# Relationship-Specific Sunk Costs and Exporter Decisions

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2007

Faculty of Business and Law

## SCHOOL OF ACCOUNTING, ECONOMICS AND FINANCE

School Working Paper - Economic Series 2007

SWP 2007/06

# Relationship-Specific Sunk Costs and Exporter Decisions

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*January 2007*

**Abstract** Using macro-level trade data, we investigate how different types of sunk costs influence decisions of exporters. We find that exporters' decisions reflect sensibly their desire to minimize the relationship-specific sunk costs. Specifically, exporters of differentiated products are more likely to reenter the export market than exporters of homogenous products. Also, the former are more likely to stay in the export market and exhibit more stability when doing so than the later. All of our findings are consistent with the view that relationship with their foreign partners matters more for trade in differentiated products than in homogenous ones.

**Keywords** International Trade; Market Reentry, Market Exit, Networks; Sunk Costs; Transition Probability Matrix

**JEL classifications** F14 O30

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† I am indebted to Mary E. Lovely, Devashish Mitra, David Richardson and Victor Trindade for invaluable comments on a preliminary version of this paper. I also wish to thank Hai-Anh Dang for comments. The usual disclaimer applies.
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## I. Introduction

Trade always involves buyers and sellers. Yet, the importance of the interactions between buyers and sellers is not the same for different products. As Rauch (1999) pointed out, buyers and sellers of homogenous products – i.e. products whose characteristics are sufficiently similar so that within a product category prices exist to signal their scarcity – even do not need to know each other for trade between them to take place. Intermediaries such as organized exchanges are formed to help trade between buyers and sellers to occur. The existence of a reference price coupled with the fact that homogenous products are easier to be produced with the same standards and qualities by more than one seller causes buyers of those homogenous products to have less incentive to stick with a unique seller for ever.[1]

On the contrary, trade in differentiated products, which do not have any reference prices requires buyers and sellers be matched in characteristics space. Consequently, buyers and sellers must interact directly with each other in a persistent process before trade between them could finally take place. [2] Given the need for direct interactions between sellers and buyers, relationship between them plays an important role in trade in differentiated products. It is la raison d'etre of international networks that Rauch (1999) advocates:

> "I argue that this uninformativeness of prices prevents 'globally scanning' traders from substituting for organized exchanges in matching buyers and sellers of differentiated products. Instead connections between buyers and sellers are made through a search process that because of its costliness does not proceed until the best match is achieved. This search is strongly conditioned by proximity and *preexisting 'ties'* and results in trading networks rather than 'markets'." (Italics added)

It is noteworthy that there is a scant empirical literature on the role of relationship in international trade. The first strand of literature is focused on the impact of networks or immigrants on the volume of bilateral trade based on the gravity equation. Rauch and Trindade (2000) empirically show that Chinese networks, as proxied by the product of Chinese population shares, are found to have increased bilateral trade more for differentiated products than for homogeneous products. Head and Ries (1998) and Dunlevly (2006) look into the same question using trade data of Canadian provinces and U.S. states respectively. For their part, Besedes and Prusa (2006a, 2006b) examines the extent to which product differentiation affects the duration of U.S. import trade relationships based on duration analysis. They find that the median survival time for trade relationships involving differentiated products is five years as compared to two years for homogeneous products.

In this paper, we investigate the extent to which relationship-specific costs as a form of sunk costs influence stay, exit and reentry decisions of exporters. We look into the role of relationship in stay, exit and reentry decisions of exporters because the theoretical framework that we are to set up in Section II suggests that relationship matters a lot in those decisions. Our findings confirm that it is indeed the case. First, exporters of differentiated products are more likely to reenter the export market than exporters of homogenous products, which is consistent with the view that good relationship needs to be revitalized. Second, exporters of differentiated products are more likely to stay in the export market than exporters of homogeneous products and exhibit more stability in doing so.

