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OECD imports: diversification of suppliers and quality search

Olivier Cadot · Céline Carrère · Vanessa Strauss-Kahn

Abstract  We posit that OECD buyers are in a continuous search for best quality suppliers from developing countries. We build a simple model of adverse selection and quality screening which captures this feature. The model predicts that diversification happens by “bouts”, or temporary episodes, during which OECD buyers search for high-quality suppliers. Each diversification episode is followed by a phase of re-concentration on the best performers, until those fail (which happens stochastically), triggering new search phases. The model also shows that concentration across origin is highly volatile, especially for goods with high-quality heterogeneity. Finally, as the set of suppliers expands and buyers continue sampling,
the overall trend is an increased diversification across time. We empirical explore these conjectures using OECD imports over time (1963–2006) and measuring their concentration across 250 origin countries at the product level (1,300 products). We provide strong empirical evidence corroborating the model predictions.

Keywords Import diversification · International trade · OECD · Developing countries · Suppliers search

JEL Classification F1 · O11

1 Introduction

In spite of the rapid growth of emerging markets, OECD markets are still, today, the world’s largest (representing 66% of the world GDP in 2011), providing key outlets for goods exported from developing countries. How much access there is for developing countries on OECD markets has been the subject of considerable attention from a policy angle (see e.g. Kee et al. 2009 and references therein). By contrast, to our knowledge, not much has been written on the outcome—the overall evolution and composition of OECD imports. Yet, it matters whether they are opening up in the sense of letting more extra-OECD exporters in, or concentrating on a few “preferred” suppliers. Contestable OECD markets would make it easier for entrants to get a foothold; in contrast, if they exhibited strong incumbency advantages, they could create a two-track world among extra-OECD exporters (between countries that make it and countries that do not).

So far, a rapidly expanding literature has looked at the other side of the story, namely how export diversification interacts with economic development. Klinger and Lederman (2004) and Cadot et al. (2011) focus on product diversification and find that diversification evolves with income levels in a non-monotone way with peaks at middle income levels, a pattern similar to what Imbs and Wacziarg (2003) found for production. Parteka (2010) contributes to this literature by showing that the diversification of exports along the economic development path is dependent on the choice of concentration measures (absolute vs. relative). Hummels and Klenow (2005) account for the economic significance of the goods and show that the extensive margins of exports explain up to 60% of cross-country export variation. Other papers have looked at the extensive margin defined geographically instead of product-wise. The first paper in that vein was Evenett and Venables (2002), who showed that about one-third of the export growth came from the expansion of existing exports to new markets. On the basis of a larger sample, Brenton and Newfarmer (2007) found that the extensive margin accounted for only 19.6% of export growth; of that, 92% came from the export of existing products to new markets. Two recent papers, Parteka and Tamberi (2012) and Jaimovich (2012), also look at the import side. Parteka and Tamberi (2012), focusing on product diversification, carefully examine the evolution of import and export diversification.

1 Data in this introduction are from the World Bank WDI database.
along the economic development path. They find a positive correlation between countries’ GDP per capita and both import and export diversification. Jaimovich (2012) studies geographic import diversification and finds evidence for an increase in imports source diversification along the growth path.

Another strand of the trade literature, going back to the work of Hanson (1996), has emphasized the formation of regional production networks by multinational firms. According to this literature, a country’s exports may be determined by the outsourcing decisions of multinationals based in other countries. Anecdotal evidence also suggests that it is retailers who decide which foreign suppliers (and hence countries) are included in cross-border supply chains. Thus, for producers located in developing countries, export opportunities are, at least partly, driven by the policies of large buyers in OECD countries. If those buyers decide to concentrate on a few suppliers in order, say, to simplify logistics or quality-control processes, opportunities will be fewer for entrants at every level of productivity and trade costs. Put differently, given the continued importance of OECD markets for developing-country exports (in 2011, exports towards the OECD account for 58 % of developing countries total exports), it seems difficult to understand how developing-country exports evolve without looking at how OECD imports evolve.

Understanding the origin and diversity of imports is also relevant for OECD countries. The literature on endogenous growth (e.g., Romer 1987), technological spillovers (e.g., Coe and Helpman 1995; Keller 2004) as well as recent empirical works on firm level data (e.g., Halpern and Koren 2011; Kasahara and Rodrigue 2008; Goldberg et al. 2010; Bas and Strauss-Kahn forthcoming; Aristei et al. 2013) show the importance of an increase in the number and diversity of imported intermediate inputs in raising productivity as well as product and export scope. Broda and Weinstein (2006) also show that increasing imports diversity enhances aggregate welfare though a decrease in the price index. These strands of literature do not however focus on the dynamic of the geographical sources of imports. This is what we set out to do in this paper. 2

We posit that OECD buyers are in a continuous search for best quality suppliers from developing countries. Our model, a simple finite-horizon version of a classic two-arm bandit problem where buyers screen suppliers for quality and toss them out when they under-perform, captures this feature. The model predicts that diversification happens by “bouts”, or temporary episodes, during which OECD buyers search for high-quality suppliers. Each diversification episode is followed by a phase of re-concentration on the best performers, until those fail (which happens stochastically), triggering new search phases. Finally, the model suggests that with an increasing number of suppliers the overall trend is an increased diversification across time.

