Intermediaries, quality screening and export channel switching *

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Abstract

This paper develops a simple model of intermediated trade. Exporters and importers want to form a match in order to obtain a type specific surplus. Matching takes place via a direct trade route or via a single intermediary. As information barriers impede direct matching, the intermediary opens up another channel for exchange through its trading network. Establishing a network is costly and hence the intermediary charges a commission rate for participation. In equilibrium, optimal commission rate and network size are determined. Consequently, expected trade and welfare increase.

Keywords: International Trade, Pairwise Matching, Information Cost, Intermediation, Networks

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1 Introduction

Intermediary firms connect importers and exporters around the globe and are therefore vital in trade creation. These enterprises don’t necessarily produce any goods themselves and are merely connecting trading partners. It is for example difficult to imagine how the rise of Chinese exports should have taken off in the early nineties without the links of overseas Chinese in Europe and North America to mainland China. However, standard trade theory proceeds on the assumption of centralized markets and neglects the intermediate step of trade. An example for such an intermediary is the Hong Kong based firm Li & Fung.

“Li & Fung Limited provides sophisticated, one-stop-shop supply chain solutions to meet customers’ specific needs. From product design, raw material sourcing and production management to quality control, logistics, shipping and other important functions, its spectrum of services covers the entire supply chain end-to-end.”

Recent papers such as Ahn, Khandelwal, and Wei (2011) show that 20% of Chinese exports are accounted for by intermediaries. Feenstra, Hanson, and Lin (2004) find that in the period of 1988 - 1998 an average of 53% of Chinese exports have been re-exported via Hong Kong. Tariff evasion is what comes first to mind if you here this. Nonetheless, this is not the story here. If only so called ”processing exports” are considered, i.e. exports that are duty free, the share of re-exports via Hong Kong even rises to 72%. More recently, Blum, Claro, and Horstmann (2010) find on a firm level, that about 35% of Chilean imports from Argentina are traded via wholesalers.

From an economic theory perspective, trade intermediaries influence aspects such as trade costs, terms of trade, quality signalling and welfare gains. Dasgupta and Mondria (2012) develop a two period framework where trade intermediaries have a major role in alleviating quality uncertainty. Other mechanisms, such as which firms are choosing what form of exporting, are however still not fully understood. As Ahn, Khandelwal, and Wei (2011) and Krüger (2009) show, firms tend to switch from indirect exporting to direct exporting over time and the more productive a firm is, the more likely it is to export directly. Rauch and Watson (2004) develop one of the first models in this field of research. They focus on a situation with incomplete information between importers and exporters. Intermediaries build networks that are able to lower informational costs. Bargaining power and intermediation technology determine the amount of intermediation in a general equilibrium setting. By manipulating the intermediaries bargaining

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1Excerpt from http://www.lifung.com/eng/company/
power, policy has a say in this framework. Petropoulou (2010) follows this line of research and builds a model with asymmetric information on both sides of a match. Differentiated products of an exporter and an importer can be traded in a network or outside of it. The former has the advantage that a match is more likely, but firms in the networks have to occur costs. Antrás and Costinot (2011) analyze welfare effects of intermediaries in a North-South environment. This paper builds on Petropoulou (2010) and focuses on the matching role of an intermediary in the market. Importers and exporters form pairs such that they exchange goods which creates a surplus for each of them. In this setting goods are differentiated, matches are type specific and information costs hinder trade. It follows that agents only match with a certain probability. Another trade route is via a single intermediary in the market. This intermediary invests in a network of importers and exporters and can match pairs. Traders are charged a commission rate if a match is successful. What is new in this approach, is that the model is set up in a heterogeneous framework. Match surplus of an importer and an exporter, depends on a distribution of surplus. Moreover, direct trading firms have to occur fixed costs in pursuing this trading channel. This is motivated by the cost a firm faces in searching for a trading partner directly, which involves for example time, effort and fees for trade fairs. In this paper, firms probability of matching depends on its quality level and the signal of their quality in each period. The closer the signal is to its true quality level and the higher quality is in general, the more likely it is for a firm to find a direct match. If a firm chooses to make use of an intermediary, a different mechanism is applying. The intermediary is screening the firm’s product to determine its true quality. the standards set by the International Organization for Standardization (ISO Standards) are an example for this. Screening in the sense of proving a certain quality level is value enhancing in this case. The following section is providing the core model of the paper. Subsequently, a numerical simulation illustrates the mechanisms in place.