Our paper is organized as follows. Section II sets up a theoretical model of firms' entry and exit with sunk costs. The empirical methodology is presented in Section III. Section IV describes the data. Section V analyzes the results and Section VI concludes.

**II. A Model of Entry and Exit with Sunk Costs**

To motivate our empirical work, this section briefly sets up a model of firms' entry and exit with sunk costs as laid down by Roberts and Tybout (1997). Firm *i's* maximization problem is to choose among options $Y_{it}$ ( $Y_{it}$ =1 if firm $i$ is exporting in year $t$ and $0$ otherwise ) in order maximize the expected present value of its payoffs:

$$V_{it}(\Omega_{it}) = \underset{Y_{it}^{+}}{Max}\, E_t(\sum_{j=t}^{\infty} \delta^{j-t} R_{ij} \mid \Omega_{it}) \tag{1}$$

where $R_{it}$ is year-t exporting profits of firm *i*. $E_t$ denotes the expected values conditioned on the information set $\Omega_{it}$ while $\delta$ is the annual discount rate.

Firm *i's* exporting profits in year $t$, which are adjusted for sunk costs, are defined as follows:

$$R_{it}\ (\mathbf{Y}_{it}^{(-)}\ ) = Y_{it}\left[\pi_{it} - F_i^0(1-Y_{i,t-1}) - \sum_{j=2}^{J_i}(F_i^j - F_i^0)\tilde{Y}_{i,t-j}\right] - X_i Y_{i,t-1}(1-Y_{it}) \qquad (2)$$

where $\pi_{it}$ ($\boldsymbol{p_t}$, $\boldsymbol{s_{it}}$) is the difference between firm *i*'s expected gross profits when exporting and its expected gross profits when not exporting. $\boldsymbol{p_t}$ is a vector of exogenous market-level variables while $\boldsymbol{s_{it}}$ is a vector of plant-specific state variables. $F_i^0$ and $F_i^j$ $(F_i^0 \geq F_i^j)$ are firm *i's* entry cost with no exporting experience and its reentry cost when it last exported in year $t - j(j \geq 2)$ respectively. It is noteworthy that $F_i^j$ is zero if we assume the knowledge and experience gained in earlier years are completely irrelevant for the firm. $\tilde{Y}_{i,t-j} = Y_{i,t-j}\prod_{k=1}^{j-1}(1-Y_{i,t-k})) = 1$ if the firm was last in the export market *j* years earlier. Thus, it summarizes firm *i's* most recent exporting experience. Finally, $X_i$ is the loss firm *i* incurs when it exits the export market.

Bellman's equation allows us to express the maximization problem of firm *i* as follows:

$$V_{it}(\Omega_{it}) = \underset{Y_{it}^{+}}{Max}\, E_t(R_{it}(\mathbf{Y}_{it}^{(-)}) + \delta E_t\{V_{i,t+1}(\Omega_{i,t+1}) \,|\, \mathbf{Y}_{it}^{(-)}\}\ ) \qquad (3)$$

Given (1), (2), and (3), the behavior of firm *i* in year *t* can be summarized by the following participation rule:

$$
\begin{cases}
Y_{it} = 1 \text{ if } \pi_i(\boldsymbol{p_t}, \boldsymbol{s_{it}}) + \delta[E_t(V_{i,t+1}(\Omega_{i,t+1}) \mid Y_{it} = 1) - E_t(V_{i,t+1}(\Omega_{i,t+1}) \mid Y_{it} = 0] \\
\qquad \geq F_i^0 - (F_i^0 + X_i)Y_{i,t-1} + \sum_{j=2}^{J_i}(F_i^0 - F_i^j)\tilde{Y}_{i,t-1} \\
Y_{it} = 0 \text{ otherwise}
\end{cases}
\tag{4}
$$

