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Jennifer Abel-Koch

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Johannes Gutenberg University Mainz
Gutenberg School of Management and Economics
Jakob-Welder-Weg 9
55128 Mainz
Germany
wiwi.uni-mainz.de

Contact details

Dr. Jennifer Abel-Koch
Assistant Professor of Economics
Johannes Gutenberg University Mainz
Jakob-Welder-Weg 4
55128 Mainz
Germany

abel-koch@uni-mainz.de

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Jennifer Abel-Koch†

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Abstract

In international trade models, it is typically assumed that manufacturers ship their goods directly to their foreign customers. In reality, however, many manufacturers call in trade intermediaries to perform this task for them. Which manufacturers make use of this option? Theory suggests that it is mostly the small firms which are not profitable enough to cover the high fixed costs of building an own distribution network abroad. Large and efficient firms, on the contrary, prefer to export their goods directly. The present paper brings this hypothesis to a test. Using survey data from the World Bank Enterprise Survey conducted in Turkey in 2008, it shows that there is indeed a negative correlation between firm size and the relative importance of intermediated exports. This result is highly robust to the inclusion of a variety of controls, different estimation methods, and different measures of firm size.

Keywords: Heterogeneous firms, intermediated trade

JEL Classification: F12, F14

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†Gutenberg School of Management and Economics, University of Mainz, Jakob-Welder-Weg 4, 55128 Mainz, Germany. E-Mail: abelkoch@uni-mainz.de, phone: 0049-6131-39-22114, fax: 0049-6131-39-20385.

1 Introduction

In international trade theory, it is typically assumed that manufacturing firms which want to serve the foreign market ship their products directly to their final consumers. What we observe in reality, however, is that very often trade intermediaries are involved in the exchange of goods and services across borders. Intermediaries are *"... economic agents that purchase from suppliers for resale to buyers or that help buyers and sellers to meet and transact"* (Spulber, 1996). If buyers and sellers are based in different countries, these agents are trade intermediaries. They include wholesalers and retailers in the exporting and importing country as well as large trading companies. In the 1990s, for instance, Japanese trading companies exported over 40% and imported over 70% of the country's products (Jones, 1998), and Hong Kong intermediated over 50% of the volume of China's exports to the rest of the world (Feenstra and Hanson, 2004). Survey evidence suggests that in 2003 in Germany, 47% of all firms with foreign customers exported directly, while 44% sold their goods abroad indirectly via a trade intermediary (Fryges, 2007).

Only recently, researchers have started to explore why firms may prefer using a trade intermediary to exporting their goods directly. Not surprisingly, the choice of export mode depends on destination country characteristics, such as the size of the foreign market (Schröder et al., 2005), the risk of expropriation and the enforceability of international contracts, or the cultural distance to the target country (Felbermayr and Jung, 2011).

However, another important insight that emerges from new theoretical contributions on the choice of export mode is that all else equal, smaller firms prefer to export their products via trade intermediaries, while larger firms prefer to sell their goods abroad directly. Ahn et al. (2011) introduce an intermediation technology in an otherwise standard heterogeneous firm model of international trade. As in the seminal model of Melitz (2003), firms can ship their goods directly if they incur a fixed cost of exporting. Alternatively, firms can export their products via a trade intermediary. This involves lower fixed costs, but as the trade intermediary incurs an additional per unit cost to handle the goods, it also implies lower export revenues. In the presence of such an intermediation technology, firms sort into export modes according to their sizes. The smallest firms do not export at all and sell to the domestic market only. Larger firms export indirectly via a trade intermediary, and the largest firms export directly to the final consumers.

A similar approach is taken by Felbermayr and Jung (2011). In their model, lower revenues from indirect as opposed to direct exports result from imperfectly enforceable contracts between exporters and trade intermediaries. Due to this distortion, larger exporters prefer to incur the higher fixed costs of building their own distribution network and export their goods directly. For smaller exporters trading via an intermediary is

nevertheless attractive, as it helps them to save on the fixed costs of exporting. Akerman (2010) derives the same sorting pattern of firms by introducing wholesalers who are able to spread the fixed costs of exporting across more than one good, but have to charge an additional markup on the procurement price of the firm to cover these fixed costs.[1]

Blum et al. (2010) consider a search and matching model in which both exporters and final consumers expend resources to find and match with an appropriate trading partner. An exporter can match with a final consumer in the foreign country either directly or indirectly by matching with a trade intermediary who then matches with a final consumer. If the exporter is large, it is highly visible and easy to identify by final consumers in the foreign country. In this case, matching directly is efficient. On the contrary, if the exporter is rather small, it is less likely to be found by potential foreign customers and would have to spend considerable resources to match directly with a final consumer. Therefore, the smaller exporter better matches with a large trade intermediary who then matches with a final consumer. A large trade intermediary makes matching cheaper, not only because it is easier to identify by both exporters and foreign customers, but also because it pools the costs of matching and spreads them over many exporters and final consumers.[2]

Although the theoretical literature provides clear results on the relationship between firm size and the choice of export mode, to date there is little evidence whether these results are also empirically valid. Knowing which manufacturers make use of trade intermediaries is however important to design effective export promotion policies, to evaluate the impact of protectionist measures, or to analyze the effect of regulatory reform in the intermediary sector on aggregate welfare and trade volumes, for instance. The present papers fills this gap and uses data from the World Bank Enterprise Survey conducted in Turkey in 2008 to evaluate whether smaller firms do indeed rely more heavily on trade intermediaries. In addition to information about a variety of firm characteristics, the survey provides information about the share of revenues generated by selling domestically, by exporting directly, and by exporting indirectly via a trade intermediary. It covers a comparatively large representative sample of Turkish firms in terms of firm size, and includes both exporters and non-exporters from a broad range of manufacturing sectors. An indisputable drawback of the data is that it does not contain any information on the destination of a firm's exports. However, I will argue that if the number and the identity of a firm's export markets depend on the firm's size, there is still a clear pre-

[1] Keller et al. (2011) provide empirical evidence which supports the idea that trade intermediaries reduce the fixed costs of gaining access to foreign markets.

