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Research Technical Paper

Geography and Firm Exports: New Evidence on the Nature of Sunk Costs

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Abstract

This paper presents an extension of the analysis of the geographic dimension of trade, by examining the trading patterns of individual firms. Aggregate data does not tell us if a sector is geographically diversified because there are many exporting firms, each of which specialises in a separate destination, or if the firms themselves are selling their exports in many markets. This analysis is made possible by access to a new survey dataset of Irish firms, which includes detailed information on firm characteristics and on the destinations of their exports over a two-year period. In line with Eaton, Kortum and Kramarz (2004), we find that a large number of firms serve only the domestic market and many exporting firms export to a single foreign market. Although there is little movement of firms into and out of exporting, firms' involvement in individual export markets is much more dynamic. Over thirty percent of firms change their market coverage, usually by entering or exiting one additional market. This is interpreted as evidence that the bulk of any sunk cost encountered in exporting in incurred during the initial entry to the export market. Subsequent entry to additional markets is made easier by prior export experience, which reduces the sunk cost of extending market coverage.

1. Introduction

The aim of this paper is to extend the analysis of the geographic dimension of trade by examining the trading patterns of individual firms. Increasing availability of firm-level data has resulted in a number of papers examining firm export decisions, primarily in terms of sunk costs to entry (Roberts and Tybout, 1997, Bernard and Jensen, 2004b, Bernard and Wagner, 2001) and spillovers from other exporters (Aitken, Hanson and Harrison, 1997). Throughout this literature, the export market has generally been treated as a single entity, with little consideration given to the fact that firms can export to multiple geographic markets at the same time. This gap in the literature has been primarily due to an absence of firm level data containing detailed information of export destinations. This paper utilises a new survey of Irish firms that contains information on both export participation and the geographic coverage of exports. The data cover two years, which allows us to examine both the export coverage of firms and the extent of entry and exit to and from new destination markets.

This paper makes three contributions to the emerging literature on firm exporting. The first is a confirmation of some stylised facts identified by Eaton, Kortum and Kamarz (2004) and Bernard, Jensen and Schott (2005). A consistent finding to emerge from this firm-level analysis of exporting is the large number of firms serving only the domestic market and that even amongst exporting firms, many export only to a single foreign market.

The second contribution is to provide some evidence on the firm characteristics associated with the decision to export and the number of markets exported to. A number of characteristics of the firm prove to be important. In particular, larger firms are more likely to export and also export to more markets, as are high technology firms. Age had opposite effects on market participation compared to coverage: Older firms more likely to export, but once export status was controlled for, younger firms were more diversified across markets.

The third contribution of this paper exploits the availability of two years of data to shed some light on the nature of the sunk costs associated with becoming an exporter. If there are significant sunk costs associated with entry into each new export market, we would expect to see a high level of persistence in the firms' portfolio of destination markets. On the other hand, if the main sunk cost involved in exporting is captured by the initial effort involved in becoming outward orientated, we might expect to find that firms experience less persistence in their market coverage than they do in their export status.

Our analysis shows that although there is little movement of firms into and out of exporting, firms' involvement in individual export markets is much more dynamic. Approximately thirty percent of firms change their market coverage over the two years of data, usually by entering or exiting one additional market. These patterns seem consistent with the hypothesis that the experience of exporting to one market significantly reduces the costs associated with entering a second market.

The paper is organised as follows. Section 2 reviews some literature on the destination of trade. Section 3 introduces the data sources. Section 4 describes firm-level export market coverage and reports the results of a regression analysis of its determinants. Section 5 exploits the two-year span of the data by analysing the entry and exit of exporting firms to and from individual markets. Section 6 concludes.

2. Sunk Costs and Trade Patterns: Previous Work

The existence of sunk costs has been posited as an important factor in explanations of both trade patterns at a macro-level and the decision to export at the firm level. If sunk costs exist in the export market, they could result in transitory changes (perhaps in the exchange rate or in trade policy) having permanent effects on export patterns. Examples of sunk costs in exporting are thought to be mainly those of information gathering on the new market, setting up new distribution networks, marketing and possibly repackaging of the product to appeal to new consumers etc.

Decomposing the growth of exports of twenty-four developing countries comparing export products and destination markets, Evenett and Venables (2001) find that the extension of an existing product line to a new geographic market accounts for around one-third of export growth, with the contribution being made by the introduction of new products averaging ten percent of growth. The 'geographic spread of trade' of a product to a new market is more likely if the exporting country already exports to a country close-by the new market, something Evenett and Venables refer to as "distance to the supply frontier", which they use to enhance the usual gravity model distance variable. The

importance of this supply frontier distance is attributed to "the effect of information acquisition by exporting firms about potential new foreign markets".

The initial decision of the firm to enter the export market has been the topic of a number of papers e.g. Roberts and Tybout (1997) for Columbian firms, Bernard and Jensen (2004b) on exporting activity in the US. The question of whether sunk entry costs are relevant to the decision to become an exporter seems to be answered positively by Bernard and Jensen (2004b), who found that exporting in the previous period substantially increases the probability of being an exporter in the next period, although some firms do transfer in or out of the export market. Relating exporting activity to firm characteristics finds that exporters tend to be larger, pay higher wages and have higher productivity (Bernard and Jensen, 2004b).

While the literature on sunk costs for exporting in general is now a relatively large one, the literature on the issue of exporting to a range of markets remains limited. This gives rise to the question of whether such sunk costs are encountered in entering each new market or if they may be reduced if the firm has experience of already supplying a similar market.