Similarly, the exit rule of firm *i* in year *t* is as follows: [3]

$$
\begin{cases}
Y_{it} = 0 \text{ if} \\
\delta[E_t(V_{i,t+1}(\Omega_{i,t+1}) \mid Y_{it} = 0, Y_{it-1} = 1) - E_t(V_{i,t+1}(\Omega_{i,t+1}) \mid Y_{it} = 1, Y_{it-1} = 1] > \pi_i(\boldsymbol{p_t}, \boldsymbol{s_{it}}) + X_i \\
Y_{it} = 1 \text{ otherwise}
\end{cases}
\tag{5}
$$

Equations (4) and (5) can be used to illustrate how firms' participation or exit behavior may be very different depending on the type of sunk entry costs. A typical type of sunk costs is those that are independent of the frequency of interactions between buyers and sellers. In other words, the firm's past experience is completely irrelevant for its current performance. If that is the case, entry sunk costs and reentry sunk costs in our model as laid down above are the same and equal to $F_i^0$. It is reasonable to assume that exporters of homogenous products are faced with this type of sunk costs as they rely on intermediaries such as organized exchanges in order to find an importer and consequently don't have to interact with the later.

In presence of constant sunk costs the two last elements in participation equation (4) disappear. Thus, in year *t* firm *i* does not take in account its past exporting experience in making its participation decision. In other words, all other things being equal, firm *i* is not more likely to reenter the export market in year *t* when it was last in the export market in year $t-2$ than when it was last in the export market in year $t-10$.

Sunk costs may depend on the last experience. This is clearly the case for trade of differentiated products in which relationship matters more. Sunk costs associated with the search and matching process are likely to be less when exporters have past exporting experience than when exporters enter the export the market for the first time. Similarly, long absence from the market, which negatively affects relationship between sellers and buyers may substantially increase the sunk costs when exporters reenter the market.

In presence of relationship-specific sunk costs, participation equation (4) shows that other things being equal, the firm has incentive to reenter immediately the export market to reduce sunk costs. In other words, it is more likely to reenter the export market when it was last in the export market in year $t-2$ than when it was in the export market in year $t-10$. As for the exit behavior, exit rule (5) shows that the firm has incentive not to leave the export market in order to avoid sunk costs in the future.

Given the above predictions of firms' decisions, the two hypotheses we are to investigate at the marco-level trade data are the following:

***Hypothesis 1*** *an exporting country is more likely to reenter the foreign market of a differentiated product than the foreign market of an homogenous product.*

***Hypothesis 2*** *an exporting country is more likely to exit the foreign market of a homogeneous product than the foreign market of a differentiated product.*

**III. Econometric Methodology**

In order to investigate the role of relationship-specific sunk costs in decisions of trading partners, we first compute the following Balasa's export-based index of revealed comparative advantages:

$$RCA^1 = \frac{X_{ij}}{\sum_j X_{ij}} \Bigg/ \frac{\sum_i X_{ij}}{\sum_i \sum_j X_{ij}} \qquad (1)$$

where *X, i, j* denote exports, country of the group of eleven emerging economies, and industry respectively. As in the previous literature, we use the following adjusted measure of Balassa's index, which has its mean equal to zero and its values in the range (-1, 1):

$$RCA^{Adjusted} = \frac{RCA^1 - 1}{RCA^1 + 1} \qquad (2)$$

A country having $RCA^{Adjusted}$ greater (smaller) than 1 in an industry is considered to have revealed comparative advantages (disadvantages) in that industry as compared to the average of the group. Table 1 presents the summary statistics of the Balassa's index and its adjusted measure.

Second, we estimate, by the maximum likelihood method, transition probabilities separately for homogenous and differentiated products. The five states of transition matrices are *exogenously* defined as follows:

State 1: no-longer-exporter to the U.S.