2 The Model

Consider a situation where a local firm wants to start exporting its differentiated product to another country. It knows that there is a potential buyer in another market. The problem is however, the firm knows that only the highest qualities can easily find matching partners and that it has to convince this partner of its own quality. Facing these two hurdles, the exporter tries to establish itself in the market so that in the long run it is able to signal its true quality level. Being of
medium or low quality, a firm can however try to connect with an intermediary agent which is finding a partner for it. This setup is explained in detail in the next part. Then the equilibrium concept, including optimal network size, is depicted.

2.1 Setup

There exists a two-sided market where importers and exporters, both risk neutral, form a match \((X_j, M_j)\) to exchange a single good. A match generates a joint surplus given by the cumulative distribution function \(G(S)\), \(S \in [0, \tilde{S}]\) where \(\tilde{S}\) is an upper value for the surplus. Surplus in this case goes hand in hand with quality, implying the higher a firm's quality, the higher its surplus is. Surplus and quality are therefore used interchangeably throughout the paper. If agents fail to locate each other, surplus is zero. All traders draw their surplus at the beginning of the first period. A motivation for this setting can be given by trade in differentiated goods, such as specific features or timing of delivery.

Without informational frictions, every pair matches directly ('direct trade') and every surplus is realized. In direct trade, every importer and exporter has to pay a fixed cost \(F\) to engage in trade. Information asymmetries are present in the sense that importers do not know the long run surplus of their partner in the first period and will learn it only as time unfolds.

Considering a three period model, one can think of it in the following way. In the first period, every exporter draws her own signal value \(S^*\). Nonetheless, a match in this period will have a return of \(S^*_t\) where \(t\) is a time subscript, which is again independently drawn from \(S^*_t \in [0, S^*]\). The reason for this is that in the first trading period, the long term expected surplus level is just realized after the two trade partners established it. An importer-exporter relationship is terminated after one period. However, in the following periods the draw comes from a smaller interval around the true surplus value (i.e. \(S^*_t \in [S^*_{t-1}, S^*]\)) and will converge over time to its true value (\(\lim_{t \to \infty} S^*_t = S^*\)). Each firm draws a new signal only with probability \(\lambda\) in each period. \(\lambda\) is equal to one when the firm exported via an intermediary in the previous period and equal to the probability of a direct match if it exported directly. This results in a switching of some firms from direct to indirect exporting and vice versa.

In a second version of the converging process, the signal is centered around the true value and fluctuates around it. This is captured by the signal which is drawn around the true value of \(S^* \cdot \left[\frac{S^*_{t-1}}{\tilde{S}}, \frac{S^*_{t+1}}{\tilde{S}}\right]\). Truncated from above with \(\tilde{S}\), means that the signal can't be above the maximum quality in the market. As will be seen later both specifications result in similar simulation results.

Intermediaries can undertake a screening of the firms surplus value and signal
the true quality $S^*$. As a result, firms with a particularly bad draw may resort to this technology and export indirectly. The cost of screening is increasing with the firms quality and depends also positively on the size of the intermediary’s network.

Direct trade happens with a certain probability that is positively correlated with the quality of the firm and with how close the signal is to the the actual true quality level. This is captured by $q(I, G)$ the probability of a match in direct trade where $I = \frac{S^*}{S}$ is the screening intensity for each firm. The further away a firm’s signal is from its true quality, the less likely it is to match. A second source is the value of overall quality $S^* \in [0, \bar{S}]$. The higher the quality the higher the probability of a match so that $G = \frac{S^*}{\bar{S}}$. $q'_I(I, G) > 0$, $q'_G(I, G) > 0$. The maximum quality $S^*_m = \bar{S}$ and the signal being equal to the true value $S^m = S^*$, matching probability is one ($q(0, \bar{S}) = 1$). A signal of zero or a surplus of zero hinder direct trade entirely ($q(0, G) = 0$, $q(I, 0) = 0$).