[2] A similar argument has been made by Rauch and Watson (2002), who show that trade intermediaries can draw on strong networks and thereby facilitate matches between domestic sellers and foreign buyers. The relevance of formal and informal networks for shaping bilateral trade relations has been emphasized among others by Rauch (1999), Rauch and Trindade (2002) and Combes et al. (2005).

diction regarding the relationship between firm size and the share of indirect exports in total exports. A small firm will start exporting indirectly to a foreign market which is easily accessible. A large firm will deliver to the same market rather directly. Even if it uses a trade intermediary to enter into additional foreign markets, which are most likely less accessible, the share of indirect exports in total exports will be lower as it is for a small firm. In other words, if I do not control for the number of destination countries served, I would underestimate the negative relationship between firm size and the relative prevalence of intermediated exports. In that sense, my estimates are very conservative indicators of the negative relationship between firm size and the share of indirect exports in total exports to a given foreign market.

In fact, the empirical analysis indicates that the share of indirect exports in total exports declines significantly with firm size, and this result is robust to the inclusion of a variety of control variables, different estimation methods and different measures of firm size. In particular, adding proxies for firm age, management experience, ownership structure, legal status or research and development activities has no effect on the sign or significance of the estimated coefficient of firm size. Going beyond ordinary least squares regressions and applying a non-linear quasi-maximum likelihood estimator developed for fractional dependent variables does not change the main conclusions either, nor does it matter whether sales or employees are used as a measure of firm size. A potential concern in interpreting the estimated coefficients as the causal effect of firm size on the choice of export mode is reverse causality. It may well be conceivable that firms have less employees simply because they opted for indirect exports and hence do not need a foreign sales department. To alleviate the problem of reverse causality, I use lagged firm size as an alternative explanatory variable. The coefficient on firm size is only slightly smaller in absolute terms and remains negative and highly significant, suggesting that causality does indeed run from firm size to the choice of export mode.

I further find that firms which are part of a larger company export a larger fraction of their goods indirectly, which is in line with the idea that these firms trade relatively more intermediate inputs and unfinished goods with each other, and export relatively less final goods which are potentially shipped directly to the final consumer. Having a highly skilled workforce and developing new and innovative products is generally associated with relatively less indirect exports, which is consistent with the argument that technically more sophisticated products require more direct contact to the customers, and that innovative firms prefer a higher level of control.

The most closely related empirical studies in the growing literature on the role of intermediaries in international trade are Felbermayr and Jung (2011), Ahn et al. (2011), Fryges (2007), and Hessels and Terjesen (2010). Using census data on exports of U.S.

firms, Felbermayr and Jung (2011) relate the relative prevalence of trade intermediaries to destination country characteristics as well as to the dispersion of firm size across industries. They find that industries with a higher size dispersion exhibit a significantly lower relative prevalence of trade intermediaries, a result that is consistent with their prediction regarding the sorting pattern of firms into different export modes. Yet, they do not provide direct evidence at the firm level regarding the relationship between firm size and the choice of export mode.

Ahn et al. (2011) also focus on the correlation between aggregate shares of intermediated exports and destination country characteristics. They use Chinese customs data which allows them to classify exporters into manufacturing firms and trade intermediaries. One of their observations is that trade intermediaries export higher unit values, which is in line with the idea that intermediaries charge additional markups and export more expensive goods produced by less efficient firms. As the customs authorities have no information about the clients of the trade intermediaries, however, Ahn et al. (2011) cannot use the data to test the prediction regarding the relationship between firm size and the choice of export mode directly. Only in a recent revision, Ahn et al. (2011) provide more direct evidence on the sorting pattern of Chinese firms, also drawing on data from the World Bank Enterprise Survey. Their findings are largely consistent with my findings for Turkish firms, showing an inverted U-shaped relationship between firm size and the fraction of indirect exports in total sales for a sample of both exporters and purely domestic firms. Yet, they do not control for firm characteristics other than industry affiliation, which may bias their results. This is particularly true as export sales and domestic sales, which both enter their dependent variable, are likely to be affected by different firm characteristics. My work differs from theirs not only in adding important control variables, but also in addressing the issue of causality and in checking the robustness of the results.[3]

Analyzing survey data of German and British firms, Fryges (2007) identifies the factors that drive firms to switch between different export modes. Controlling for destination country characteristics, he finds that firm size has a significantly positive effect on the probability to change from indirect exports to direct exports, and interprets his result as evidence for the claim that larger exporters are more likely to dispose of sufficient resources to establish their own distribution network abroad. But his sample is rather small and covers only young firms in high-tech industries. Hessels and Terjesen (2010) also

[3]Two other recent studies which use data from the World Bank Enterprise Survey to analyze the export behavior of manufacturers are McCann (2010) and Lu et al. (2010). These studies do not address the issue of causality either. Moreover, both studies pool data from different countries, which is problematic for reasons explained in footnote 8. Neither the revision of Ahn et al. (2011) nor the studies by McCann (2010) and Lu et al. (2010) were available before the first version of the present paper appeared as CDSE Discussion Paper.

provide evidence on the determinants of the choice of export mode at the firm level. For a sample of small and medium sized enterprises in the Netherlands, they find no significant effect of firm size on the probability to export indirectly as opposed to directly, which is presumably due to their very small sample which basically excludes the largest firms in the economy.

In the following section, I sketch a very simple and highly stylized model on the relationship between firm size and the choice of export mode to capture the main arguments from the literature and to clarify the basic idea. In section 3, I derive some testable hypotheses on the relationship between firm size and the choice of a trade intermediary. I briefly describe the data in section 4 before I show the results of the empirical analysis in section 5. In section 6, I address the robustness of the results, before I summarize and conclude in section 7.