State 2: high revealed comparative disadvantages (High RCD): $RCA^{Adjusted} < -0.5$

State 3: low revealed comparative disadvantages (Low RCD):

$-0.5 \leq RCA^{Adjusted} < 0$

State 4: low revealed comparative advantages (Low RCA): $0 \leq RCA^{Adjusted} < 0.5$

State 5: high revealed comparative advantages (High RCA): $0.5 \leq RCA^{Adjusted}$

For the purpose of this study a country is considered to be in the state of being no-longer-exporter to the U.S. market at time *t* only if its exports are zero at time *t and* if it already exported to the U.S. market at a time prior to time *t*.

Third, we estimate transition probability matrices separately for homogenous and differentiated products. The maximum likelihood function for estimating transition probabilities is shown in formula (3) where $n_{ij}$ is the number of transitions from state *i* to state *j* ( *i, j = 1,2,…m*):

$$f(P) = A \prod_{i=1}^{m} \frac{n!}{n_{i1}!n_{i2}!...n_{im}!} P_{i1}^{n_{i1}} P_{i2}^{n_{i2}} ....P_{im}^{n_{im}} \qquad (3)$$

This maximum likelihood function results from the assumption that for a given initial state *i* and a number of trials $n_i$, the sample of transition counts can be considered as a sample size $n_i$ from a multinomial distribution with probabilities $(P_{i1}, P_{i2}, ..., P_{im})$, such that $\sum_1^m P_{ij} = 1$. [4] Taking the derivative with respect to $P_{ij}$ $(j = 1, 2, ..., m-1)$ and solving the system of (*m-1*) equations yields the following estimated probabilities:

$$\hat{P}_{ij} = n_{ij} / n_i \qquad i, j = 1,2,...,m \qquad (4)$$

where $n_i$ is the total number of transitions starting from state *i*. [5]

**IV. Data**

Data are available from the *United Nations Commodity Statistics Trade Database (UN Comtrade).* They are SITC 1 data of exports to the U.S. in manufacturing industries (1-digit SITC 2= 5, 6, 7, 8) at the four-digit level. The sample consists of 14 emerging economies for which trade data are available with a time span of at least 12 years from the UN Comtrade database. They are Argentina, Brazil, China, Chile, Colombia, India, Indonesia, Korea, Malaysia, Mexico, Philippines, Singapore, Thailand and Venezuela. [6]

Since the Balassa's index is sensitive when the group is small, we restrict the sample to SITC 2 four-digit classifications that have at least five exporters to the U.S. market. Finally, classifications of products in two categories: homogeneous products having referenced prices and differentiated products are from Rauch (1999). [7]

**V. Results**

Table 2 presents the five-state transition matrices for the pooled sample using Rauch's "conservative" and "liberal" aggregation. Given our above definition of the five states, $P_{11}$ is the estimated probability that a country after leaving the U.S. export market at time *t* remains a non-exporter at time *(t+1)*. $P_{1j}$ (*j= 2, 3, 4,* and *5*) are probabilities that a country enter the U.S. market. Finally, $P_{i1}$ (*i= 2, 3, 4,* and *5*) is the estimated probability that a country leaves the U.S. export market. The transition matrices of each country are estimated separately for homogenous products (i.e. products having prices quoted on organized exchanges and products with prices quoted in trade publications) and differentiated products. [8]

As we can see from Table 2, exporters of homogenous products and differentiated products show systematic differences in their stay, exit and reentry decisions. First, the probability that trading partners remain no-longer-exporter after leaving the U.S. market is significantly higher for homogenous products than for differentiated products. When trade data of emerging economies are used the probabilities associated with the two types of products are 68% and 61% respectively whether Rauch's "conservative" aggregation or Rauch's "liberal" aggregation is used.

Second, Table 2 also shows that trading partners are more likely to stop exporting homogenous products than differentiated products. For example, from one year to another the probability is 16 % and 8 % that an emerging exporter having a high index of revealed comparative disadvantages (High RCD) leaves the export market in homogenous and differentiated products, respectively.