What we have in mind is a story where OECD buyers test suppliers from different developing countries where least developed countries (LDCs) differ in their exports quality. We identify a supplier as a country and believe quality of a

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2 As mentioned above Jaimovich (2012) studies geographic import diversification. We add to this paper by focusing on the OECD as importers and most importantly by providing and testing a model where quality search leads to specific form of geographic import diversification over time.
trade relationship has a country specific dimension. This conjecture is in line with a recent strand of trade literature which associates a product variety to a product-country pairs (e.g., Feenstra 1994; Broda and Weinstein 2006; Goldberg et al. 2010). Several arguments support the view that the probability of non-performing in export markets differs across developing countries. First, as emphasized by Hausmann and Rodrik (2003), there is an uncertainty about what a country can be good at producing. Similarly, as revealed in Djankov et al. (2010), countries differ in their ability to export products in due time. The average delay before shipping goods varies greatly across LDCs with an average of 47 days for African countries (and a maximum of 116 days for Central African Republic) and of 24 days for East Asian countries. As stated in the paper, long time delays are likely to be associated with more uncertainty about success of the trade relationship. Suppliers in countries with long delays are of lower quality. Rauch and Watson (2003) use the ISO 9000 certification as a measure of lower quality of management across countries and show that the rate of ISO 9000 is much lower in LDCs than in developed countries (DCs). Quality of management may indeed be necessary to provide international quality and delivery standards in OECD markets. The rate of ISO 9000 varies greatly across developing countries. Following Rauch and Watson’s (2003) methodology we find for example that in 2000, China has five times more ISO 9000 certificates per industrial workers than Morocco and 40 times more than Bangladesh while Turkey or Brazil report about 3 times more certificates than China.3 Finally, working at the country level and using different measures of quality, Hallak and Schott (2011) and Khandelwal (2010) find substantial differences in exports quality across countries.

Using a very large database of OECD imports at the 5-digit level Standard International Trade Classification (SITC) since 1963, we test the model’s basic predictions by looking at the evolution of unit values during re-concentration episodes and at how the volatility of concentration indices varies across products types, taking the variation in unit values as a proxy for quality heterogeneity.4 We find, as predicted by the model, that re-concentration, when it happens, is associated with a rise in unit values. That is, when buyers re-concentrate, they do so on higher-priced (and hence presumably higher-quality) suppliers rather than on the most price-competitive. We also find that concentration indices are more volatile, over time, for products whose quality (as proxied by unit values) is more heterogeneous across suppliers. Finally, consistent with an extension of our model, we provide evidence of an overall diversification in OECD import’s sources of supplies

3 The number of ISO 9000 certificates comes from the ISO Survey of ISO 9000 and ISO 14000 certificates—Tenth cycle provided by the International Organization of Standardization. We obtain data for industrial employment combining data on share of industrial employment in total employment, share of employment in population and population from the World Development Indicators (World Bank 2011).

4 Whether unit values are good proxies of product quality is disputable. Differences in unit value may reflect both changes in product quality and/or firms’ markups. In our context however, higher markups could easily be associated with performing suppliers as buyers keep high unit-price suppliers only if they are reliable. Note that unit values are still widely used in the literature discussing issues related to product quality (see for example Kugler and Verhoogen 2012; Manova and Zhang 2012).
(geographically) at the product level. This is reflected in a decreasing concentration index and a rising number of export sources over the 1963–2006 period.5

As in Rauch and Watson (2003), we design a model which presents a partnership between developed countries buyers and developing countries suppliers in a state of uncertainty on the ability of suppliers to honor their exports. We share the same concern of understanding the trade relationship between DC buyers and LDC suppliers. In Rauch and Watson’s model, search for suppliers is costly and buyers may start with small orders in order to test suppliers’ ability to fulfill their requirement in quality and delivery. Buyers may chose to end a relationship in favor of a newly discovered supplier. Our focus is not on the size of the transactions but on the number of transactions. DC buyers test numerous suppliers and keep only the performing ones. Our views are not incompatible: when testing many suppliers, likely orders are small. Our finding that buyers, when they re-concentrate, prefer high-priced products is in line with Baldwin and Harrigan (2011). They show that unit values are positively related to countries’ distances suggesting that high-quality/high-price products are the most competitive (as these goods can bear the high transportation cost implied by long distances).6

The paper is organized as follows. Section 2 sets up a simple model of supplier screening in the presence of adverse selection. Section 3 explores empirically the model’s implications for patterns of concentration and diversification by analyzing the temporary movement and overall trend in OECD imports. Section 4 concludes.

2 A simple model of quality search

We know little about the forces that drive the diversification/concentration of OECD buyers on specific sets of geographic suppliers. In the spirit of Rauch and Watson (2003), we posit that OECD buyers, in search for quality, test suppliers and concentrate on the best. As the set of suppliers expands and buyers continue sampling, diversification takes place. In order to explore this conjecture, we first build a very simple, stripped-down model of quality search. This model is a finite-horizon version of a classic two-arm bandit problem in the spirit of Rothschild (1974) and Bar-Isaac (2003). As usual in reputation models (e.g., Leland 1979; Tirole 1996), there are one type of buyers and two types of sellers with exogenous quality draws.7 We then introduce additional assumptions on buyer tastes and

5 This trend in diversification reversed itself in recent years; we show however in Sect. 3 that this is entirely explained by the rising share of Chinese products in OECD imports. Concentration indices keep on decreasing monotonically when China is excluded.

6 Baldwin and Harrigan (2011) develop a general equilibrium model based on Melitz (2003) with a taste for quality so that the lowest prices goods are not necessarily the most competitive.

7 As in the incomplete contract literature (see Antrás 2011 for a survey in the context of international trade), there is some uncertainty about the quality of the relationship between buyers and suppliers. Our focus is however different. In our work, the organizational form of the transaction (outsourcing or integration) is not the central question and termination does not incur any cost. Our model is better understood as outsourcing contracts where buyers shop around for the best suppliers rather than buyers and sellers adapting contracts in order to improve the transaction.
expanding supplier pool potentially interfering with the basic quality-search mechanism.