Analysis relating to the geographic coverage of a firm's exports has been carried out by Eaton, Kortum and Kamarz (2004), using French data for 1986. They find great heterogeneity in firms' export participation. Most firms sell only in the domestic market, and for the exporters they find that the modal firm exports to a single market, and only a

small fraction of firms exports to a large number of markets. This pattern holds across all sixteen industries in the data.

Sutherland (2003), analysing the export decisions of Irish-owned firms, also found significant sunk costs exist in entering the export market. Dividing exporters into those exporting only to the UK market compared to exporters to the rest of the world revealed entry costs for Irish firms to the UK market to be significantly lower than the average sunk cost of exporting (i.e. the coefficient on lagged export status was lower for exporting to the UK compared to exporting in general).

3. Data – Enterprise Ireland Firm Survey

The firm-level data come from a survey of Irish-owned manufacturing firms carried out by Enterprise Ireland in 2001 and made available by Forfás, the Irish national policy advisory board for enterprise and trade. The sample consists of 1087 firms of whom 773 are exporters. The survey includes information on various firm characteristics such as employment, inputs, wage costs, R&D spending, as well as export sales and the breakdown of countries to which the firm exports. This survey of Irish indigenous manufacturing covers firms of over 25 employees. It is the only data of its kind that questions firms on the exact destination of their exports. The survey covers 1999, 2000 and 2001 for firm characteristics and for 2000 and 2001 includes the destination of exports question.[1]

[1] The information on firm characteristics available for 1999 allows us to lag these explanatory variables without losing any of the export data we are particularly interested in.

Ireland is known as a highly specialised economy, the bulk of exports coming from a relatively narrow range of products. Changes in market orientation have been observed at the aggregate trade level. For example, for much of its history, Ireland's trade relied heavily on the UK as a destination market (see for example Gallagher and McAleese, 1994). Table 1 shows the decline in the pre-eminence of this market, although it remains one of Ireland's largest trading partners. However, aggregate data does not tell us if a sector is geographically diversified because there are many exporting firms each of which specialises in a separate destination, or if the firms themselves are selling their exports in many markets.

4. Evidence on Geographic Destinations for Exports

4.1 Basic Patterns

The distribution of firms according to the number of markets they serve is graphed in Figure 1. As was found by Eaton, Kortum and Kamarz (2004), a large number of firms serve only the domestic market (market coverage = 1), and many exporting firms export to a single foreign market. In the French data, this single destination was usually Belgium, for Irish firms it is the UK. The number of markets covered declines quite steeply, with only a small number of firms exporting to many markets. The distribution is strongly skewed to the left with 312 firms (29 percent) serving only the domestic market, and 183 firms exporting to one foreign market (16.8 percent of the total sample or 23.7 percent of the exporting firms).

The average number of export markets for the exporting firms in the data is 5.8, with the median being two markets. This average market coverage is higher than the 3.5 markets

found by Bernard, Jensen and Schott (2005) for US exporters. The difference is likely due to the greater openness to trade of the Irish economy coupled with the small size of the domestic market.

The percentage of firms exporting to any individual market appears to decline in line with the distance of the market from Ireland. This is as would be expected from standard gravity model predictions of trade, where distance is a commonly used proxy for transportation costs. Figure 2 shows that over three-quarters of Irish exporting firms sell to England, 60 percent export to Northern Ireland and almost a third export to France and/or Germany. In contrast, less than five percent of exporters sell to markets such as Brazil or Malaysia. The exception to this geographic distance rule is the US, with slightly more than 30 percent of Irish exporters selling to this market.

Distance also plays a role in the dependence of firms on an individual market. Firms that export to only one market usually export to closer destinations. These are typically part of the UK or EU, although some firms also send all their exports to the US, as shown in Figure 3. This could indicate that firms do not extend exporting activity to more distant markets without some initial export experience, although this is difficult to test without a longer time dimension to the data. The US exception could be due to links initially established by supplying US-owned multinational based in Ireland, although this type of relationship cannot be identified in the current data.

In addition to distance, export links depend on the level of demand in the destination market. GDP per capita is used in Figure 4 to establish a link between measure the level of demand and the attractiveness of a destination for exporting firms to establish themselves. [2] As would be expected, there is a positive correlation between the higher levels of GDP per capita in the destination market and the number of firms exporting to that market. There are two obvious outliers in this figure; these relate to England and Northern Ireland[3]. However, proximity and historical links have made these markets major export destinations for Irish firms.

4.2 Regression Analysis

We use a Heckman selection model to empirically test the determinants of export diversification, controlling for the firm's endogenous selection into being an exporter. The first stage of the estimation is the export decision of the firm. The profit-maximising firm makes this decision based on expected profits from exporting, taking into account the fixed costs of entering the new market. If the expected profits are positive, then the firm will become an exporter. The export status of the firm i is denoted by Y_i where

$$Y_i = 1 \quad \text{if } \beta Z_i + \varepsilon_i > 0$$

$$= 0 \quad \text{otherwise}$$

The firm will enter the export market if its expected current and future profits from doing so are greater than the costs involved. These profits depend on firm specific factors denoted by Z_i that include variables such as size, age, productivity etc. while the residual

[2] GDP per capita for 2000 from Penn World Tables version 6.1 (Heston, Summers and Aten, 2002) in constant 1996 US dollars

[3] The Penn World Table gives GDP per capita for the United Kingdom – it is assumed here that the constituent parts of the UK for which separate export data is available (England, Scotland and Northern Ireland) share the same GDP per capita

term ε_i captures any other non-firm-specific effects. Once the firm has made the decision to participate in the export market, the second step of deciding market coverage is made. The market coverage equation is estimated as

$$M^*_i = \beta X_i + \nu_i$$

With:

$$M_i = M^*_i \quad \text{if} \quad Y_i = 1$$

$$M_i = 0 \quad \text{if} \quad Y_i = 0$$

The observed market coverage is zero if the firm is not an exporter. If the firm is an exporter, its market coverage will be determined by a vector of firm characteristics and by other effects captured by the error term ν_i. The vector of firm characteristics included in the market coverage equation, X_i, can include some of the same variables as Z_i in the selection equation, but in order to identify the equations, they cannot overlap completely. The correlation between the error terms (ε_i, ν_i) is given by ρ, and the two decisions (i.e. to export and how many markets to export to) are related if ρ is not equal to zero. In such a case, estimating only the market coverage equation would induce a sample selection bias, which is avoided by estimating both equations as proposed by Heckman (1979).