$$q(I, G) = \left( \frac{S^m}{S^*} \right)^\alpha \left( \frac{S^*}{\bar{S}} \right)^\beta = I^\alpha G^\beta$$

$\alpha$ and $\beta$ are weights for $I$ and $G$ accordingly. Moreover, $q(I, G)$ can be seen as expected direct trade volume in the case without an intermediary and

$$q(I, G) \int_{F}^{S} (S - F)dG(S)$$

is the related expected joint surplus. Any exporter/importer pair with a joint surplus below $F$ will not engage in direct trade because fixed costs are not covered by the surplus.

The second possibility for trade is to match via a single intermediary (‘intermediated trade’). This agent develops a network of importers and exporters to match suitable pairs. The network’s size is determined by the profit it can extract from each particular firm. There is no analytical solution for this problem since the intermediary simply picks the firms that make the biggest profit. The Intermediary selects the exporting firms into its network, screens them and matches them with an importer interested in their product quality.

Network formation involves two forms of costs for the intermediary, a fixed cost which is the same in indirect trade, $F$ per firm, and marginal costs $c(S^m, S^*, N)$ which are increasing in the particular screening intensity, $S^* - S^m$, and overall network size $N$. Total costs, consisting of marginal costs for both members of a match can therefore be written as follows:

$$C = F + c(S^m, S^*, N)$$
After network investment is sunk, matching of network members is costless and occurs with probability 1. Revenues for the intermediary are generated by a commission rate it collects for incorporating an exporter into its network. As we will see, the intermediary uses its monopoly power to extract everything above the agents expected surplus in direct trade.

2.2 Timing

The first event in the whole setup is that each exporter draws its quality level which is in $S^* \in [0, \bar{S}]$. Then, the first period signal $S^S \in [0, S^*]$ for the firm is drawn. From then on, each period follows the same pattern and matching proceeds in the following way:

**Stage 1 - Draw a new signal** With probability $\lambda$ each firm draws a new quality signal from the interval $S^S \in [S^S_{t-1}, S^*]$. The intermediary knows about the signal and the quality of each agent.

**Stage 2 - Network Investment** The Intermediary contacts exporters to form a network of size $\{N\}$ and demands its commission rate $\alpha_I$ for screening them to convey the true quality of the product and to form a successful match.

**Stage 3 - Contracting** Traders decide whether to accept or decline the offer.

**Stage 4 - Indirect Trade** All exporters $X_j$ and their unique importers $X_M$, which are part of the network form a match.

**Stage 5 - Direct Trade** Traders outside the network can now decide to occur fixed costs of direct trade $F$ and match directly with probability $q(I, G)$.

2.3 Matching

After intermediary matching takes place in stage 4, unmatched firms in the final stage of the game can engage in direct trade and find a trading partner with probability $q(I, G)$. To do so they have to pay a fixed cost $F$. Since importers and exporters are assumed to have the same weight in bargaining, each of them gets half of the expected surplus and profits are thus:

$$E(\Pi_D^{DT}) = E(\Pi_M^{DT}) = E(\Pi^{DT}) = \frac{1}{2} q(I, G) S - F$$

(3)

If exporters and importers choose to deal with an intermediary in the first place, they have no expenses for fixed costs here, but instead have to pay the commission
rate $\alpha_I$. Given information costs $i$, every agent captures a share $\alpha_k$ where $k = X, M, I$. As in direct trade, traders share there surplus equally and so $\alpha_X = \alpha_M = \alpha_T$. Therefore, surplus shares have to add up to one and the following has to hold:

$$2\alpha_T + \alpha_I = 1$$  \hspace{1cm} (4)

Expected payoff for traders in indirect trade can be written as:

$$E(\Pi_{IT}^X) = E(\Pi_{IT}^M) = E(\Pi_{IT}) = \frac{1}{2}(1 - \alpha_I)S - F$$  \hspace{1cm} (5)

At the outset of the game, an exporter importer pair $(X_j, M_j)$ trades indirectly with probability $N$, the probability that an exporter is contacted by the intermediary. This results in an expected measure of intermediated trade $E(T_I) = N$.