2.1 Baseline model

In this section we explore how supplier concentration is affected by informational considerations in the presence of a selection problem. Consider a 3-period setting where, in each period, a buyer needs to procure two units of a product from either one or two suppliers called X and Y. Each supplier has the capacity to provide either one or two units, as the buyer wishes, at a constant price. Suppliers are of unknown quality, with a per-period probability of providing a non-defective product equal to $\lambda^G$ for a good type and $\lambda^B < \lambda^G$ for a bad type (that is, the arrival of defective products follows an independent Bernoulli process for each supplier). Any supplier may fail, the probability of failure is however higher in a low-quality country (a bad type) where delivery is long and uncertain, management is poor and the like. The buyer knows $\lambda^G$ and $\lambda^B$ but not the type of each supplier, and assigns a prior probability $p_1$ on a good type in the initial period. Let $p^1$ be the buyer’s profit on a non-defective product and $p^0 < p^1$ on a defective one, payoffs being additive, and let $\zeta^t = 1$ designate the event that the product is non-defective. Let

$$\Pi^G = \lambda^G p^1 + (1 - \lambda^G) p^0$$

be the expected profit from buying from a good type and similarly for $\Pi^B$. In periods 2 and 3, the buyer revises his beliefs about the quality of each supplier on the basis of information (defective product or not) he obtained by dealing with them (if he did) in the previous period.

Let

$$p^t_i = \frac{\lambda^G p^t_{i-1} \Pi^G}{\lambda^G p^t_{i-1} + \lambda^B (1 - p^t_{i-1})}, \quad t = 2, 3$$

be the revised probability that supplier $i$ is a good type in $t$, based on information from period $t - 1$.

The buyer faces two sequential-sampling (or stopping-time) problems on two independent stochastic processes, but the decisions are not independent because sampling on one has consequences for the optimal stopping time on the other. The problem is thus potentially very complicated, but the limitation to two suppliers and three periods keeps it tractable.\(^8\) Consider the period-3 problem, and let $V_3$ be the buyer’s expected profit. Suppose that he dealt with both suppliers in period 2. Then in period 3 he buys both units from the best, so

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\(^8\) The problem of selecting the stochastic process that delivers the highest expected reward among a set of independent processes is known in the statistical-decision literature as a “multi-armed bandit” problem. One strategy, called “epsilon-first”, consists of a sampling (exploratory) phase during which several “levers” are tried, after which the experimenter sticks to the lever for which he has the most optimistic belief based on information gathered during the sampling phase.
\[ V_3(2) = p_3^* (2\pi^G) + (1 - p_3^*) (2\pi^B) \tag{3} \]

where \( p_3^* = \max\{p_3^x, p_3^y\} \) is the highest of the two posteriors. If he used just one of them in period 2, \( i \), then he just keeps that one and

\[ V_3(1) = p_i^2 (2\pi^G) + (1 - p_i^2) (2\pi^B) \tag{4} \]

where \( p_i^2 \) is the revised belief on supplier \( i \) used in period 2. Clearly, by definition of the max, \( V_3(2) \geq V_3(1) \) and the difference, \( \Delta V_3 = E[V_3(2)] - E[V_3(1)] \), is the value of information generated by keeping both suppliers in period 2.

In period 2, with two suppliers and a discount factor \( \delta \),

\[ V_2(2) = p_2^x p_2^y (2\pi^G) + (1 - p_2^x) (1 - p_2^y) (2\pi^B) + \left[ p_2^x (1 - p_2^y) + p_2^y (1 - p_2^x) \right] (\pi^G + \pi^B) + \delta V_3(2). \tag{5} \]

With one supplier,

\[ V_2(1) = p_2^* (2\pi^G) + (1 - p_2^*) (2\pi^B) + \delta V_3(1) \tag{6} \]

where \( p_2^* = \max\{p_2^x, p_2^y\} \).

In period 1, finally, the prior being the same on both suppliers, both are used, generating the information used to revise beliefs from \( p_1 \) to \( p_2^x \) and \( p_2^y \) respectively.

Clearly, the “interim” payoff collected in period 2 is higher, in expected value, with one supplier than with two, since in the former case the buyer buys only from the best whereas in the latter he carries both along. However, the expected period-3 payoff is, as noted, higher when two suppliers are kept in period 2 because the information generated has a value. Thus, there is a trade off between concentrating on the most efficient supplier and keeping several in order to “test” them.

What does the value of the information depend on? Suppose that, at the end of period 1, the buyer kept only one supplier, the one with the highest probability of being good, and suppose (without loss of generality) that it was supplier \( x \). Letting \( I_2 \) stand for the information available at the beginning of period 2, the conditional expectation of the period-3 gain is (see “Appendix”):

\[ E(V_3|I_2) = 2 \left[ p_3^x \pi^G + (1 - p_3^x) \pi^B \right]. \tag{7} \]

Let \( \phi^y = \Pr(p_3^y > p_3^x | p_2^y < p_2^x) \) be the probability that \( y \) would perform better than \( x \) in period 3, given that he performed worse so far, if we could observe both in action in period 3. Using this, it can be shown that the value of the information is

\[ \Omega = \phi^y \left[ E(V_3|p_3^y > p_3^x; I_2) - E(V_3|I_2) \right] = 2\phi^y \left[ E(p_3^y|p_3^y > p_3^x) - p_3^x \right] (\pi^G - \pi^B). \tag{8} \]

Thus, the value of the information depends on three multiplicative terms. The first is the probability that a good draw for the second-best supplier would reverse the

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ranking of beliefs. In a 3-period model, sampling stops in period one and concentration has to take place.\(^9\) By contrast, with more periods a reversal of beliefs is possible, and so, depending on the parameters (\(\lambda\) and \(\pi\)) continued sampling is optimal. In Sect. 2.2 below, a multi-period simulation of the model provides evidence of this phenomenon.

The second term is that in square brackets. Observe that it is decreasing in \(p_x^2\); the better is the “front-runner” supplier (\(x\)) the less there is to gain from an eventual reversal of beliefs. In our 3-period setting, this doesn’t say much, but in a multi-period setting it would have a potentially important consequence on which we will return.