Third, after entering the U.S. market, both emerging and developed economies show more stability or persistence than their trade in homogenous products. Indeed, diagonal values ($P_{22}, P_{33}, P_{44},$ and $P_{55}$) of transition matrices associated with differentiated products are higher than diagonal values of transition matrices associated with homogenous products. In other words, a country is more likely to remain in the same state (i.e. its index of revealed comparative advantage does not change very much) after entering the foreign market of differentiated products than after entering the foreign market of homogenous products.

Thus, all of our findings about stay, exit, and reentry decisions of trading partners are consistent with the view that relationship-specific sunk costs are much more important for trade in differentiated products than in trade in homogenous products. Our findings are also in line with

Besedes and Prusa (2004), who find that the trade relationship involving homogeneous products is more fragile than the trade relationship involving differentiated ones.

***Robustness Checks***

As a robustness check of our results, we also estimate three-state transition matrices with the three states being defined as in Section III. Since we have relatively more transitions starting from state 2 and state 3 now we estimate transition probabilities separately for three types of products: products with reference prices quoted on organized exchanges, products with reference prices quoted in trade publications and differentiated products. The three states are: no-longer being an exporter, revealed comparative disadvantages (RCA<0) and revealed comparative advantages (RCA > 0). As Table 3 shows, the above findings still hold: trading partners are most likely to exit the U.S. market in products with reference prices quoted on organized exchanges and least likely to do so for differentiated products. Also, once they stop exporting, they are the most likely to remain non-exporters of products with reference prices quoted in organized exchanges while they are the most likely to reenter the U.S. market in differentiated products. Finally, while remaining in the export market exporters of differentiated products exhibit higher persistence than exporters of homogenous products as evidenced by the fact that the diagonal values of transition probabilities ( $P_{22}, P_{33}$ ) associated with differentiated products are significantly higher than those associated with homogenous products.

We also estimate transition probabilities for Indonesia, Korea, Malaysia, Philippines and Thailand for the period before the financial crisis only. The results remain essentially the same, which confirm that our results are not sensitive to macroeconomic shocks.

To check the significance of our findings, we also carry out the test for a specified transition probability matrix: $H_o$: $P = P^o$. More specifically, we test whether transition matrices associated with homogeneous products are significantly different from the transition matrices associated with differentiated products and vice versa. The statistic for the test is the following:

$$\sum_{i=1}^{m}\sum_{j=1}^{m} n_k[(p_{kl}-p_{kl}^0)^2/p_{kl}^0] \overset{d}{\sim} X^2(m(m-1)-d) \qquad (6)$$

where the summation is taken only over *(i, j)* for which $p^o{}_{kl} > 0$ and $d$ is the number of zeros in $\boldsymbol{P^o}$. All the statistics are significant at 0.5 percentage level. [9]

**VI. Conclusion**

This paper looks into the role of relationship-specific costs as a form of sunk costs in decisions of exporters to the U.S. market. In a model of firm's entry and exit with relationship-specific sunk costs, it is predicted that the firm has the incentive to stay in the export market or to reenter the export market shortly after leaving it in order to minimize the sunk costs.

Using marco-level five-digit data of exports of 13 emerging economies to the U.S. market, we find that exporters' behavior reflect sensible their desire to minimize those costs. Specifically, exporters of differentiated products are found to be significantly more likely to reenter the export market than exporters of homogenous products. Also, the former are significantly less likely to exit the U.S. market than the later. When staying in the export market, exporters of differentiated products exhibit more stability than exporters of homogeneous products. Our findings attest to the prediction that relationship with foreign partners matters more for trade in differentiated products than in homogenous products.

## Appendix A: Product classification

| Types | Characteristic | Example |
| --- | --- | --- |
| Homogeneous products | Prices quoted on organized exchanges | Unwrought lead |
| | Prices quoted in trade publications ("not branded") | Polymerization and Copolymerization |
| Differentiated products | No reference price | Footwear |

Source: Rauch (1996).