A trader considering indirect trade expects the trade partner to be part of the network with probability $N$ and hence, in this case gets $E(\Pi_{IT})$. Otherwise with probability $(1 - N)$ the agent gets $E(\Pi_{DT})$. Expected payoff can be written as:

$$E(\Pi_X|X_j \in N) = E(\Pi_M|M_j \in N)$$

$$= \frac{1}{2}N(1 - \alpha_I)S + (1 - N)(\frac{1}{2}q(i)S - F)$$  \hspace{1cm} (6)

Trader participation in the intermediary’s network can be guaranteed by adjusting $\alpha_I$ in such a way that an importer or exporter is indifferent between the two forms of trade. Equalizing expected surplus for direct and indirect trade and solving for $\alpha_I$ performs this task:

This implies that $\alpha_I(S)$ is different for every $S \in [0, \hat{S}]$ and its respective $S^S$. Any value above 1 would not be accepted by an intermediary because this would mean a trader would give away more than what he receives from the match. This is why the value is bounded by a maximum value of 1. The intermediary adjusts the commission rate for every match specifically. Traders accept an intermediary’s offer if $\alpha_I(S) \leq min\left\{1 - q(I, G) + \frac{2F_{DT}}{S}, 1\right\}$ and reject otherwise. Maximizing profits, an intermediary sets

$$\alpha_I^\ast(S, i) = min\left\{1 - q(I, G) + \frac{2F_{DT}}{S}, 1\right\}$$

and all offered contracts are accepted.
2.4 Trade and Welfare

Direct trade matching takes place after intermediated trade has been resolved. That is the reason why total trade volume in the case where an intermediary is in the market is higher than trade where only direct matching is possible. Lemma 1 shows the fact, that an intermediary raises expected trade. Lemma 2 then focuses on total welfare. This section will be done in the next version of the paper.

2.5 Equilibrium Network Size

The intermediary’s costs $c(S^*, S^S, P)$ are comprised of two additive parts, marginal costs for screening exporters and network size costs. Marginal costs of matching are convex in the distance of the signal from the true quality value $(S^* - S^S)$ and concave in the overall quality of the firm $(S^*)$. The motivation for the first case is that how further away a signal is from the true value, the more expensive it is for the firm to screen them. On the other side, the better the true quality of a firm is, the less are its costs of screening. The reason for this is, that a high quality is better known by importers. This explains concavity in this dimension.

Moreover, the intermediary has to pay a cost for its network size $N$, which is strictly convex. Costs are chosen to have this form to reflect a network that can contact some traders easily, but as the number of traders rises it needs more and more effort to do so. Further restrictions to these costs apply as follows: $F$ are the intermediary’s fixed costs. The intermediary is picking the exporters with the highest profit and is including them into its network. Profits are comprised by the surplus specific commission rate for all traders in the network minus the variable costs and the fixed costs. Let costs $c(S^*, S^S, P)$ be described according to the functional form:

$$C = (S^* - S^S)c_1(S^*)c_2 + N$$

where $N = \frac{\text{(number of firms in network)}}{(\text{totalnumberoffirms})^{c_3+1}}$ and $c_1$, $c_2$ and $c_3$ are the elasticities of marginal cost. In the next section, a numerical simulation illustrates the model.

3 Calibration

In this section, several calibrations of the model are considered that match model parameters to empirical regularities. For the moment, the following simulation can be considered the baseline approach and further versions added in the near future.
3.1 Equilibrium pattern of intermediation and trade (A)

Parameter values that are used are:

\[ T = 100 \quad \text{;} \quad S^* \in [0, 1] \quad \text{;} \quad \alpha = 2 \quad \text{;} \quad \beta = 1/3 \quad \text{;} \quad c_1 = 2 \]

\[ c_2 = 2 \quad \text{;} \quad c_3 = 2 \quad \text{;} \quad F = 0 \quad \text{;} \quad \lambda = 1/4 \]