The third term, finally, is the difference in expected gains between a good and a bad supplier, which can be written as

\[
\pi^G - \pi^B = (\lambda^G - \lambda^B) (\pi^1 - \pi^0). \tag{9}
\]

The first factor on the RHS of (9) is the difference between the prospects of a good and a bad supplier, a measure of their heterogeneity; the second is the effect of quality differences on profit, a measure of the industry’s characteristics (quality-sensitivity). Thus, the value of information, which in our setting drives the search for quality, is increasing in their heterogeneity and in the sensitivity of buyers to product quality.

2.2 More than three periods

With more periods, the revision of beliefs (i.e. the difference between posterior and prior from one period to the next) becomes smaller over time as beliefs approach asymptotically zero or one, but how fast the process of revision converges depends, of course, on the parameters of the two processes. If the two distributions (good and bad) have similar parameters, it takes, in expectation, more time to tell apart the two types, which requires longer sampling. Figure 1 illustrates how the rate of convergence varies with the parameters. In the LHS panel the two distributions are characterized by sharply different parameters and beliefs converge after twenty periods; in the RHS panel, the two distributions have similar parameters and the beliefs take almost a hundred periods to converge.

In the LHS case, positions tend to lock in fairly quickly. In the RHS case, longer sampling is needed to tell apart the two suppliers; however, note that the difference in expected returns (\(\pi^G - \pi^B\)), which is part of the value of the information, is also smaller, so the truth takes longer to appear but it matters less. Observe also that in the RHS panel, around iteration #20, supplier \(x\) has accumulated so many bad draws

\(^9\) In our 3-period model, the event that \(p_x^2 < p_y^2\) implies that \(y\) had a defect in period 1 while \(x\) did not. Then, if fortunes are reversed in period 2 (\(x\) has a defect while \(y\) has not), it is easily verified that posteriors at the beginning of period 3 will be just equal for \(x\) and \(y\). So, at best, the buyer will be indifferent between \(x\) and \(y\) in period 3. In (8), we have thus \(\phi^0 = 0\) and, given the multiplicative form of \(\Omega\), the value of the information is nil: There is no reason to keep on sampling after period 1. In a 4-period framework, at the cost of tedious algebra it is (relatively) straightforward to show that a reversal of beliefs is possible with two successive lucky draws on \(y\) and two unlucky ones on \(x\), and so, continued sampling (using both suppliers) can be optimal in period 2.
and supplier \( y \) so many good draws that the buyer is “almost certain” that \( y \) is of the good type, even though this belief is false (observe the dotted curve (\( y \)) approaching one between iterations #20 and #40). Going back to (8), we see that
\[
\lim_{px^2} \frac{\Omega}{py^3} = \lim_{py^3} E(p_y^3 | p_y^3 > p_x^3) - p_x^2 = 0; 
\]
that is, when the buyer becomes “almost certain” that his currently preferred supplier is of the good type, the value of information goes to zero and he stops sampling. If that were the case in the RHS panel of Fig. 1 (where the preferred supplier around iteration 20 is \( y \)) the part of the long-dashed curve lying to the right of the stopping time would be censored. The remaining incumbent (here \( y \)) would then be the sole supplier until sufficient evidence accumulates to convince the buyer that he had bet on the wrong horse (in the figure, that becomes clear after about iteration 60 and the posterior on \( y \) finally converges to zero around iteration 90). The buyer would turn to the alternative supplier only when his revised opinion on the incumbent drops back below the evicted supplier’s last posterior.\(^{10}\)

The model thus implies that concentration, when it occurs, is on high-quality products. It also suggests that periods of diversification are followed by periods of re-concentration and that volatility in the concentration of imports is higher for goods that are more heterogeneous in terms of quality. In order to shed light on the

\(^{10}\) Note that in this setup there can be no “informational cascade”. An informational cascade (Bikhchandani et al. 1992) can take place when a sequence of actors make binary decisions on a single issue (say, buying or selling a stock) based on a noisy signal about the correct decision and on the observed behaviour of past players. Each player forms his own belief based on a weighted average of his signal and past players’ actions, with weight on the latter that increases with the number of past players. Bikhchandani et al. show that there exists a critical number \( n \) such that, if \( n \) players observe the wrong signal and act accordingly, the \((n + 1)\)st will discard his own signal and follow the crowd. From then on, the herd behaviour cannot be reversed. Our setup is different because the buyer is repeatedly getting information about his supplier, whereas in an informational cascade the individual experimenter gets only one signal that he compares with the actions of other (past) players.
forces at works in a more dynamic setting, we add to the model two additional assumptions: (i) buyers have a taste for diversity, and (ii) the number of suppliers is expanding.

2.3 Quality search with diversification

2.3.1 Taste for diversity

A taste for diversity (as in Krugman 1979; Ethier 1982) can be introduced in the model by replacing the assumption of additive payoffs by a utility function of the form

\[ \Pi = \left[ \sum_i (\pi_i)^x \right]^{1/x} \]

(11)

where \( \pi_i \in \{ \pi^0, \pi^1 \} \) is the profit made on the purchase from supplier \( i \). To see what happens to the model’s basic predictions, consider period 3. The reasoning is similar for earlier periods. The period-3 payoff from using one supplier only (the preferred one), which was previously given by (3), is unchanged. That is,

\[ V_3(2, 1) = 2p_3^x \pi^G + 2(1 - p_3^x) \pi^B. \]

(12)

The corresponding payoff if the buyer uses both suppliers in period 3 is

\[ V_3(2, 2) = p_3^y \left\{ 2p_3^x \pi^G + (1 - p_3^x) \left[ (\pi^G)^x + (\pi^B)^x \right]^{1/x} \right\} + (1 - p_3^y) \left\{ p_3^y [ \left( \pi^G \right)^x + (\pi^B)^x ]^{1/x} + 2(1 - p_3^y) \pi^B \right\}. \]

(13)

Suppose, without loss of generality, that the preferred supplier is \( x \). Replacing \( p_3^y \) by \( p_3^x \) in (3), it is easily verified that, for \( x = 1 \), keeping one supplier is optimal (this is the benchmark case without a taste for diversity). However, as \( x \) goes down, the sign of the inequality is eventually reversed and the taste for diversity comes to dominate the selection effect. This is illustrated in Fig. 2 where \( V_3(2, 1) \) and \( V_3(2, 2) \) are shown as functions of \( \sigma = 1/(1 - x) \), the elasticity of substitution between the two suppliers, for assumed parameter values. For values of \( \sigma \) below 4.3, the taste for diversity dominates and keeping both suppliers is optimal; for values above 4.3, the selection effect dominates and keeping only one supplier is optimal.