**Appendix B: Data**

| Country | Data Time Span | Frequency |
|---|---|---|
| Argentina | 1983-2004 | 5037 |
| Brazil | 1983-2004 | 6113 |
| Chile | 1983-2004 | 4182 |
| China | 1987-2004 | 4799 |
| Colombia | 1983-2004 | 4624 |
| India | 1983-2004 | 5925 |
| Indonesia | 1983-2004 | 4019 |
| Malaysia | 1983-2004 | 5158 |
| Mexico | 1986-2004 | 6383 |
| Philippines | 1983-2004 | 4366 |
| Rep. of Korea | 1983-2004 | 6210 |
| Singapore | 1983-2004 | 5584 |
| Thailand [1] | 1989-2001 | 4647 |
| Venezuela | 1989-2001 | 4471 |

Notes: (1) Thailand has data from 1983. But it has missing trade data for 1988 and 2002. So we only use its trade data for the 1989-2001period.

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**Notes**

1. See Appendix A for examples of three types of products.

2. As Rauch (1996) points out, in the real world the matching goes from the sellers to the buyers and vice versa. See Figure 1 that I borrow from Rauch (1996) for a graphical illustration of the interaction between sellers and buyers of homogenous products and sellers and buyer of differentiated products.

3. It is straightforward to obtain participation and exit rules. Given maximization problem (3) firm *i* remains in the export market if and only if $V_{it}((\Omega_{it}) \mid Y_{it} = 1) - V_{it}((\Omega_{it}) \mid Y_{it} = 0) \geq 0$. Similarly, firm *i* exits the export market if and only if $V_{it}((\Omega_{it}) \mid Y_{it} = 0) - V_{it}((\Omega_{it}) \mid Y_{it} = 1) > 0$. Substituting (2) into these conditions yields participation rule (4) and (5) respectively.

4. See Proudman & Redding (1998), for example, for more details on the maximum likelihood estimation of transition probabilities.

5. In most of the previous studies on mobility transition matrices are estimated with states being *endogenously* determined such that the number of transitions starting from each state is almost equal. This has the advantage that we get efficient estimated transition probabilities because the number of transitions starting from one state is similar to the number of transitions starting from other states. In this paper, we choose *exogenously* states because we have relatively large sample. Also, it makes more sense to make across-country comparisons as well as across-industry comparisons within a country because the upper endpoints that define states are the same.

6. See Appendix B for more details on the data time span of the two samples.

7. See Appendix A for an illustration.

8. It is noteworthy that Rauch's "conservative" aggregation minimizes the number of three-digit and four-digit commodities that are classified as homogenous products having reference prices quoted on organized exchanges and in trade publications.

9. Results of our test are not presented in this paper but are available upon request from the author.

**Table 1: Summary Statistics**

| Variable | Observation | Mean | Standard deviation |
|---|---|---|---|
| Exports | 71518 | 4.71e+07 | 3.48e+08 |
| RCA | 71518 | 1.773 | 6.580 |
| $RCA^{Adjusted}$ | 71518 | -0.347 | 0.591 |