2 A simple model

There are two symmetric countries each of which is populated by a mass L of consumers with identical preferences over a continuum of varieties of a differentiated good,

$$U = \left(\int c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

with $\sigma > 1$. The assumption of symmetry is not crucial for the results and can easily be relaxed. Each consumer inelastically supplies one unit of labor, and the wage rate is normalized to one. Aggregate demand in each country for each variety i is

$$q_i = \frac{L p_i^{-\sigma}}{P^{1-\sigma}} \tag{2}$$

where p_i is the consumer price of variety i and $P = \left(\int p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$ is the ideal price index over all consumed varieties.

The differentiated good is produced with increasing returns to scale under monopolistic competition, which implies that each variety will be produced by at most one firm, and no firm will produce more than one variety. To produce one unit of variety i for its domestic market, firm i requires a_i units of labor. Firms differ in their marginal costs a_i. As in Melitz (2003), they can learn about their marginal costs only after they have made a fixed investment of f_E units of labor, which is thereafter sunk. In addition to the variable costs of production, there are fixed distribution costs of f units of labor, which reflect the resources needed to build a distribution network, to maintain customer relations or to meet specific product standards.

If a firms wants to sell its variety abroad, it has the choice between two different export modes. It can either ship its products directly to the final consumers. In this case, the firm has to incur iceberg trade costs $\tau_D > 1$, which reflect transport costs, import tariffs and other variable costs related to shipping the product abroad. In addition, the firm has to pay fixed distribution costs of f_D units of labor. Alternatively, the firm can use a trade intermediary. Exporting indirectly via a third party causes iceberg trade costs $\tau_I > 1$ and fixed distribution costs of f_I units of labor. Using both export modes simultaneously to ship goods to a given destination country is never optimal, as this creates unnecessarily high fixed costs.

It is assumed that the variable trade costs of exporting indirectly are higher than the variable trade costs of exporting directly, $\tau_I > \tau_D$. One interpretation is that the higher variable costs of exporting indirectly reflect an additional markup charged by the trade intermediary (Ahn et al., 2011). Another reason might be that the contract between the firm and the trade intermediary is not enforceable, and hence the trade intermediary has an incentive to hold up the manufacturer, which leads to lower export revenues (Felbermayr and Jung, 2011).[4]

Further, the fixed distribution costs associated with indirect exporting are assumed to be lower than the fixed costs of exporting directly, $f_I < f_D$. Intuitively, trade intermediaries can spread the fixed costs of building and maintaining a distribution network across many manufacturers and thus lower them for each individual firm (Schröder et al., 2005). In addition, a trade intermediary is more familiar with the target market and draws on strong networks, making access to this market cheaper (Felbermayr and Jung, 2011). Finally, for a manufacturing firm searching for a trade intermediary is most likely not as costly as searching for many new customers abroad (Ahn et al., 2011; Blum et al., 2010). In any case, getting access to a distribution network is more expensive abroad than at home, $f < f_I < f_D$.

The profit maximizing consumer price for variety i is $p_i^H = \frac{\sigma}{\sigma-1} a_i$ on the domestic market. On the foreign market, it is $p_i^I = \frac{\sigma}{\sigma-1} \tau_I a_i$ if the good is exported indirectly and $p_i^D = \frac{\sigma}{\sigma-1} \tau_D a_i$ if the good is exported directly. Multiplying prices with the respective

[4]Strictly speaking, higher iceberg trade costs lead to higher marginal costs for the manufacturer, while both the additional markup charged by the trade intermediary and the hold up problem due to incomplete contract enforcement would lead to higher consumer prices, but not to higher marginal costs for the manufacturer. Yet, the effect of higher iceberg trade costs on the revenues and profits of the manufacturer is qualitatively the same as the effect of higher consumer prices. See also the discussion in Felbermayr and Jung (2011) on this point.

quantities and simplifying notation gives the following expressions for the potential sales firm i can make on the domestic and foreign market,

$$s_i^H = A\,\varphi_i \tag{3}$$

$$s_i^I = A\,\tau_I^{1-\sigma}\,\varphi_i \tag{4}$$

$$s_i^D = A\,\tau_D^{1-\sigma}\,\varphi_i \tag{5}$$

where $A \equiv \frac{L}{P^{1-\sigma}}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}$ captures market conditions such as the size of the population and the aggregate price level, which is determined endogenously, and $\varphi_i = a_i^{1-\sigma}$ is a measure of firm productivity. The potential profits firm i can generate at home or abroad, given aggregate demand in the respective countries, are

$$\pi_i^H = \frac{A}{\sigma}\,\varphi_i - f \tag{6}$$

$$\pi_i^I = \frac{A}{\sigma}\,\tau_I^{1-\sigma}\,\varphi_i - f_I \tag{7}$$

$$\pi_i^D = \frac{A}{\sigma}\,\tau_D^{1-\sigma}\,\varphi_i - f_D. \tag{8}$$

Firm i will be active on the domestic market only if $\pi_i^H \geq 0$. It will export indirectly if $\pi_i^I \geq 0$ and $\pi_i^I > \pi_i^D$, and export directly if $\pi_i^D \geq \pi_i^I$. As marginal costs are constant, the decision to be active on the home market and the decision to export are independent of each other. This defines the following productivity cutoff values for selling on the domestic market, for exporting indirectly, and for exporting directly,

$$\varphi^H = \frac{\sigma f}{A} \tag{9}$$

$$\varphi^I = \frac{\sigma f_I}{A\,\tau_I^{1-\sigma}} \tag{10}$$

$$\varphi^D = \frac{\sigma(f_D - f_I)}{A\,(\tau_D^{1-\sigma} - \tau_I^{1-\sigma})}. \tag{11}$$

with $\varphi^H < \varphi^I < \varphi^D$, under the assumption that the difference in fixed export costs is sufficiently large to make indirect exporting attractive for small exporters, $f_D/f_I > (\tau_I/\tau_D)^{\sigma-1}$. The least productive firms with $\varphi_i < \varphi^H$ are not able to cover the fixed distribution costs and exit the market. All firms with $\varphi^H \leq \varphi_i < \varphi^I$ sell their products on the domestic market only, while all firms with $\varphi^I \leq \varphi_i < \varphi^D$ also serve the foreign market via indirect exports. The most productive firms with $\varphi_i \geq \varphi^D$ choose to deliver their products directly to their foreign consumers. The productivity cutoff values, together with the distribution of marginal costs or firm productivities, respectively, determine the aggregate price level.