What does this mean for our model? Essentially that the taste for diversity acts as a counterforce to the selection effect, generating situations where the Bayesian update of beliefs designates one supplier as preferable to others but the buyer nevertheless keeps several because he values diversity.

2.3.2 Entry of new suppliers

The number of suppliers would enlarge if trade costs were coming down or if productivity was rising exogenously among producers in a pool of potential suppliers with heterogeneous productivity levels as in Helpman et al. (2008). Several empirical studies support this increase in the number of potential suppliers.
Schott (2004) shows that the number of LDC suppliers for a given product has on average increased over time. Cadot et al. (2011) show that, over 1989–2005, on average each country has introduced 50–200 new export products. Similarly, using a more restrictive definition of new products, Klinger and Lederman (2004) found that 1,710 new product-country pairs were introduced in the 1990s (with a maximum of 160 for Indonesia). Suppliers would then appear progressively, creating scope for diversification of supplier sources at the extensive margin. As before, the repetition of transactions with incumbents would asymptotically reveal their quality, but strings of bad draws would always be possible even for good types, and their replacement would then set the clock back to zero for the new ones. With several entrants all characterized by similar priors, buyers would start by sampling all of them like at the beginning of our 3-period model, subsequently concentrating on the best. Episodes of diversification would be followed by episodes of concentration. Thus, informational considerations in the multi-period setup suggest that, in sectors where quality matters and is not standard across suppliers, entrants will find it hard to unseat incumbents as long as those perform well. But, with stochastic quality draws, incumbents are bound to fail 1 day or another. When they fail sufficiently severely (i.e. with a string of bad draws in a row), a window of opportunity opens up for entrants, ushering in a new phase of diversification, quality search, and ultimate re-concentration on the best performers. With an increasing number of suppliers, the number of best performers chosen as importers increases over time. The buyers’ taste for diversity reinforces this effect. There is diversification. What the model shows is that diversification will happen by

\[ V_3 (2,2) \]

\[ V_3 (2,1) \]

\[ \text{Re-concentration in period 3} \]

\[ \text{No re-concentration} \]

\[ \sigma \]

\[ \text{Fig. 2 Period-3 profit from one versus two suppliers, as a function of the elasticity of substitution. Note: simulated parameter values are } \pi_1 = 100, \pi_0 = 50, \lambda G = 0.8, \lambda B = 0.1, p_3x = 0.8, p_3y = 0.1 \]

Schott (2004) shows that the number of LDC suppliers for a given product has on average increased over time. Cadot et al. (2011) show that, over 1989–2005, on average each country has introduced 50–200 new export products. Similarly, using a more restrictive definition of new products, Klinger and Lederman (2004) found that 1,710 new product-country pairs were introduced in the 1990s (with a maximum of 160 for Indonesia). Suppliers would then appear progressively, creating scope for diversification of supplier sources at the extensive margin. As before, the repetition of transactions with incumbents would asymptotically reveal their quality, but strings of bad draws would always be possible even for good types, and their replacement would then set the clock back to zero for the new ones. With several entrants all characterized by similar priors, buyers would start by sampling all of them like at the beginning of our 3-period model, subsequently concentrating on the best. Episodes of diversification would be followed by episodes of concentration. Thus, informational considerations in the multi-period setup suggest that, in sectors where quality matters and is not standard across suppliers, entrants will find it hard to unseat incumbents as long as those perform well. But, with stochastic quality draws, incumbents are bound to fail 1 day or another. When they fail sufficiently severely (i.e. with a string of bad draws in a row), a window of opportunity opens up for entrants, ushering in a new phase of diversification, quality search, and ultimate re-concentration on the best performers. With an increasing number of suppliers, the number of best performers chosen as importers increases over time. The buyers’ taste for diversity reinforces this effect. There is diversification. What the model shows is that diversification will happen by

\[ 11 \text{ Note that these studies consider new products at the HS6 level. The number of new producers is obviously much larger.} \]

\[ 12 \text{ Failure may also be triggered endogenously by moral hazard if incumbents slacken the monitoring effort as time passes. For a reputational model with both selection and moral hazard, see e.g. Laeven and Perotti (2001).} \]
“bouts”, as a result of repeated failures in established buyer–supplier relationships, rather than as a continuous phenomenon.

Whereas the taste-for-diversity forces generate maximum diversification at all times (an essentially static prediction), quality search suggests alternating phases of diversification and re-concentration. The existence of these phases is implied only by the informational features of the model. Thus, volatility in concentration levels can be taken as a hallmark of informational phenomena and it depends on the heterogeneity of quality levels across suppliers. Our model suggests three testable propositions that we empirically explore in the next section: (i) If driven by quality search buyers will, at the end of each search phase, concentrate on the best supplier. (ii) Time-wise volatility in the concentration of imports is higher for goods that are more heterogeneous in terms of quality. (iii) With an increasing number of suppliers, new search phases are likely to entail higher diversification over time.