**Table 2: Stay, Exit and Reentry Decisions of Exporters**

*Five-State Transition Probability Matrices*

| Homogenous Products | | | | | | Differentiated Products | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No of transitions | **State 1** *No longer Exporter* | **State 2** *High RCD* | **State 3** *Low RCD* | **State 4** *Low RCA* | **State 5** *High RCA* | No. of Transitions | **State 1** *No longer Exporter* | **State 2** *High RCD* | **State 3** *Low RCD* | **State 4** *Low RCA* | **State 5** *High RCA* |
| *Rauch's conservative aggregation* | | | | | | | | | | | |
| | N | -0.5 | 0.0 | 0.5 | 1.00 | | N | -0.5 | 0 | 0.5 | 1.00 |
| 1880 | **0.68** | 0.26 | 0.02 | 0.02 | 0.02 | 2626 | **0.61** | 0.35 | 0.02 | 0.01 | 0.01 |
| 3313 | 0.16 | **0.71** | 0.09 | 0.03 | 0.01 | 11156 | 0.08 | **0.82** | 0.08 | 0.02 | 0.00 |
| 1279 | 0.03 | 0.22 | **0.51** | 0.19 | 0.05 | 4080 | 0.02 | 0.21 | **0.61** | 0.15 | 0.01 |
| 1457 | 0.02 | 0.05 | 0.17 | **0.61** | 0.15 | 4040 | 0.01 | 0.03 | 0.15 | **0.71** | 0.10 |
| 1574 | 0.03 | 0.01 | 0.02 | 0.15 | **0.79** | 2541 | 0.01 | 0.01 | 0.02 | 0.16 | **0.80** |
| Ergodic distribution | 0.20 | 0.31 | 0.13 | 0.17 | 0.19 | Ergodic distribution | 0.11 | 0.44 | 0.17 | 0.18 | 0.10 |
| *Rauch's liberal aggregation* | | | | | | | | | | | |
| | N | -0.5 | 0 | 0.5 | 1.00 | | N | -0.5 | 0 | 0.5 | 1.00 |
| 2158 | **0.68** | 0.27 | 0.02 | 0.02 | 0.01 | 2348 | **0.61** | 0.35 | 0.02 | 0.01 | 0.01 |
| 3915 | 0.16 | **0.71** | 0.10 | 0.02 | 0.01 | 10554 | 0.08 | **0.83** | 0.08 | 0.01 | 0.00 |
| 1572 | 0.03 | 0.22 | **0.52** | 0.19 | 0.04 | 3787 | 0.02 | 0.21 | **0.62** | 0.15 | 0.01 |
| 1746 | 0.02 | 0.04 | 0.16 | **0.63** | 0.15 | 3751 | 0.01 | 0.03 | 0.15 | **0.72** | 0.09 |
| 1758 | 0.02 | 0.01 | 0.03 | 0.15 | **0.79** | 2357 | 0.01 | 0.01 | 0.02 | 0.16 | **0.81** |
| Ergodic distribution | 0.20 | 0.32 | 0.14 | 0.17 | 0.17 | Ergodic distribution | 0.11 | 0.48 | 0.17 | 0.15 | 0.09 |

Notes: (1) RCA $^{Adjusted}$ = -0.5, 0.0, 0.5 and 1.00 are the upper endpoints of state 2, state 3, state 4, and state 5, respectively.