3 Hypotheses on the choice of export mode

The sorting pattern of firms into purely domestic sellers, indirect exporters and direct exporters implies that the share of indirect exports in total exports to a given destination country is

$$S_i = \frac{s_i^I}{s_i^I + s_i^D} = \begin{cases} 1 & \text{if } \varphi^I \leq \varphi_i < \varphi^D \\ 0 & \text{if } \varphi^D \leq \varphi_i \end{cases} \tag{12}$$

In a world with a variety of destination countries with different characteristics, such as population size, the aggregate price level or the extent of the fixed and variable trade costs, a strict partitioning into only indirect and only direct exporters will of course not be observed, as the respective productivity cutoff values for different destination countries will overlap. However, I would expect a negative relationship between the share of indirect exports in total exports and firm productivity to persist. Highly productive firms may serve additional countries which are not profitable enough for inefficient firms,[5] and they may even use a trade intermediary if these countries are hardly accessible. Yet, as highly productive firms will also ship their goods directly to markets that inefficient firms can access only via a trade intermediary, their share of indirect exports in total exports will most likely be lower.

Ideally, I would like to test the relationship between indirect exports and firm productivity directly. However, firm productivity is unobserved and has to be estimated from the data. This is inherently problematic and estimates of firm productivity are most likely inconsistent due to simultaneity problems. There are methods to deal with such problems, but they generally require a panel dimension that the survey data I use in this paper is lacking.[6] Therefore, I will use firm size as measured by employment as a proxy for firm productivity instead. Employment is observable, and it is positively correlated with firm productivity. To see this, note that the labor used by a firm with productivity φ_i to produce and distribute its variety on the domestic and foreign market is

$$l_i = \begin{cases} A\,\frac{\sigma-1}{\sigma}\,\varphi_i + f & \text{if } \varphi^H \leq \varphi_i < \varphi^I \\ A\,\frac{\sigma-1}{\sigma}\,\left(1+\tau_I^{1-\sigma}\right)\,\varphi_i + f + f_I & \text{if } \varphi^I \leq \varphi_i < \varphi^D \\ A\,\frac{\sigma-1}{\sigma}\,\left(1+\tau_D^{1-\sigma}\right)\,\varphi_i + f + f_D & \text{if } \varphi^D \leq \varphi_i \end{cases} \tag{13}$$

[5] A positive relationship between firm productivity or firm size and the number of export destinations is documented by Bernard et al. (2009) and Eaton et al. (2008), for instance.

[6] Usually, firm productivity is interpreted as the residual that results from fitting a specific production function. A simultaneity problem arises because a firm may observe its productivity and change its factor inputs. Panel data methods to deal with this issue have been suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2003), who use lagged investment or intermediate inputs as proxies, respectively.

which is a strictly increasing function of firm productivity φ_i under the assumptions made on the fixed and variable trade costs.[7]

There is also strong empirical evidence for the positive relationship between firm size as measured by employment and firm productivity that arises in heterogeneous firm models of international trade. Ark and Monnikhof (1996) show this relationship for France, Germany, Japan, the United States and the United Kingdom. Leung et al. (2008) and Baldwin et al. (2002) add evidence on the positive relationship between employment and productivity for Canada, and Biesebroeck (2005) documents it for a variety of African countries. Snodgrass and Biggs (1995) also find a large productivity gap between the largest and the smallest manufacturing firms in Turkey.

I am now ready to formulate the main hypothesis on the relationship between firm size and the choice of export mode as reflected by the share of indirect exports in total exports.

Hypothesis 1 *There is a negative relationship between firm size and the share of indirect export sales in total export sales.*

Apart from size, other firm characteristics are likely to influence the choice of export mode. The age of the firm may play a role, as hypothesized by the international business literature (e.g. Bilkey and Tesar, 1977 or Bilkey, 1978). Young firms start out as purely domestic firms, and once they are established on the national market, they start to export indirectly. After having made first experiences in the foreign market, they begin to export also directly. Similarly, Keller et al. (2011) argue that there may be cumulative learning effects which reduce the fixed cost of exporting directly as opposed to trading via an intermediary. Thus, I expect a negative impact of firm age on the share of indirect exports in total exports. Further, Anderson and Gatignon (1986) argue that firms which invest in new technologies and offer innovative and sophisticated products prefer a higher level of control over their foreign activities and therefore rather choose the direct export mode. If they would use a trade intermediary, which has to be trained and equipped with the technological knowhow that is necessary to sell the product, they would risk losing their competitive advantage. From this I hypothesize that a higher degree of innovation is associated with a lower share of indirect exports in total exports. And finally, as the enforceability of international contracts improves, the hold-up problem associated with using a trade intermediary becomes less severe, making indirect exports more attractive (Felbermayr and Jung, 2011). Thus, there is most likely a positive relationship between the level of contract enforceability and the share of indirect exports in total exports.

[7] Two alternative measures of firm size are total sales or export sales. These are also strictly increasing in the productivity of the exporting firm.

4 Data and descriptive statistics

This study uses data from the Business Environment and Enterprise Performance Survey carried out by the World Bank in cooperation with the European Bank for Reconstruction and Development in Turkey in 2008.[8] All data is freely accessible to researchers[9] and comprises rich information on stratified random samples of firms with different sizes from different sectors and geographic regions. As manufacturing firms are the focus of the theoretical literature on firm size and intermediated trade, I exclude those firms from the Turkish sample that are in the service, telecommunication or construction sector. This leaves me with 704 firms for which I have observations on the main variables of interest.[10]

To give a first impression on the relationship between firm size and the relative importance of different export modes, table 1 assigns the 704 firms to different size categories according to the number of full-time employees and indicates the percentage of firms within each size category which do not export at all and serve only the domestic market, which export exclusively via trade intermediaries, which use both the indirect and the direct export channel, and which ship their goods only directly.