3 Quality search and diversification: empirical evidence

3.1 Concentration index and data

We measure, product by product \( k \), the geographical concentration of OECD country \( i \)'s imports in \( t \) across origin countries. Our measure is the Theil’s entropy index (Theil 1972) given by:

\[
\text{Theil}_{ikt} = \frac{1}{n_k} \sum_{j=1}^{n_k} x_{ikt}^j \ln \left( \frac{x_{ikt}^j}{\mu_{ikt}} \right) \quad \text{where} \quad \mu_{ikt} = \frac{1}{n_k} \sum_{j=1}^{n_k} x_{ikt}^j,
\]

where \( x_{ikt}^j \) is imports of OECD country \( i \) from origin country \( j \) of product \( k \) at time \( t \) and \( n_k \) is the total number of countries with the capability to export good \( k \). Our baseline definition of the set of potential exporters, \( n_k \), which is time-invariant, is the set of all countries having exported good \( k \) to some destination in the world (not necessarily OECD countries) at least two consecutive years in a row over the sample.

\[\footnote{However, supply shocks knocking out suppliers periodically could also create exogenous volatility at the extensive margin. This is to be kept in mind in the empirical exploration that follows, as baseline volatility is unlikely to be exactly zero.}

\[\footnote{Parteka (2010) found very high correlations between the different measures of concentration (Theil and Herfindahl indices are correlated at 0.95). Results in her paper do not depend on the choice of the concentration index. We re-run all specifications of the present paper using the Herfindahl index and found similar results as the ones presented here. These results are available upon request. We decided not to use the Gini coefficient because of the issues associated with this concentration index. The Gini coefficient is a numerical representation of the degree of concentration and represents the distance between the Lorentz curve and the 45\(^\circ\) line (egalitarian distribution). There are two issues with Gini coefficients. First, they place more weight on changes in the middle part of the distribution. If a transfer occurs from a larger number of exporters to a smaller number of exporters, it has a greater effect on the Gini if these numbers of exporters are near the middle rather than at the extremes of the distribution. Second, if the Lorentz curves cross, it is impossible to summarize the distribution in a single statistic without introducing value judgements. While studying concentration of import across time these issue should be relevant. Herfindahl and Theil indices are robust to these sensitivity issues [on this, see Sen (1997)].} \]
We impose the requirement of two consecutive years of exports instead of just one in order to ensure that the exporter is a successful one (Besedes and Prusa 2006a, b show that 2 years is the median duration of export spells; only 1 year might signal failure rather than the capacity to export). This definition has the advantage of being time- and importer-invariant (the latter matters for the part of our analysis where we disaggregate OECD imports by importing country).

As shown in Cadot et al. (2011), the presence of logarithm in the Theil index is not an issue for “zero” trade flows as at the limit, and by L’Hôpital’s rule, “zero” trade flows do not contribute to the measure of concentration. Our index of concentration captures both actions at the extensive and intensive margin without distinction. In order to explore action at the extensive margin, we also consider the simple number of exporters of good \( k \) to the OECD country \( i \) in \( t, N_{ber,igi} \).

Our data is COMTRADE import data for OECD countries (either taken as a bloc or disaggregated by importer) at the product level. Our preferred product classification is the 5-digit level SITC data (using the backwards classification—revision 1). The alternative, HS6, is more disaggregated (with 4,990–5,016 lines depending on the year against 1,158–1,300 for 5-digit level SITC), but the sample period is longer with SITC, which also underwent fewer revisions. In terms of country coverage, 5-digit level SITC data covers 253 countries and territories between 1962 and 2006 (44 years); HS6 coverage is nominally available starting 1988, but with only 12 countries (9 of which are OECD members) expanding gradually to 116 countries in 1995 and 140 in 2006.

In order to calculate the Theil index and capture the evolution in geographic import concentration, we need to define a potential number of source countries than is constant over time. In effect, if we let \( n_k \) vary over time, (say by making it equivalent to the number of countries that export a specific product each year), we cannot disentangle concentration/diversification on actual suppliers from changes in the universe of potential suppliers. For example, an increase in the Theil index may be caused by either concentration of imports on fewer sources or an increase in the number of potential sources. Our model however suggests that concentration occurs because buyers select the best suppliers after testing them. If \( n_k \) varies, we may observe concentration while the number of actual suppliers does not change, which would be misleading. Similarly, the geographic diversification of imports across time could results from the elimination of some countries from the set of potential suppliers. The OECD is not more diversified in the sense that it tests extra supply sources. As we are interested in the importers selections of source countries and its link with unit values, we do not want our concentration index to be modified by changes on the supplier side.

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The definition of OECD countries used in this paper includes the 29 countries that belonged to the OECD in 2006, i.e. Australia, Austria, Belgium-Luxembourg, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Japan, Spain, Korea, Mexico, the Netherlands, New-Zealand, Norway, Poland, Portugal, the Slovak Republic, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

We do not believe that the level of disaggregation (SITC 5-digit or HS6) matters for our analysis: although Theil variations may results from composition effect at the sub-product level, such variations randomly correlate with product unit value. In order to confront our main findings to the choice of disaggregation of the database, we re-run our main regression (Table 1) on the sub-sample of SITC codes that correspond to only one (alternatively two or less) HS6 lines. Results are similar to the ones obtain with the full SITC database and are available upon request.
Proposition 1 involves unobservable quality heterogeneity. We approximate quality by unit values, of which we calculate import-weighted averages for each OECD importer, good and year. If re-concentration, when it takes place, is on the best performers, we expect positive year-on-year changes in the Theil index to correlate with positive changes in the average unit value of imports. The average unit value’s rise is a composition effect, as buyers concentrate on high-quality suppliers. Thus, a straightforward test would consist of regressing, on a panel of OECD importer × product pairs (recall that we are looking at concentration across source countries), first differences in Theil indices on first differences in average unit values across sources, expecting a positive correlation. However, we can sharpen this test using a key corollary.