**Table 3: Stay, Exit and Reentry Decisions of Exporters**

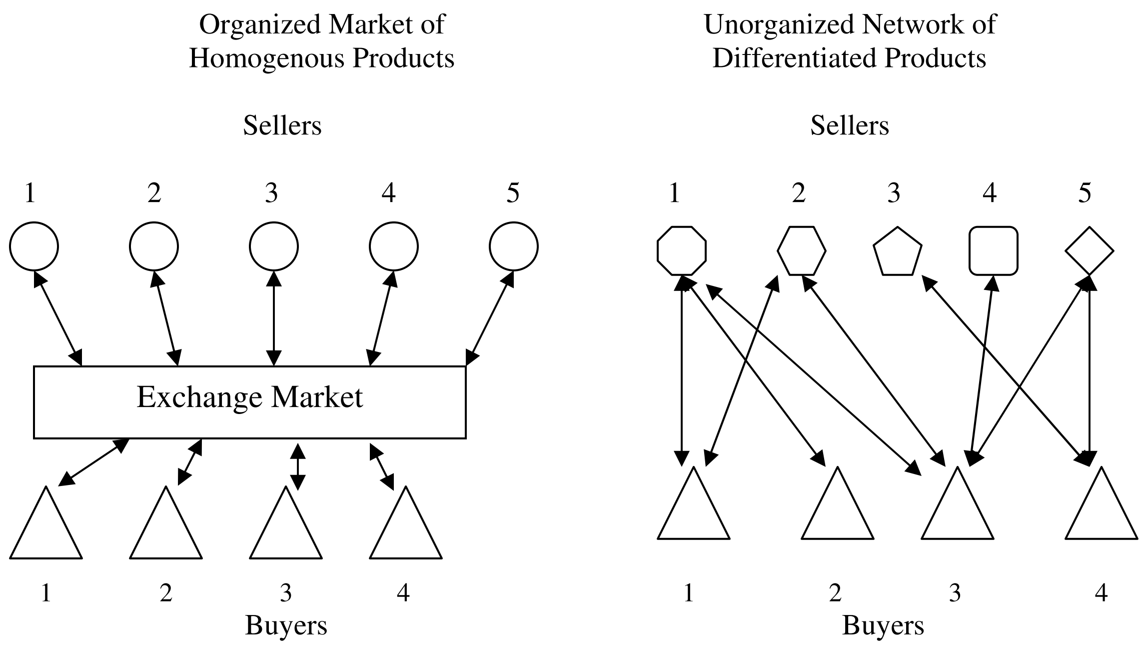
*Three-State Transition Probability Matrices*

| Products with Prices Quoted on Organized Exchanges | | | | Products with Reference Prices | | | | Differentiated Products | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No of Transitions | **State 1** *No longer exporter* | **State 2** *RCD* | **State 3** *RCA* | No of Transitions | **State 1** *No longer exporter* | **State 2** *RCD* | **State 3** *RCA* | No of transitions | **State 1** *No longer exporter* | **State 2** *RCD* | **State 3** *RCA* |
| *Rauch's conservative aggregation* | | | | | | | | | | | |
| | N | 0.0 | 1.00 | | N | 0.0 | 1.00 | | N | 0.0 | 1.00 |
| 456 | **0.71** | 0.26 | 0.03 | 1424 | **0.68** | 0.29 | 0.03 | 2626 | **0.61** | 0.37 | 0.02 |
| 722 | 0.18 | **0.74** | 0.09 | 3870 | 0.11 | **0.80** | 0.09 | 15236 | 0.07 | **0.88** | 0.05 |
| 475 | 0.04 | 0.12 | **0.85** | 2556 | 0.02 | 0.13 | **0.85** | 6581 | 0.01 | 0.12 | **0.87** |
| Ergodic distribution | 0.30 | 0.42 | 0.28 | Ergodic distribution | 0.19 | 0.48 | 0.33 | Ergodic distribution | 0.12 | 0.62 | 0.26 |
| *Rauch's liberal aggregation* | | | | | | | | | | | |
| | N | 0.0 | 1.00 | | N | 0.0 | 1.00 | | N | 0.0 | 1.00 |
| 535 | **0.73** | 0.24 | 0.03 | 1623 | **0.67** | 0.30 | 0.03 | 2348 | **0.61** | 0.37 | 0.02 |
| 877 | 0.17 | **0.76** | 0.07 | 4610 | 0.11 | **0.80** | 0.09 | 14341 | 0.06 | **0.88** | 0.06 |
| 500 | 0.04 | 0.11 | **0.85** | 3004 | 0.02 | 0.12 | **0.86** | 6180 | 0.01 | 0.12 | **0.87** |
| Ergodic distribution | 0.31 | 0.43 | 0.26 | Ergodic distribution | 0.18 | 0.48 | 0.34 | Ergodic distribution | 0.10 | 0.60 | 0.30 |

Notes: (1) $RCA^{Adjusted}$ = 0.0 and 1.00 are the upper endpoint of state 2 and state 3, respectively.

**Figure 1**

**Interaction between Buyers and Sellers**

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Source: Rauch (1996)