Table 1: Export status and firm size

	Firm size measured by employees			
Export status	< 20	$20 - 99$	≥ 100	Total
No exports	67%	40%	17%	40%
Indirect exports only	11%	12%	12%	12%
Indirect and direct exports	8%	17%	25%	17%
Direct exports only	14%	31%	45%	31%
Total	100%	100%	100%	100%
Number of firms	189	295	220	704

About 40% of the 704 manufacturers sell all their goods nationally and do not export at all. Approximately 12% of all firms in the sample export only via trade intermediaries, while 17% export both indirectly and directly, and 31% export only directly. The share of non-exporters is considerably higher among small firms with less than 20 employees, and is much lower among large firms with 100 or more employees. The reverse is true for the share of direct exporters. While it is only 22% among small firms, it is 48% and 70%

[8] Similar surveys have been conducted elsewhere, in particular in a variety of Eastern European and Central Asian countries. Compared to Turkey, however, sample sizes in these countries are very small and hence the empirical results are less reliable. Instead of focusing on just one country, I could also pool observations across countries. However, market conditions and export destinations differ across countries, and a given level of productivity in a particular sector corresponds to different levels of employment or sales in different countries. Hence, the relationship between firm size and the choice of export mode is country specific and thus the addition of more countries to the sample is of little use.

[9] http://www.enterprisesurveys.org

[10] For details on the sectoral distribution of firms in the sample, see table 8 in the appendix.

among medium sized and large firms, respectively. This finding is in line with what is now considered a fact in the empirical literature on firms in international trade, namely that in a cross-section of firms, exporters are generally larger than non-exporters.[11] Similarly, the share of indirect exporters rises from 19% to 37% when moving from the small to the large firm category. Comparing the prevalence of different export modes across different firm size categories suggests that as firms get larger, they shift from non-exporters to indirect exporters, and further from indirect exporters to direct exporters. The relative prevalence of firms which use an indirect export channel as opposed to firms which do not export at all increases with firm size. However, the relative prevalence of firms which use a trade intermediary as opposed to firms which export only directly declines as firms get larger.

Summary statistics of the main variables of interest for the 421 firms which export either indirectly or directly or both are given in table 2. All information refers to the fiscal year 2007. Since the survey was answered by business owners and top managers, sometimes in cooperation with company accountants and human resource managers, I expect the information to be reasonably accurate. Respondents were asked to indicate the firm's total annual sales in local currency and to report the percentage of total annual sales that were national sales, indirect exports, which were specified as goods sold domestically to a third party that exports them, and direct exports. With this information I can construct the measure S_i. The share of indirect exports in total exports is 0.331 on average and varies considerably across exporters. Firm size as the main explanatory variable is measured by the number of full time employees. The distribution of firm size is skewed to the right, with a mean of 192 and a median of 73 employees.[12]

Table 2: Summary statistics

Variable	**Mean**	**(Std. Dev.)**	**Min.**	**Max.**	**N**
S_i	0.331	(0.411)	0	1	421
Firm size	191.729	(388.515)	2	4263	421
Firm age	18.076	(11.931)	0	82	421
Experience	23.798	(12.343)	1	70	421
Multiplant	0.112	(0.315)	0	1	421
Share university	0.14	(0.163)	0	0.9	421
Share nonproduction	0.254	(0.175)	0	0.842	421
R&D	0.352	(0.478)	0	1	421
New product	0.518	(0.5)	0	1	421
Courts	1.081	(1.29)	0	4	421

[11] See for instance Bernard and Jensen (1995) or Bernard et al. (2007).

[12] The key results are insensitive to alternative measures of firm size such as total annual sales or total export sales.

In addition to firm size, a variety of other firm characteristics may have an impact on the export behavior and need to be taken into account in the empirical analysis in order to avoid that their effect on the share of indirect exports in total exports is wrongly assigned to the effect of firm size.[13] Firm age indicates the years that have passed since the establishment began its operations and thus captures whether the firm is new to the market, while experience describes the years the top manager has worked in the respective sector. Multiplant is a dummy variable that equals 1 if the firm is part of a larger company. If this is the case, however, all information given in the survey refers to the firm, and not to the larger company. Share university indicates the fraction of employees that have a university degree and hence is a measure for skill intensity, while share nonproduction indicates the fraction of employees that do not work in production, but in areas such as management, administration, sales, or research and development. Both R&D and new product are dummy variables that equal 1 if the firm invested in research and development in 2007 or introduced a new product in the past three years, respectively. These variables reflect firm innovativeness. The variable courts indicates whether firms perceive courts to be an obstacle to their current operations. Answers are integers ranging from 0 (no obstacle) to 4 (very severe obstacle). Courts is used as a proxy for the enforceability of contracts.

Table 3: Share of indirect exports in total exports and firm size

	Firm size measured by employees		
	< 20	$20 - 100$	≥ 100
Indirect exports/total exports (S_i)	0.45	0.33	0.29

Sorting exporters into different size categories as in table 1 and looking at the average share of indirect exports in total exports sheds first light on the relative importance of intermediated as opposed to direct trade. It seems that indirect exports are indeed less important for larger firms. However, to gain deeper insight into the determinants of the choice of export mode, I will now turn to a multivariate analysis.

5 Empirical results

To assess the correlation between firm size and the relative importance of intermediated exports, I will first estimate equations of the form

$$S_i = \beta_0 + \beta_1 \ln(\text{firm size}_i) + \beta_2 X_i + \epsilon_i \tag{14}$$

[13]For an overview of the variables that are commonly used to explain the export behavior of firms see Bernard and Jensen (2004), Wagner (2001), and Fryges (2007), for instance.

where S_i is the share of indirect exports in total exports of firm i, X_i is a vector of control variables, and ϵ_i is an error term. Nearly all estimations include sector and region dummies.[14] The econometric method used is ordinary least squares with heteroskedasticity robust standard errors.[15] Results are presented in columns (1) to (4) of table 4.

