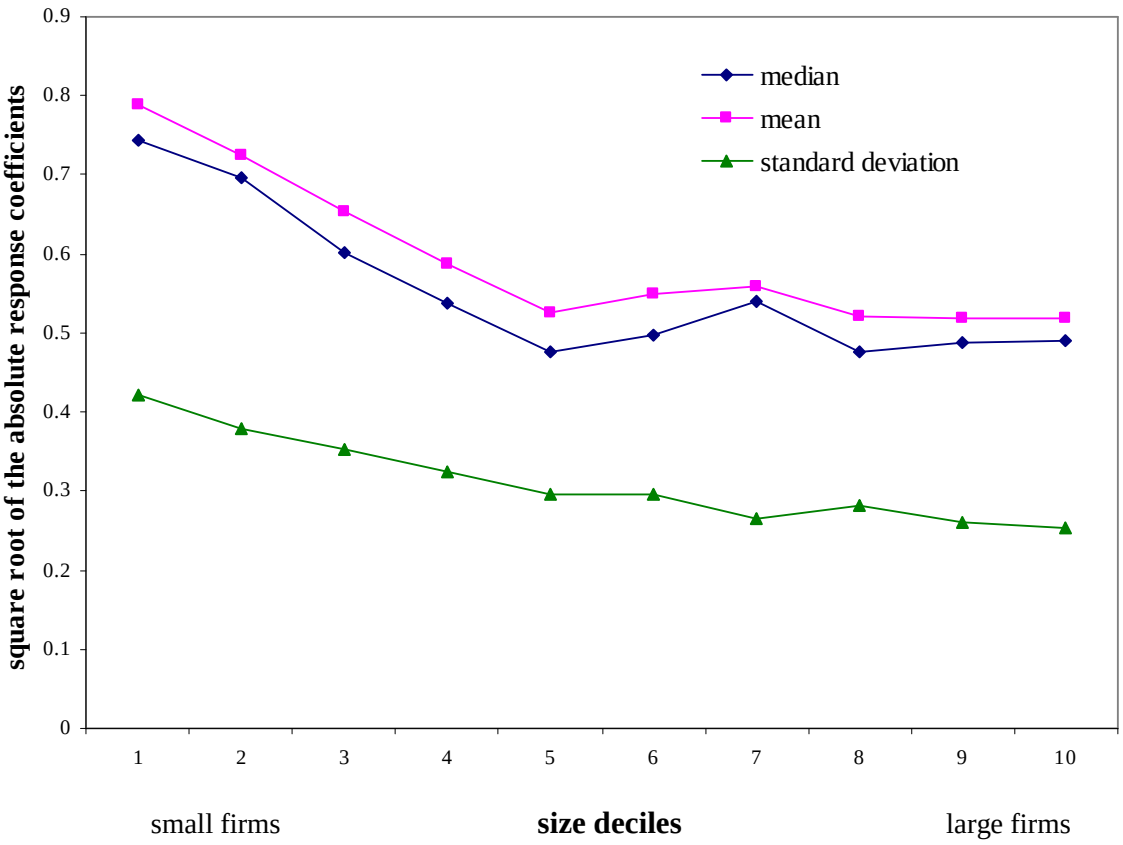
Notes. Panel A plots the trade openness for each country, ranked left to right. The figures for trade openness were obtained from Penn World Table Version 6.1, for the period 1984-2000 (from Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP)) (http://pwt.econ.upenn.edu/php_site/pwt61_form.php). In Panel B the log of trade openness for each country is plotted against the log of absolute GDP for 2003.