The firm's export coverage is measured in three ways. We first use a count of the markets to which it exports. Secondly, the percentage of a firm's exports that go to its largest market is used as a measure of dependence on a single destination. A weakness of these first two measures is that they do not tell us if the firm has one main market and a number of smaller markets or if it exports equally to all its identified destinations. To

adjust for this a third measure is used, which is a weighted measure of geographic market concentration is used, equivalent to a Herfindahl (HH) index of industrial concentration.

$$HH = \sum_{d=1}^{n} \left(s_d^2 \right)$$

In this instance, it measures the squared shares, *s*, of each destination market, *d,* in the exports of a given firm, summed over all its destinations. Therefore, a HH of 1 would indicate that the firm exports to only one country, in other words that it is completely specialised geographically. HH measures close to zero indicate a great deal of diversification by the firm, with no destination being dominant.

The first specification uses firm market coverage as the dependent variable and the results are presented in Table 2. The selection into exporting column is the first stage of the regression and tests the determinants of the firm's export status. We find that larger, older firms that spend more on R&D and on average wages are those most likely to export. Domestic sales, which are included only in the selection equation, have a negative effect. Given the selection into exporting, we find that larger firms export to more markets. Age however has a different effect in the market coverage equation with younger firms exporting to more markets. It is likely that this effect is due to many older traditional firms being reliant on the UK as an export market. High technology firms are also more likely to export to a greater number of markets, although technology level did not affect the selection into exporting. R&D intensity is positively associated with greater market coverage, as well as with the exporting decision.

An alternative measure of export specialisation or diversification is the Herfindahl index. The results in Table 3 are similar for the export selection equation. The Herfindahl results show larger firms are more diversified in their exporting, while older and low technology firms are more specialised. R&D expenditures have no effect on the market diversification in this specification, although it was still significant and positive for entry to the export market. Greater dependence on a single export market is associated with smaller, low technology firms, as demonstrated in Table 4. This is primarily explained by exports to England and Northern Ireland by more traditional firms.

5. Entry and Exit

The literature on firm export decisions has found considerable persistence in export status over time. For example, Roberts and Tybout (1997) find average entry and exit rates of firms to exporting in the region of 2.7 percent and 11 percent respectively, while Bernard and Wagner (2001) find entry and exit among their German sample of 2.4 percent and 2.3 percent. Transitions to and from exporting occur more frequently amongst US firms, with entry and exit rates of 13.9 percent and 12.6 percent respectively (Bernard and Jensen, 2004b). The level of persistence in the sample of Irish firms is extremely high with only two firms changing export status (becoming exporters in both cases). This is a very low transition rate but may be due in part to the dataset following only existing firms and the short time period.

Despite the persistence in exporting status, there is a much more dynamic picture when it comes to the market coverage of current exporters. Quite a large number of exporters

increase or decrease their market coverage over these two years. Approximately 14 percent of exporters increased their number of export destinations, while slightly fewer, 12.5 percent, decreased market coverage. In addition some 61 firms (8 percent of exporters) both entered and exited markets. Of these 61 firms, 14 (23 percent) had a net increase in the number of markets, and 20 (33 percent) had a net decrease. The remainder had no net change in their market coverage, entering and exiting the same number of markets.

Changes in the number of firms exporting to individual destinations are shown in Figure 5, which shows simultaneous entry and exit of firms to most destinations. There is no pattern of systematic entry to a newly attractive market or of exit from a declining one. On the contrary, the picture is one of heterogeneity amongst firms, with movement into and out of all observed markets. However, one consistent result is found; Rates of entry and exit are both positively associated with the stock of Irish firms already exporting to the market. The correlation coefficient between numbers of entrants and the number of incumbent exporters is 0.75, while the correlation between existing exporters and number of exits is slightly lower at 0.63.

Figure 5 also illustrates a potential difficulty faced by policy-makers who would like to encourage exporters: The option of promoting a particular destination or region is unlikely to be effective in the face of such heterogeneity in exporting firms. Relating this to the existence of sunk costs to exporting, it would appear to be more consistent with the idea of initial sunk cost to becoming an international player and then relatively smaller

costs to changing markets. This implies less importance is attached to factors associated with a particular market relative to the initial effort required by the firm in becoming internationally competitive and viable as an exporter.

The most common change in market coverage was to increase or decrease the number of destinations by one, as shown in the distributions of entry and exit in Figures 6 and 7. Only a very small number of firms changed their market coverage by more than five destinations. The average number of markets entered was 1.78 and exited was 2.2. An investigation of firm characteristics and changes in market coverage showed that smaller and younger firms were somewhat more likely to enter new markets, although the correlations were small (-0.005 and –0.07 respectively). A reduction in market coverage was associated with larger and older firms (correlations of 0.11 and 0.03 respectively). The larger the firm's portfolio of existing markets, the more likely it is both to enter and to exit markets (correlations of 0.2 and 0.4 respectively). In addition, the larger the firm's existing number of markets, the more likely it is to simultaneously enter and exit markets (correlation of 0.29).