Table 4: Effect of firm size on S_i

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) QMLE
Ln(firm size)	-0.033**	-0.050***		-0.060***	-0.063***
	(0.015)	(0.016)		(0.018)	(0.019)
Firm age			-0.003	-0.001	-0.001
			(0.002)	(0.002)	(0.002)
Experience			0.000	-0.000	-0.000
			(0.002)	(0.002)	(0.002)
Multiplant			0.147**	0.194***	0.217***
			(0.067)	(0.068)	(0.073)
Share university			0.024	0.083	0.085
			(0.125)	(0.123)	(0.133)
Share nonproduction			-0.159	-0.269*	-0.278*
			(0.138)	(0.139)	(0.146)
R&D			-0.025	-0.017	-0.016
			(0.045)	(0.043)	(0.044)
New product			-0.067	-0.066	-0.068
			(0.046)	(0.045)	(0.046)
Courts			0.029*	0.025	0.026
			(0.017)	(0.017)	(0.017)
Sector dummies	no	yes	yes	yes	yes
Region dummies	no	no	yes	yes	yes
N	421	421	421	421	421
R^2	0.011	0.051	0.089	0.115	
Adjusted R^2	0.009	0.014	0.027	0.052	

Constant included

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (1) shows the estimated coefficient of log firm size from a naive regression without further control variables. It is negative and significant, which is consistent with the hypothesis that larger firms have a lower share of indirect exports in total exports. Including sector dummies to control for sectoral differences in the size distribution of firms in column (2) strengthens this result. However, holding the sector fixed, firm

[14]For the purpose of the survey, Turkish provinces have been aggregated into five regions, which are Marmara, Aegean, Black Sea and Eastern Turkey, Central Anatolia, and South Turkey.

[15]A Breusch-Pagan test rejects the hypotheses of constant variance.

size is correlated with a set of other firm characteristics which may affect the relative importance of indirect exports. For instance, larger firms are more likely to be part of a larger company, and they have a lower share of nonproduction employees, reflecting economies of scale in headquarter services.[16] Including such firm characteristics, but omitting firm size in column (3) shows that being part of a larger company is associated with a significantly higher share of indirect exports in total exports. A firm's degree of innovation as measured by the variables share nonproduction, R&D and new product, on the contrary, has a negative impact on the relative prevalence of intermediated exports. Hence, controlling for these additional firm characteristics is important to estimate the true relationship between firm size and the share of indirect exports in total exports.

In fact, as reported in column (4), the negative relationship between firm size and the relative importance of intermediated exports is reinforced once other firm characteristics are controlled for. The estimated coefficient of log firm size falls to -0.060 and gets highly significant. It implies that for the smallest firm with only two employees, one more worker is associated with a decline in the share of indirect exports in total exports by about -0.03. The sign and the size of the coefficient of log firm size are very robust to the inclusion of further firm characteristics, such as the legal status of the firm or the share of the firm that is owned by foreign investors. Since these control variables turned out to be insignificant, however, I omitted them from the set of regressors.[17]

As pointed out in the introduction, I cannot control for the number of destination countries, nor for the characteristics of specific foreign markets. Part of this effect may be captured by the sector dummies, which indicate the comparative advantage of an industry compared to potential trading partners, and by the region dummies, which reflect the proximity of the firm to a specific destination country. Nevertheless, if larger firms use a trade intermediary to export to less accessible countries which are not served by smaller firms, the estimated coefficient is a rather conservative indicator for the negative relationship between firm size and the share of indirect exports in total exports to a given destination country. In other words, if I could run a separate regression for each destination country, I would presumably find a coefficient of firm size that is much larger in absolute terms.

Neither firm age nor the experience of the manager seem to play an important role for the choice of export mode. This might not be surprising, as both are very crude proxies for the experience of a manufacturer in a given destination country. As an alternative measure for foreign experience I used the years that have passed since the firm first exported. However, this variable is available only for a small subset of exporters. It

[16]The correlation coefficient is 0.192 for firm size and multiplant, and -0.176 for firm size and share nonproduction.

[17]See table 9 in the appendix for the results of these alternative specifications.

turned out to have no significant effect on the share of indirect exports in total exports, neither did it change the coefficient of log firm size.

Being part of a larger company, as indicated by the multiplant variable, has a significantly positive effect on exporting indirectly as opposed to exporting directly. A potential explanation is that firms which are part of a larger company mainly sell intermediate inputs and unfinished goods to related firms, but ship relatively less products directly to final consumers.

The fraction of employees that have a university degree per se does not seem to play an important role for the choice of export mode, although part of the effect of a high skilled labor force might be captured by the fraction of employees that work in areas other than production. Investing research and development and launching new products enter with the expected sign but turn out to be insignificant at conventional levels.

The variable courts which is supposed to capture the legal environment and the enforceability of contracts does not have the expected sign, nor is it significant. Firms were asked not only whether they perceive courts as an obstacle to their operations, but also whether they perceive the legal system as fair, impartial and uncorrupted, whether they think that the court system is quick, and whether they believe that the court system is able to enforce its decisions. None of these alternative measures had a significant impact on the share of intermediated exports in total exports. This may be due to the fact that these measures are highly subjective, and potentially endogenous to the choice of export mode. That is, a firm that frequently contracts with a trade intermediary is more likely to end up in a dispute, and may then perceive dealing with courts as a hindrance to its current operations. In addition, agreements between the exporter and the intermediary may be subject to the legal system in the importing country, in which case courts would not have any informative value for the actual enforceability of contracts.