In order to get a better idea of the process, a first attempt of simulating the process is made. Parameter values are chosen as follows. Time is set to one hundred periods that can be thought of as months a firm is active in exporting. Every firm draws uniformly a quality level in the interval of 0 and 1 to which it converges over the long run. Matching probability for the firms is convex in the distance of the signal from its true value \( I \). That is the closer the signal is to its true value, the higher the probability of a match. Moreover, the probability depends positively and concave on \( G \). \( c_1 \) is the elasticity of marginal costs with respect to screening intensity which is equal to two. Similar, \( c_2 \) is the elasticity with respect to the overall quality level and is as well equal to two. Network size costs are important in the sense of congestion costs. The more firms to screen the more expensive it gets for the intermediary. Hence, the parameter \( c_3 = 2 \). In the baseline calibration fixed costs \( F \) of trade are set equal to zero. An agent draws a new signal with probability \( \lambda = 1/4 \) in each period. The simulation is done for 5000 individual firms. In the following, the results are discussed first for the signal that is converging from below and then for the centered signal. Figure 1 plots matching probabilities for the median values of the top 50% of firms, the overall median and the bottom 50%. It is clear that all of them start out low, meaning that there signal \( S^* \) is lower than there true quality level \( S^* \). As time passes, the signal values increase and the differences between the three quality levels become more pronounced. Eventually, every firm reaches its true signal value and matching probability stays constant. The centered signal starts out higher, although it looks similar in shape. This stems from the fact that the signal is truncated from above with the signal’s maximum value of \( \bar{S} \). Equilibrium network size, as shown in Figure 2 starts out at about 36% and reaches at about period 40 its steady state of 18%. In the beginning, matching probabilities for all firms are relatively low, therefore the intermediary can extract a higher revenue per firm in its network. As signals improve, revenue by firm fall and make them less profitable to remain in the network. Hence, network size is decreasing. For the centered signal, network size is generally lower but follows the same pattern. In the same line of argument, the intermediaries profit is in both specifications falling over time and reaches a constant value of 65 (Figure 3). As can be seen in
Figure 1: (A) Direct matching probability (dotted line represents centered signal)

Figure 4, the percentage of firms entering and exiting the intermediaries network are as well higher in the beginning and decrease over time. Since signal draws are random, this graph is not as smooth as the ones previously shown. Interestingly, the number of firms changing in the network dies out only after period 80. This is true although the intermediary’s profit is constant since around period 40. Switching rates are a lot higher for the centered signal since fluctuations of the signal are much higher and therefore firms switch in and out of the network more frequently. Figure 5 shows estimates of the distribution of firms in the Intermediary’s network. It can be seen, that over time the distribution shifts to the left. Implying that high quality level firms tend to use intermediaries in the first periods and then shift to direct trade. Low quality firms have a too small revenue for the intermediary to capture and are therefore not part of the network. This can also be seen in 6 although less clear. The findings presented above are in line with empirical regularities and contribute to the understanding of trade intermediaries.

4 Outlook

Here, I want to give an overview of the next steps to follow. So far, I have built a model where exporters and importers can either match directly or become part of an intermediary’s network to match indirectly. The intermediary screens firms in its network and makes it easier for them to find matching partners. Match surplus
Figure 2: (A) Equilibrium Network size

Figure 3: (A) Intermediary’s Profit
Figure 4: (A) Firm switching behavior

Figure 5: (A) Kernel Estimates of firms in intermediary network for different time periods (signal from below)
in the sense of a quality level is type specific and every trader pair is drawing its match value from a distribution. Acknowledging direct trade as the outside option for exporters and importers, the intermediary chooses its commission rate of screening in such a way that it extracts all surplus above this option value. In equilibrium, the intermediary chooses its optimal network size. A formal analysis on trade and welfare in the case with and without an intermediary in the network will be done. Another interesting aspect to work on, would be to make matches of intermediaries and exporters last for more than just one period and that they can only split up after some time. Modelling entry and exit in the market to get a full general equilibrium would be another aspect to look at. This might lead to a model which is closer to reality. In the model presented, there is only one single intermediary. Changing this environment to a situation of multiple intermediaries and creating an oligopolistic situation or even consider a competitive market is another option. As previously mentioned, calibrating the model more closely to empirical facts is an important issue. Ideally, getting access to a firm level dataset with intermediary’s in the market will provide these.

References