These results can be interpreted as giving an indication of the nature of the sunk costs associated with becoming an exporter. The literature has established that considerable persistence exists in firm export status, which can be explained as resulting from costs associated with becoming an exporter. If the same level of sunk costs were associated with entry into each new export market, we would also expect to see a high level of persistence in the firm's portfolio of destination markets. This is not found to be the

case. Instead, amongst the sample of continuing exporters, substantial levels of entry and exit of markets are found. This is consistent with the alternative hypothesis that the experience of exporting to one market significantly reduces the costs associated with entering additional markets. The bulk of the sunk costs involved in exporting therefore appear to be associated with the initial movement to outward orientation of the firm.

6. Conclusions

This paper looked at the geographic dimension of trade using detailed export destination information at the firm level. This data allows us to extend the existing literature on firm export decisions by decomposing the export market into its constituent individual country markets. We can then ask what affects the firm's decision about how many of these markets it will export to. We find that a large number of firms serve only the domestic market and many exporting firms export to a single foreign market. Although there was virtually no entry and exit to exporting, a large number of exporters are found to change their market coverage over these two years. Approximately 14 percent of exporters increased their number of export destinations, 12.5 percent decreased market coverage and 8 percent simultaneously entered and exited markets. Of these, most increased or decreased market coverage by one market.

The paper also provides some evidence on the firm characteristics associated with the decision to export and the extent of coverage of different markets. A Heckman selection model was used to examine market coverage whilst controlling for the export status of the firm. The selection estimation for being an exporter found that larger, older firms that

spend more on R&D and on average wages, are those most likely to export. The measures of market coverage used are the count of export destinations and a Herfindahl index to measure market specialisation. One of the main findings is that larger firms are more likely to export, and once in the export market they have greater levels of market coverage. The existence of a dominant market for exports has a negative relationship with firm size.

The high levels of entry and exit of markets relative to the export decision allows us to shed some light on the nature of the sunk costs associated with becoming an exporter. The high levels of persistence observed in the firm's export status are not found in the market coverage decision. Once the firm has made the decision to become an exporter, there is considerable turnover in the portfolio of export destinations. This can be explained if the main sunk cost involved in exporting is captured by the initial effort involved in becoming outward orientated and that subsequently the experience of exporting to one market significantly reduces the costs associated with entering a second market.

Understanding the reasons firms become exporters and where they export to is a necessary condition for the implementation of successful policy decisions to encourage exporters. Given the strong finding in the firm export literature regarding the existence of sunk costs in entering the export market, an obvious route for policymakers is to attempt to reduce these costs. If the costs involved were specific to each new market, policies such as provision of information on market conditions and assistance in establishing

distribution networks would help firms interested in a exporting to a particular destination. However, if the bulk of the observed sunk cost to exporting is encountered in the firm's initial effort at becoming internationally orientated, assistance with information on individual markets would have a much smaller effect. This is particularly the case if such market-specific information is provided mainly to existing exporters. If, as indicated in this paper, the sunk cost is concentrated at the initial entry to exporting, the focus of policymakers should be on providing assistance to firms entering their first export market.

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Table 1: Destination of Aggregate Manufactured Exports (Percent)

	UK	Europe: ex UK	USA	Other
1960	75	6	8	11
1970	62	11	13	14
1980	43	32	5	20
1990	34	41	8	17
1999	22	43	15	20
2003	18	42	22	18

Source: CSO (2004)

Table 2: Heckman Selection Model for Market Coverage

	Ln(Market Coverage)	Selection into Exporting
Employment	0.17557*** (0.0307)	0.5305*** (0.07339)
Age	-0.0746* (0.0412)	0.2039*** (0.0675)
R&D	0.0353** (0.018)	0.051* (0.0297)
Training	-0.0385** (0.0193)	-0.0177 (0.0333)
Average Wage	0.0168 (0.0582)	0.328*** (0.118)
Low Technology Dummy	-0.3238*** (0.071)	-0.012 (0.131)
Domestic Sales		-0.344*** (0.0492)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	842 (c=134, u=708)	
P	-0.6838 (0.0639)	
Λ	-0.566 (0.0623)	
LR test of indep. eqns. (ρ=0)	$\chi2$ (1) = 29.88	Prob> $\chi2$ = 0.000
Wald Test	$\chi2$ (8) = 61.26	Prob> $\chi2$ = 0.000

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 3: Heckman Selection Model for Market Concentration

	Export Market Herfindahl	Selection into Exporting
Employment	-0.029** (0.0119)	0.4816*** (0.0853)
Age	0.0265* (0.0154)	0.2049*** (0.0696)
R&D	-0.008 (0.0068)	0.0503* (0.0302)
Training	0.0035 (0.0072)	-0.0164 (0.0338)
Average Wage	-0.00536 (0.0214)	0.2631** (0.1188)
Low Technology Dummy	0.095*** (0.026)	-0.0394 (0.1316)
Domestic Sales		-0.2938*** (0.0532)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c=134, u=707)	
P	0.6663 (0.131)	
Λ	0.2028 (0.047)	
LR test of indep. eqns.	$\chi2$ (1) = 12.95	Prob> $\chi2$ = 0.000
Wald Test	$\chi2$ (8) = 27.07	Prob> $\chi2$ = 0.0007

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 4: Heckman Selection Model for Dependence on Largest Market