Some researchers have raised concerns about using ordinary least squares regressions if the dependent variable is a proportion that, by definition, can only take values from 0 to 1. Wagner (2001) has argued that this problem may be especially severe if there are many limit observations, as in the case of the export to sales ratio, but also in the present case where the dependent variable is indirect exports over total exports. Basically, because the dependent variable is bounded between 0 and 1, the effect of any explanatory variable cannot be constant throughout its range. Including non-linear functions of the explanatory variable such as log firm size partly alleviates the problem, however, the predicted values from an ordinary least squares regression can never be guaranteed to lie in the interval $[0, 1]$. Papke and Wooldridge (1996) suggest a non-linear quasi-maximum likelihood estimator (QMLE) that yields consistent and asymptotically normal distributed estimates regardless of the distribution of the dependent variable

conditional on the controls, and that leads to predicted values between 0 and 1. The results from applying the fractional response model to the relationship between firm size and the relative importance of indirect exports are presented in column (5) of table 4. Note that the reported numbers are marginal effects evaluated at the mean.[18] The marginal effects depend on the specific likelihood function and therefore differ from the estimated coefficients.

When evaluated at the mean, the marginal effect of log firm size on the share of indirect exports in total exports is -0.063 and thus very similar to the marginal effect obtained from an ordinary least squares regression. The marginal effect of log firm size is somewhat stronger when evaluated at the 10th percentile (-0.073) and slightly weaker when evaluated at the 90th percentile (-0.049), which reflects the non-linear relationship between firm size and the choice of export mode. However, it is always negative and significant at the 1% level. The sign and the significance of the marginal effects of other explanatory variables do not change much either, indicating that the results are insensitive to the econometric method used.

6 Robustness checks

In this section, I will perform a number of robustness checks to further strengthen the previous findings. I will use different functional forms. In addition, I will explore alternative measures of firm size. And finally, I will use the status of being an indirect versus a direct exporter as a binary dependent variable to show that the assumption of a continuous share of indirect in total exports does not drive the results.

The results for different functional forms of firm size are given in table 5. The coefficient on firm size remains negative and significant at the 5% level even if it does not enter in logs, as shown in column (1). Sorting firms into different size categories according to the number of full-time employees and regressing the share of indirect exports in total exports on firms size dummies in column (2) reveals that both medium and large firms drive the result. Compared to small firms, the share of indirect in total exports is about -0.167 lower for medium sized firms and about -0.254 lower for large firms. The coefficients for medium sized and large firms are both highly significant and differ at the 10% level.

Taking the log of firm size, but using the number of full-time employees in 2004 rather than 2007 gives the results shown in column (1) of table 6. The coefficient on lagged firm size is negative, significant, and only slightly smaller than the coefficient on contemporary

[18] In case the explanatory variable is a dummy, the reported number is the effect of a discrete change of the explanatory variable from 0 to 1.

Table 5: Effect of firm size on S_i for alternative functional forms

	(1) OLS	(2) OLS
Firm size	-0.000**	
	(0.000)	
Firm size 20-99		-0.167**
		(0.065)
Firm size ≥100		-0.254***
		(0.070)
Firm age	-0.002	-0.001
	(0.002)	(0.002)
Experience	0.000	-0.000
	(0.002)	(0.002)
Multiplant	0.170**	0.191***
	(0.069)	(0.067)
Share university	0.035	0.100
	(0.125)	(0.124)
Share nonproduction	-0.203	-0.265*
	(0.140)	(0.136)
R&D	-0.021	-0.016
	(0.044)	(0.043)
New product	-0.064	-0.070
	(0.046)	(0.046)
Courts	0.027	0.026
	(0.017)	(0.017)
N	421	421
R^2	0.097	0.121
Adjusted R^2	0.032	0.056

Constant, region and sector dummies included

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

firm size. This suggests that causality does in fact run from firm size to the relative prevalence of intermediated trade, unless firms anticipate their export activities already three years in advance and adopt their production and sales capacities accordingly. The finding is also consistent with other results from the empirical trade literature which show that high productivity precedes entry into export markets, substantiating the theory of fixed entry costs.[19]

A potential concern might be that all these results are sensitive to using the number of full-time employees as a measure of firm size. This is however not the case. As shown in columns (2) and (3) of table 6, using the log of total sales or the log of total export sales as alternative measures of firm size yields very similar results, that is larger firms make relatively less use of trade intermediaries.[20]

Given that I cannot regress the share of indirect in total exports on firm size for each destination country separately it seems natural to treat S_i as a continuous variable. In fact, table 1 reveals that if exports are aggregated across all destination countries, nearly a third of all exporters uses both export modes simultaneously and hence has $S_i \in (0, 1)$. Nevertheless, as a further robustness check, I consider the choice of export mode as a binary variable and estimate the effect of firm size on the probability of being an indirect exporter as opposed to being a direct exporter. I define a firm to be an indirect exporter as soon as the share of indirect in total export sales is larger than zero. Hence, a firm counts as a direct exporter only if $S_i = 0$.[21] The estimated marginal effects, evaluated at the mean, are shown in table 7.[22] They indicate a significantly negative relationship between firm size and the probability of being an indirect exporter as opposed to being a direct exporter, and are thus perfectly in line with the previous findings.

Finally, to check whether outliers drive the result, I excluded the largest and the smallest firms from the sample (top and bottom 5 %). I also excluded sectors with only a few observations, and I used 4-digit industry dummies instead of 2-digit sector dummies. None of this affects the key result, namely that firm size has a negative and significant effect on the share of intermediated trade.[23]

[19] See Clerides et al. (1998), Bernard and Jensen (1999), or Aw et al. (2000), just to give a few examples.

[20] Unfortunately, total annual sales or total export sales are not available for all firms in the sample. As these firms do however report an estimate of the percentage of their total annual sales that were due to indirect and direct exports, I decided to keep them in the sample when using the number of full-time employees as a measure of firm size. Excluding firms with missing sales date has however no significant effect on the results.

[21] Alternatively, I could define a firm as an indirect exporter if it makes more than 50 % or all of its export sales via a trade intermediary. This changes the estimated marginal effects slightly, but does not invalidate the main conclusions. Results are available upon request.

[22] Again, in case the explanatory variable is a dummy, the reported number is the effect of a discrete change of the explanatory variable from the base level.