The corollary is that the effect is asymmetric: whereas the model predicts that unit values should rise during concentration phases, it is silent on the evolution of unit values during diversification phases. For instance, at the beginning of a search phase (i.e. diversification), new tested suppliers may be of higher quality than the best selected supplier of the preceding sampling phase. In this case, quality increases during diversification. This corollary can be used to sharpen our test of the model’s base prediction. To do this, we replace annual first differences in unit values as a regressor (ΔUVikt) by two interaction terms defining two distinct regimes. In regime 1 (concentration), first differences in unit values are interacted with a dummy equal to one if concentration is rising (ΔTheilikt > 0). In regime 2 (diversification), first differences in unit values are interacted with a dummy equal to one if concentration is decreasing (ΔTheilikt ≤ 0). Table 1 gives regression results for this test and a variant where the regimes are restricted to ΔTheilikt > 0.1 and ΔTheilikt ≤ 0.1 respectively (this 0.1 threshold corresponding to the top 25 % of the re-concentration phases in terms of ΔTheilikt).

The first two columns of Table 1 confirm the model’s base prediction. Positive year-on-year changes in the Theil index correlate with positive changes in unit values, and this result holds for a large set of fixed effects. That is, when there is re-concentration, it takes place on higher-quality suppliers. As shown in columns (3) and (4), this positive impact becomes stronger when restricted to deeper re-concentration phases, i.e. for phases where first differences in the Theil index are above 0.1. Strikingly, no significant correlation is found in diversification phases. We tested the robustness of this result by running the same estimation using the annual first difference in the numbers of partners of country i in good k as the dependent variable (with a threshold still corresponding to the top 25 % of the re-concentration phases in terms of ΔNberikt). As shown in columns (5) and (6), results are similar to those presented in the 2 preceding columns.19

Finally, a similar regression using import-weighted averages of the exporters’ GDP per capita instead of unit values gives a qualitatively similar result, suggesting

19 Note that importer-product as well importers fixed effects control for late appearance of some OECD countries within the database (e.g., we have data for Poland, the Slovak Republic and the Czech Republic starting in the early 90’s). Year fixed effects control for exogenous shocks that may affect several OECD countries on their sourcing behaviour alike.
Table 1  Regression results: change in the Theil index or numbers of partners on change in unit values

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Dep. var</th>
<th>( \Delta \text{Theil}_{ik}(t-(t-1)) ) (1)</th>
<th>( \Delta \text{Theil}_{ik}(t-(t-1)) ) (2)</th>
<th>( \Delta \text{Theil}_{ik}(t-(t-1)) ) (3)</th>
<th>( \Delta \text{Theil}_{ik}(t-(t-1)) ) (4)</th>
<th>( \Delta \text{Nber}_{ik}(t-(t-1)) ) (5)</th>
<th>( \Delta \text{Nber}_{ik}(t-(t-1)) ) (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) &gt; 0 ))</td>
<td>1.05E-06**</td>
<td>9.78E-07*</td>
<td>5.50E-07</td>
<td>5.70E-07</td>
<td>3.47E-07</td>
<td>2.04E-07</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) \leq 0 ))</td>
<td>-3.47E-07</td>
<td>-2.04E-07</td>
<td>(1.95E-06)</td>
<td>(2.30E-07)</td>
<td>1.45E-06**</td>
<td>1.43E-06**</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) &gt; 0.1 ))</td>
<td>1.45E-06**</td>
<td>1.43E-06**</td>
<td>(7.54E-07)</td>
<td>(7.42E-07)</td>
<td>-2.02E-07</td>
<td>-1.56E-07</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) \leq 0.1 ))</td>
<td>-2.02E-07</td>
<td>-1.56E-07</td>
<td>(1.48E-07)</td>
<td>(1.63E-07)</td>
<td>2.39E-06***</td>
<td>2.24E-06*</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) \leq 0.1 ))</td>
<td>2.39E-06***</td>
<td>2.24E-06*</td>
<td>(7.39E-07)</td>
<td>(1.21E-06)</td>
<td>6.92E-06***</td>
<td>6.68E-06***</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) \geq -1 ))</td>
<td>6.92E-06***</td>
<td>6.68E-06***</td>
<td>(5.89E-07)</td>
<td>(4.82E-07)</td>
<td>277,294</td>
<td>277,294</td>
<td></td>
</tr>
<tr>
<td>( \Delta \text{UVlk}<em>{ik}(t-(t-1)) ) (( \Delta \text{Theil}</em>{ik}(t-(t-1)) \leq -1 ))</td>
<td>277,294</td>
<td>277,294</td>
<td>251,895</td>
<td>251,895</td>
<td>251,895</td>
<td>251,895</td>
<td></td>
</tr>
</tbody>
</table>

Observations (\( ikt \)) | 1,059,984 | 1,059,984 | 1,059,984 | 1,059,984 | 1,059,984 | 1,059,984 |
No. of products (\( k \)) | 1,299 | 1,299 | 1,299 | 1,299 | 1,299 | 1,299 |
No. of importers (\( i \)) | 29 | 29 | 29 | 29 | 29 | 29 |
Observations with \( \Delta \text{Theil} > x \) | 640,038 | 640,038 | 277,294 | 277,294 |
Observations with \( \Delta \text{Nber} < x \) | 251,895 | 251,895 |
Importer \( \times \) product fixed effects | Yes | – | Yes | – | Yes | – |
Importor fixed effects | – | Yes | – | Yes | – | Yes |
Product fixed effects | – | Yes | – | Yes | – | Yes |
Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |

Estimation with OLS; standard errors in parentheses: heteroskedasticity-consistent and adjusted for product-level clustering

***, **, * indicate significance at the level of 1, 5 and 10 % respectively
that when re-concentration takes place, it is on suppliers located in higher-income countries, which tend to produce higher-quality goods (on this, see Hallak and Schott 2011). The evidence in Table 1 is thus suggestive of a quality-search process rather than a price-search one (in a price-search model, the search phase would settle on the lowest-price supplier).