	Percentage Exported to Main Market	Selection into Exporting
Employment	-2.557** (0.9977)	0.5065*** (0.07998)
Age	2.011 (1.323)	0.2132*** (0.0703)
R&D	-0.9411 (0.581)	0.0632** (0.031)
Training	0.3882 (0.6159)	-0.0295 (0.0343)
Average Wage	-0.8733 (1.84)	0.2465** (0.1211)
Low Technology Dummy	7.315*** (2.26)	-0.07778 (0.1325)
Domestic Sales		-0.2863*** (0.0551)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c=134, u=707)	
P	0.4134 (0.122)	
Λ	10.702 (3.366)	
LR test of indep. eqns.	$\chi2$ (1) = 6.56	Prob> $\chi2$ = 0.010
Wald Test	$\chi2$ (8) = 28.07	Prob> $\chi2$ = 0.000

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Figure 1: Distribution of Firms by Market Coverage

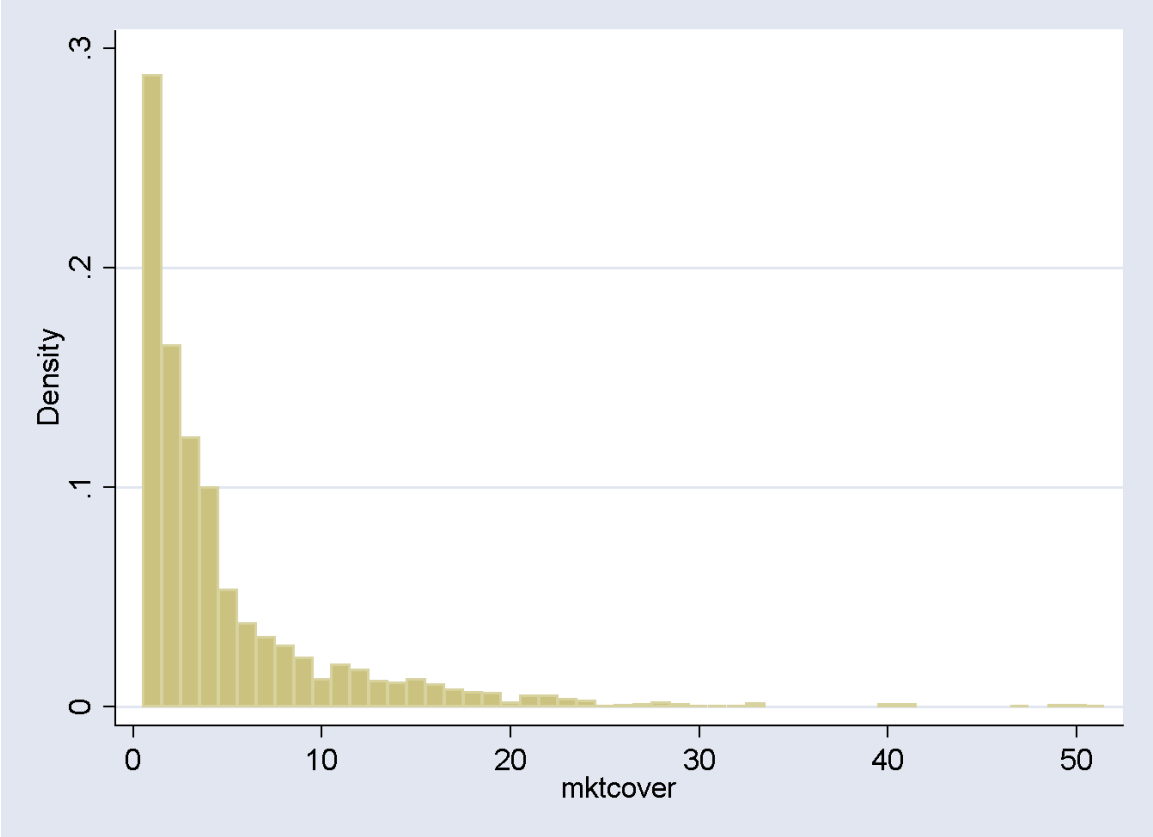

Figure 2: Number of Exporters by Destination

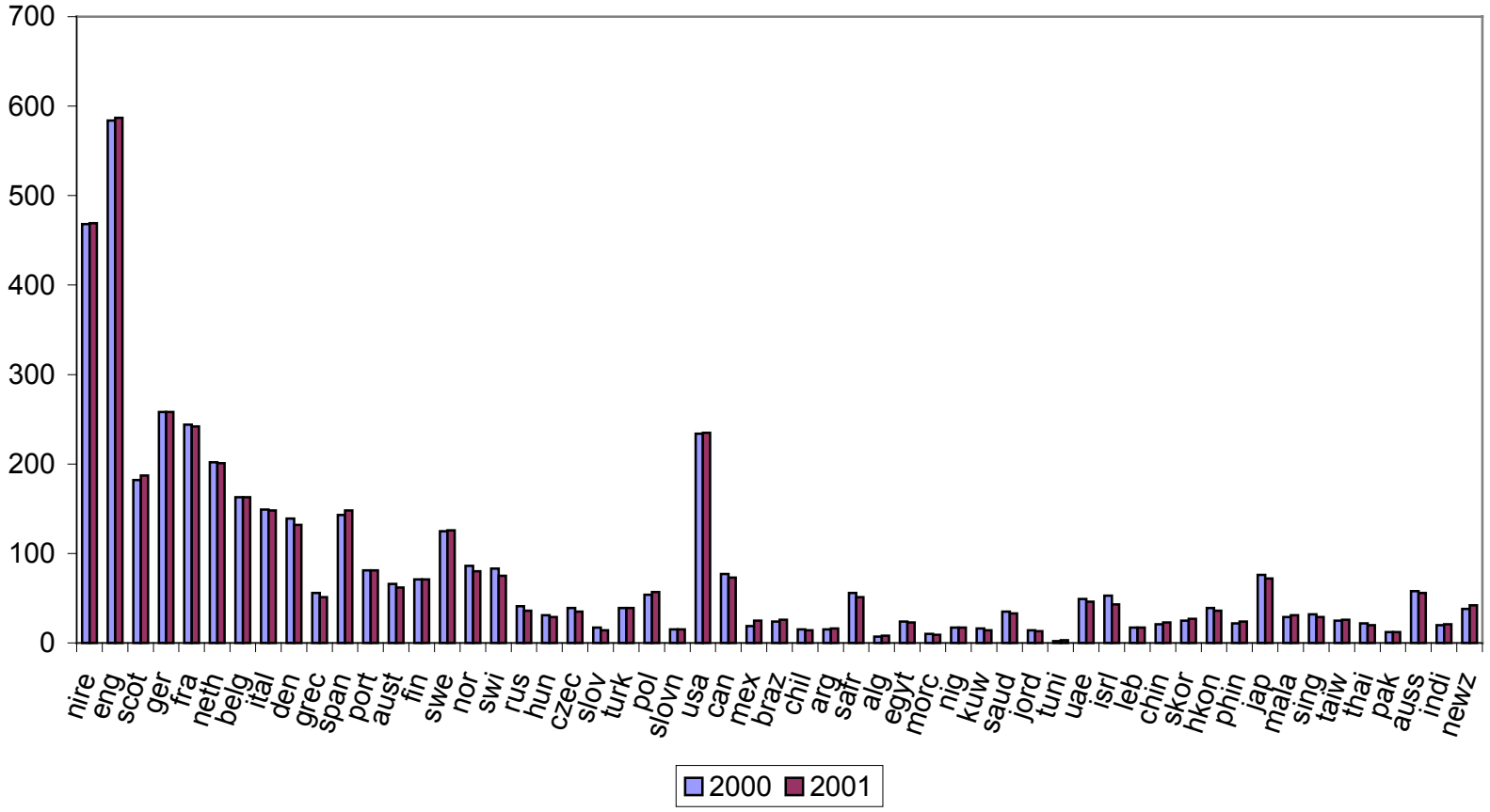

Figure 3: Maximum Percentage Exported by Any Firm to Each Destination

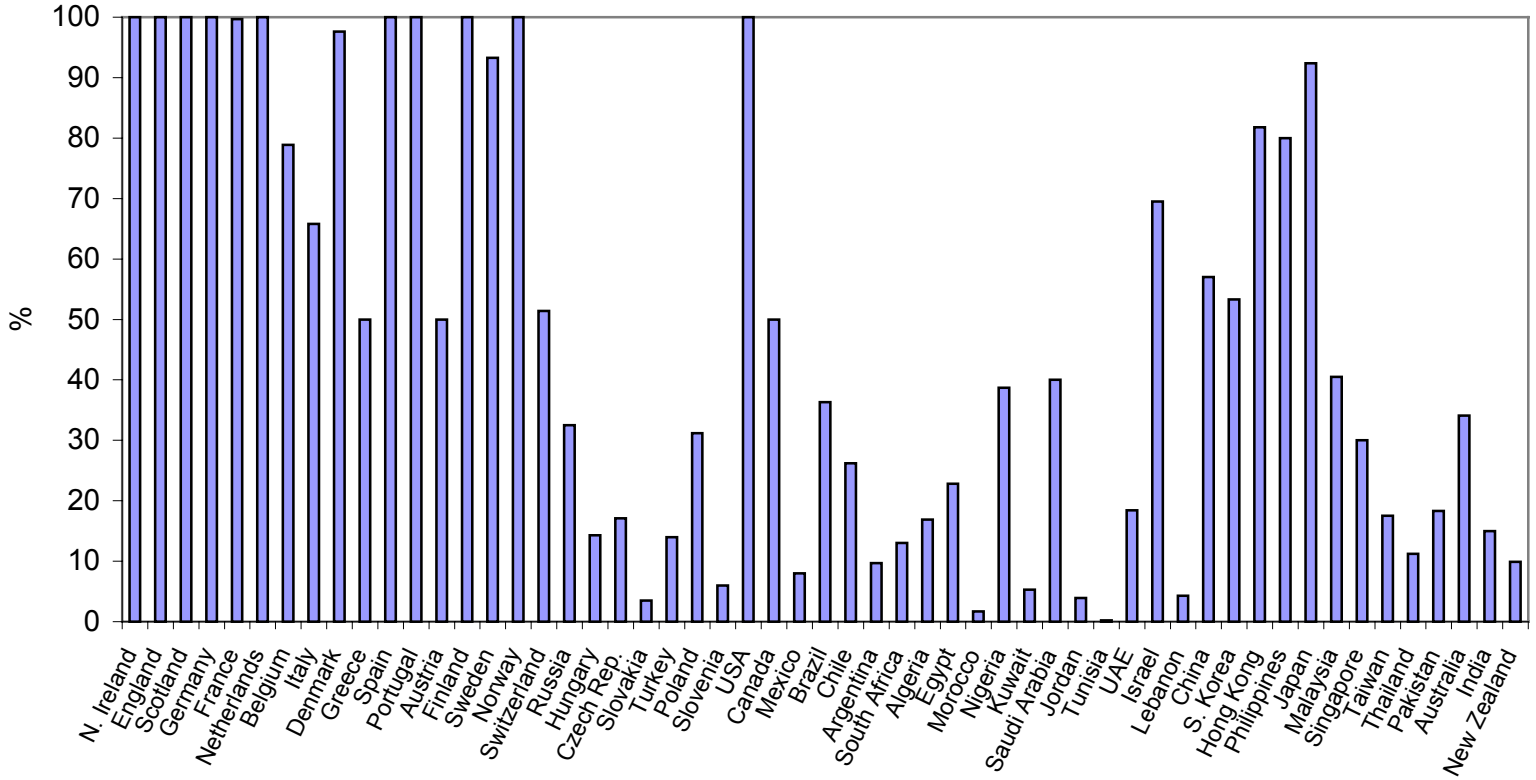