[23] Results are available upon request.

Table 6: Effect of firm size on S_i for alternative measures of firms size

	(1) OLS	(2) OLS	(3) OLS
Ln(firm size in 2004)	-0.047**		
	(0.019)		
Ln(sales)		-0.040***	
		(0.014)	
Ln(export sales)			-0.029***
			(0.011)
Firm age	0.000	-0.002	-0.001
	(0.002)	(0.002)	(0.002)
Experience	0.001	-0.000	-0.001
	(0.002)	(0.002)	(0.002)
Multiplant	0.135*	0.199***	0.203***
	(0.072)	(0.073)	(0.072)
Share university	0.104	0.029	0.066
	(0.138)	(0.130)	(0.130)
Share nonproduction	-0.298*	-0.082	-0.084
	(0.152)	(0.150)	(0.151)
R&D	-0.031	-0.006	-0.030
	(0.048)	(0.047)	(0.048)
New product	-0.084	-0.072	-0.050
	(0.051)	(0.049)	(0.049)
Courts	0.025	0.017	0.016
	(0.019)	(0.018)	(0.018)
N	355	365	357
R^2	0.113	0.134	0.119
Adjusted R^2	0.040	0.062	0.044

Constant, region and sector dummies included

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Probability of being an indirect exporter

	(1) Probit	(2) Probit
Ln(firm size)	-0.055**	
	(0.023)	
Firm size 20-99		-0.153**
		(0.076)
Firm size ≥100		-0.247***
		(0.083)
Firm age	0.001	0.001
	(0.002)	(0.002)
Experience	-0.000	-0.000
	(0.002)	(0.002)
Multiplant	0.253***	0.257***
	(0.087)	(0.086)
Share university	0.085	0.108
	(0.181)	(0.181)
Share nonproduction	-0.284	-0.295*
	(0.178)	(0.176)
R&D	-0.029	-0.030
	(0.057)	(0.058)
New product	-0.025	-0.029
	(0.058)	(0.058)
Courts	0.020	0.021
	(0.021)	(0.021)
N	417	417

Constant, region and sector dummies included

Robust standard errors in parentheses

$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

7 Conclusion

Although trade intermediation is a phenomenon well established in reality, it has only recently been addressed in the international trade literature. While many contributions focus on the nature of trade intermediaries, little is known about the manufacturers that actually ship their goods indirectly. Recent theoretical research suggests that the choice of export mode depends, among other factors, on the size and the productivity of a firm. Since intermediated exports are associated with lower fixed costs of gaining access to foreign markets, they are an attractive option for small and rather inefficient firms which want to export their goods. Building an own distribution network and maintaining customer relations abroad is much more costly, and only pays for large manufacturers which are profitable enough to cover the higher fixed costs.

The present paper brings this hypothesis to a test. Using data from the World Bank Enterprise Survey conducted in Turkey in 2008, it shows that there is indeed a significant negative correlation between firm size and the relative importance of indirect exports as opposed to direct exports. This relationship is robust to the inclusion of a variety of controls, different estimation methods, and different measures of firm size.

One drawback of the data used is that is does not contain any information on the number and the features of the destination countries a firm serves. This seems to be a more general problem in the empirical international trade literature. Transaction based data sets as provided by customs authorities have information on destination countries, however they rarely provide details on the firms involved in intermediated trade. Rich information about firm characteristics from the analysis of balance sheet data or survey data does however rarely comprise details about firms' export destinations. Combining both destination country and firm characteristics in a large sample seems to be a promising avenue for further research on the role of indirect exports for different manufacturers. Another way to improve upon the existing evidence is to use rigorous measures of firm productivity estimated from panel data instead of proxies for firm size such as employment or sales.

From a theoretical perspective, modeling a trade intermediation sector instead of simply assuming a specific intermediation technology would be the next step. First attempts in this direction have been made by Antràs and Costinot (2011) and Antràs and Costinot (2010).

Appendix

Appendix A: Sectoral composition of firms

Manufacturing firms are classified into industries as defined in Rev. 3.1 of the International Standard Classification Code according to their main product.

Table 8: Sectoral composition of firms

Industry (ISIC)	Number of firms	Share in %
Food and beverages (15)	134	19.03
Textiles (17)	157	22.30
Apparel (18)	86	12.22
Leather (19)	3	0.43
Wood (20)	2	0.28
Paper (21)	2	0.28
Publishing (22)	1	0.14
Coke and fuel (23)	2	0.28
Chemicals (24)	91	12.93
Rubber and plastics (25)	29	4.12
Non-metallic minerals (26)	91	12.93
Basic metals (27)	11	1.56
Fabricated metals (28)	35	4.97
Machinery (29)	35	4.97
Electrical appliances (31)	5	0.71
Communication equipment (32)	4	0.57
Motor vehicles (34)	10	1.42
Furniture (36)	6	0.85
Total	704	100.00

Appendix B: Additional control variables

Including additional controls for the legal status of a firm and the percentage of a firm owned by foreign investors gives the results presented in columns (1) and (2) of table 9.

Table 9: Effect of firm size on S_i with additional controls

	(1)	(2)
Ln(firm size)	-0.059***	-0.061***
	(0.018)	(0.018)
Firm age	-0.002	-0.001
	(0.002)	(0.002)
Experience	0.000	-0.001
	(0.002)	(0.002)
Multiplant	0.202***	0.209***
	(0.069)	(0.068)
Share university	0.051	0.088
	(0.126)	(0.125)
Share nonproduction	-0.283**	-0.246*
	(0.141)	(0.140)
R&D	-0.019	-0.008
	(0.044)	(0.044)
New product	-0.068	-0.079*
	(0.045)	(0.046)
Courts	0.025	0.026
	(0.017)	(0.017)
Share foreign		-0.001
		(0.001)
Legal status dummy	yes	no
N	421	418
R^2	0.128	0.120
Adjusted R^2	0.053	0.054

Constant, region and sector dummies included

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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