Figure 2 Stock market index response coefficients versus openness



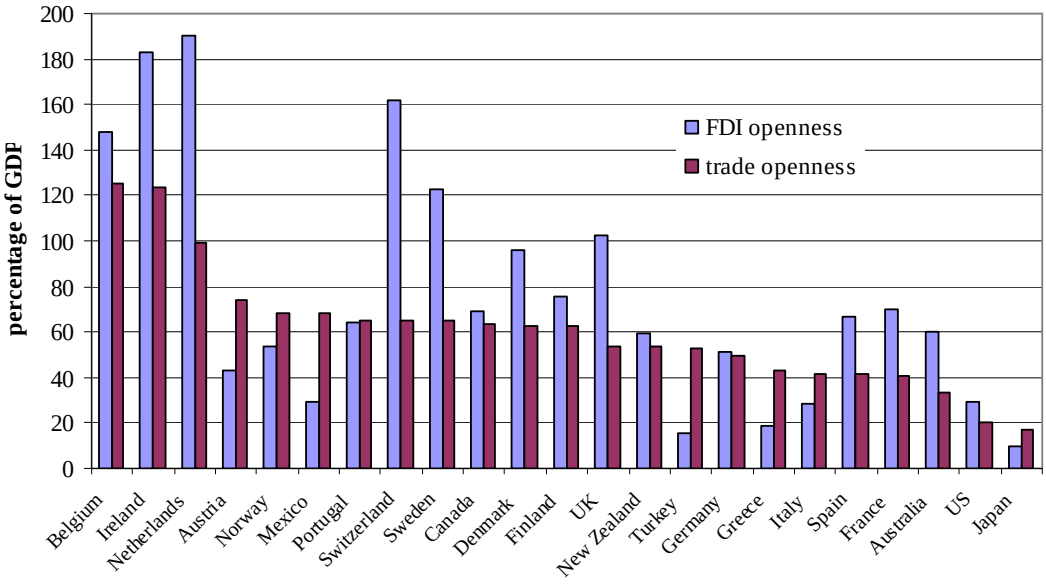
Notes. This figure plots the absolute value of the market-level foreign exchange response coefficients (β_1^j) estimated via equation (2) against the log of trade openness. Trade openness data were obtained from Penn World Table Version 6.1, for the period 1984-2000 (from Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP)) (http://pwt.econ.upenn.edu/php_site/pwt61_form.php).

Figure 3 Firm-level response coefficients by size decile



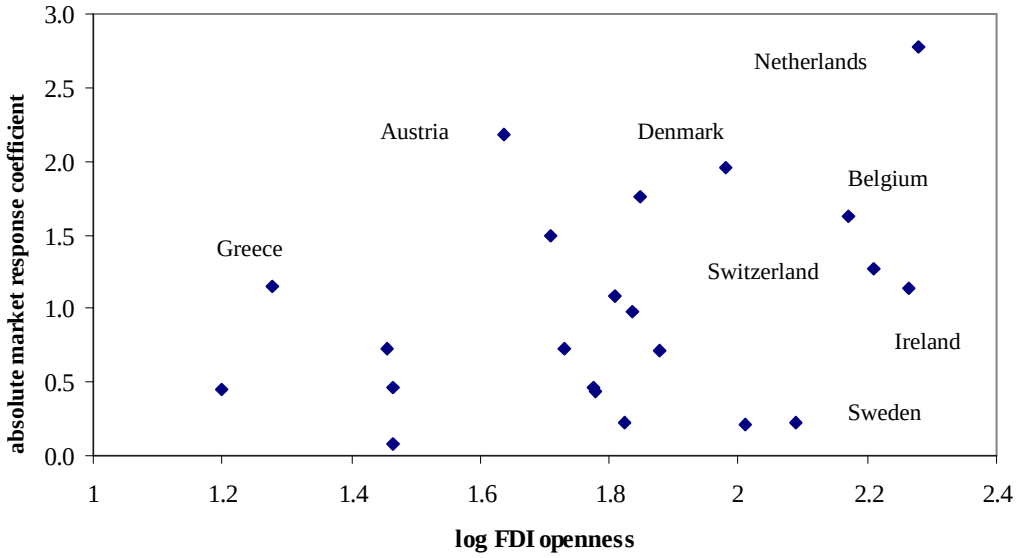
Notes. To construct this figure, we divided our 3,788 firms into deciles based on size (market value as at 31 December, 2003). We then took the mean, median and standard deviation of the square root of the absolute response coefficient ($\sqrt{|\alpha_2^i|}$, with α_2^1 estimated via equation 1), for each size decile. This figure therefore plots summary exchange exposure statistics for the firms in each size decile.

Figure 4 Trade and FDI openness



Notes. This figure plots the FDI and trade openness for each country, ranked (left to right) on trade openness. The figures for trade openness were obtained from Penn World Table Version 6.1, for the period 1984-2000 (from Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP)) (http://pwt.econ.upenn.edu/php_site/pwt61_form.php), and the figures for FDI are inward plus outward stock of FDI as at 2003 (from UNCTAD's 2005 World Investment Report) standardised by dividing by GDP.

Figure 5 Stock market index response coefficients versus FDI openness



Notes. This figure plots the absolute value of the market-level foreign exchange response coefficients (β_1^j) estimated via equation (2) against the log of trade openness. FDI data are inward plus outward stock of FDI as at 2003 (from UNCTAD's 2005 World Investment Report), standardised by dividing by GDP.