Figure 4: Exporting Firms and Destination GDP Per Capita

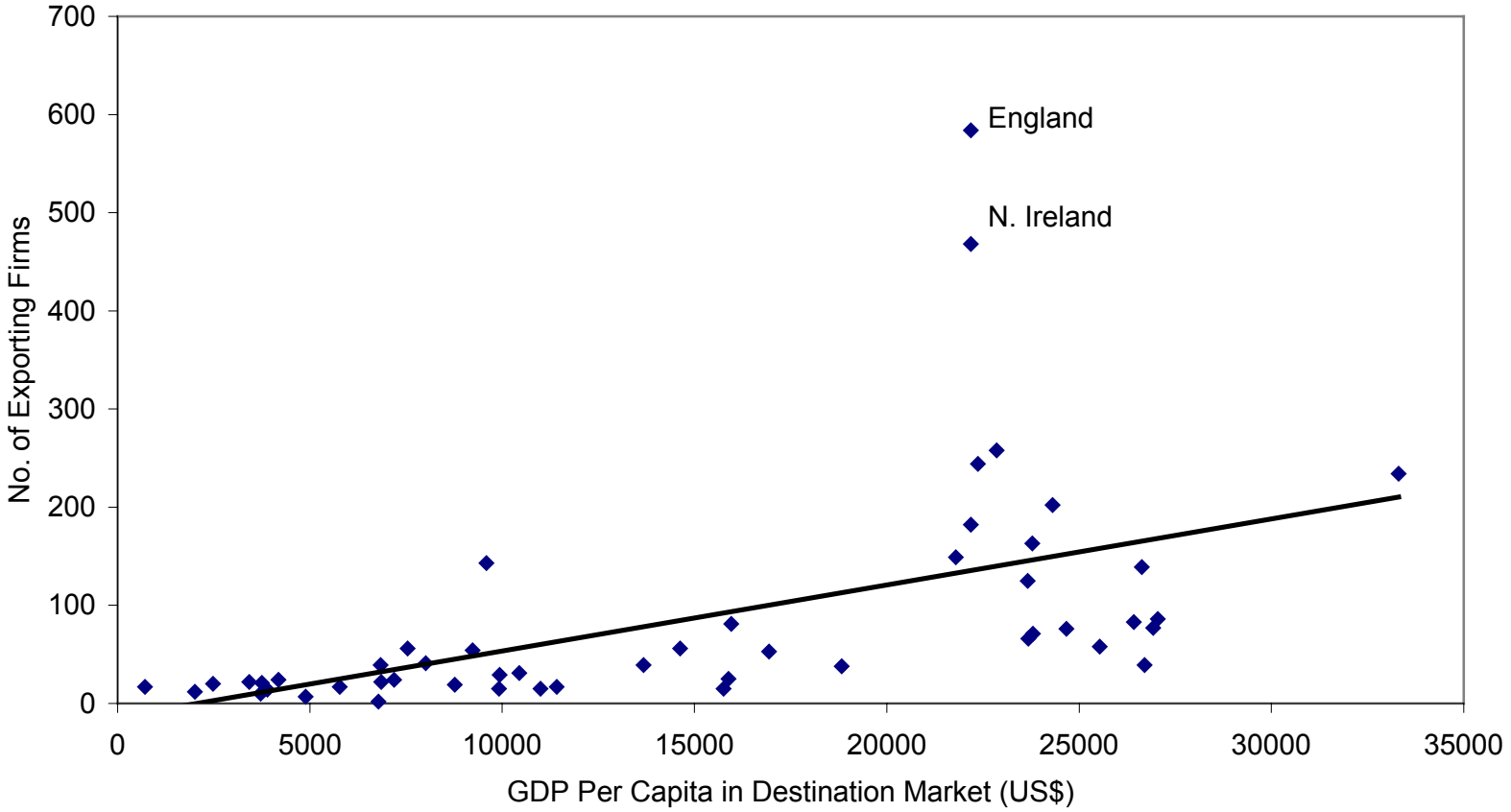

Figure 5: Number of Firms Entering and Exiting Markets

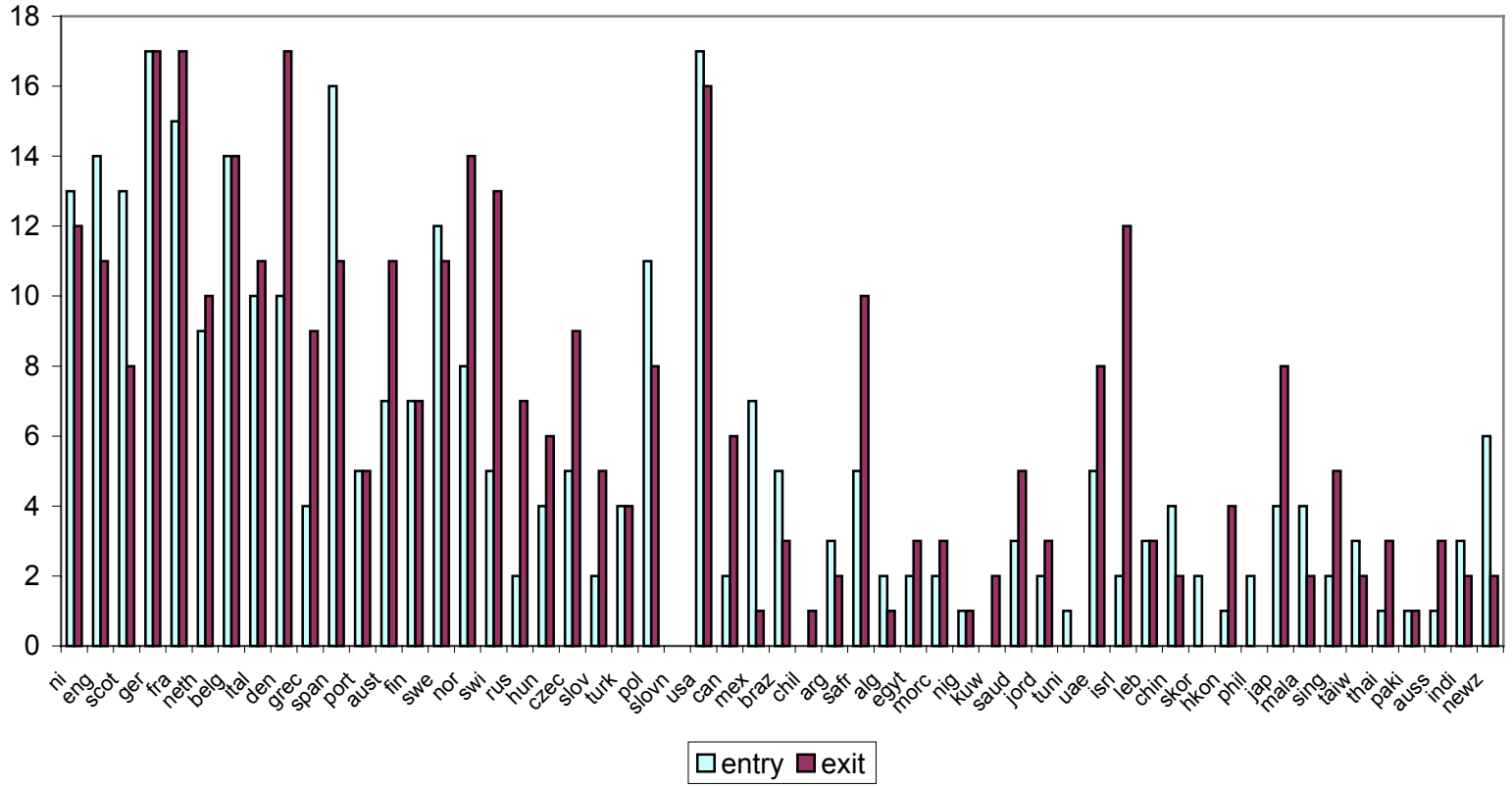

Figure 6: Distribution of Entry (No. of Additional Markets)

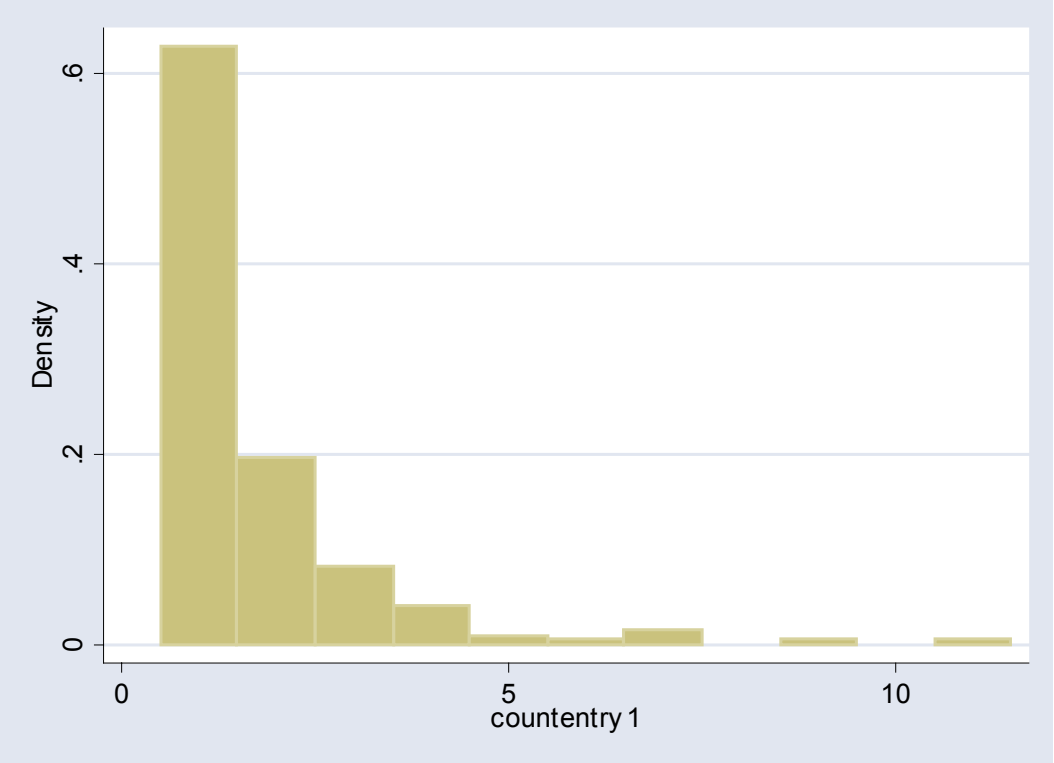

Figure 7: Distribution of Exit (No. of Markets)