We now turn to Proposition 2, which says that the alternating phases of quality screening and re-concentration will be more pronounced for products whose quality matters and where it is not standardized across suppliers. That is, the time-wise volatility of concentration should correlate with the dispersion of quality across suppliers. In order to test for this, we measure the time-wise volatility of concentration at the (importer × product) level by the normalized standard deviation of the Theil index over the entire sample period. We approximate the dispersion of quality across suppliers, also at the (importer × product) level, by the standard deviation of unit values across time and exporters. Note that, in so doing, we reduce the sample’s dimensionality from three (importer × product × time) to two (importer × product), i.e. we collapse our panel into a cross-section of (importer × product) pairs.

Before we turn to regression results, let us take a look at the relationship for the 1,299 products between the time-wise volatility of concentration and the variability of unit values for an average OECD country’s imports (i.e. disregarding heterogeneity between importing countries). The plain line in Fig. 3 is generated by regressing standard deviations of Theil indices on standard deviations of unit-values using pooled OLS with White-corrected standard errors. The broken curve in the same figure is generated by running a “smoother” (non-parametric) regression instead of OLS. Non-parametric regression imposes no functional form and is therefore well suited to the exploration of data with no pre-determined relationship between variables. Both show a positive relationship between the volatility of concentration over time (the amplitude of the alternating diversification/re-concentration phases) and the variability of unit values across time and suppliers (the extent of the selection problem).

We run a parametric test exploiting cross-importer variation in our base relationship (although the time dimension of the panel is still collapsed by the construction of our volatility variables). In Table 2, the normalized standard errors of the Theil index and unit values are computed using both the whole sample (column 1) and the sub-sample of (importer × product) pairs with at least 30 non-missing observations over 1963–2006 (column 2). Results presented in Table 2 confirm the positive correlation between volatility in concentration indices and variability in product quality. As shown in columns (3) and (4), our results are also robust to the use of standard deviations in the numbers of partners as the dependent variable instead of standard deviations in Theil indices.

20 For every product, Theil and unit value volatilities correspond to simple averages over countries belonging to the OECD.
21 95 % confidence interval is also reported.
22 Non-parametric “smoother” regression consists on re-estimating the regression for overlapping samples centered on each observation.
Thus by and large, results are as suggested by the model. Re-concentration phases occur on goods of better quality and the volatility of concentration indices is higher for products with high-quality heterogeneity. This indeed suggests alternating periods of diversification and concentration in search for quality.

3.3 Measuring overall geographical import concentration

We now examine whether there is an overall diversification trend over the entire period. Our set up suggests that with entry of new suppliers and a taste for variety,
OECD imports become globally more diversified (even if this diversification happens by bouts). We test this conjecture by looking at the overall evolution of the concentration index and the number of imported products over the years 1963–2006.

Figure 4 shows the evolution of simple averages over all products imported by OECD countries at $t$ of our Theil index as well as the number of products. Panel a) shows Theil indices calculated using all OECD imports (i.e., imports from all partners, including intra-OECD ones) as well as using only extra-OECD partners (i.e., developing countries). A strong diversification trend until 2002 is shown by the Theil index when accounting for all imports, after which the indices rise until 2006, the sample’s last year. The diversification is less pronounced while excluding intra-OECD trade and it re-concentrates after 1990. Between 1999 and 2006, this Theil index rises by 7.4%, almost three times its coefficient of variation over the period 1963–1999. Panel b) looks at the extensive margin by showing the evolution of import-weighted averages, across 5-digit level SITC lines, of the number of non-OECD exporters to the OECD over the sample period.23

The trend reversal is unmistakable as far as the concentration index for imports from non-OECD countries is concerned. However, it takes place quite late in the sample period. In order to verify whether it is statistically significant, and that it is not a pure composition effect between products (i.e., a sectoral shift away from widely-procured products toward narrowly-procured ones), we now turn to regressions of concentration indices on time and its square using fixed (product) effects. Results are shown in Table 3. Column (1) shows results with concentration indices (the dependent variable) calculated over all imports (including intra-OECD) whereas column (2) presents results for extra-OECD imports only (a more interesting measure from a developmental perspective). The within estimator confirms the convex time trend, as both time and its square are significant with opposite signs.

Columns (4) and (5) of Table 3 report the results of fixed-effects regressions of the number of exporters to the OECD on time and its square. Column (5) includes a specific time trend for the post-2000 period. The extensive margin as measured by the average number of source countries does not seem to show the same kind of trend reversal that we observed in the concentration indices, which pick up action at both the extensive and intensive margins. Figure 4 shows a decline in the rate of increase in the number of exporters to the OECD (the trade-weighted average number of suppliers per product stabilizes over 100). For many products, this is likely to exhaust the pool of potential exporters, so a leveling off is to be expected. This is reflected by the negative coefficient on Post 2000. This inflexion is however not strong enough to reverse the trend. The observed re-concentration of OECD imports thus seems to be entirely caused by action at the intensive margin.

In order to explore further what might be driving the apparent re-concentration of OECD imports, we now decompose OECD imports by importing country and construct a three-dimensional panel whose unit of observation (the basis for the calculation of our concentration indices) is a product imported by an OECD country.

23 Figures including all suppliers and using simple averages of number of exporters to OECD at the product (SITC4) level are very similar to the one presented here and are available upon request.
in a year (a triplet importer × product × year). Looking at things this way allows us to look for another type of composition effects where more concentrated OECD countries increase their relative share of total OECD imports. Regression results are shown in Column (3) and (6). Several observations emerge. First, the reconcentration apparent in the Theil index seems robust to the introduction of fixed effects by importer × product pair. The news comes from the extensive margin, where not only the square term on time preserves the monotonicity of diversification but even the post-2000 time trend no longer indicates a trend inflexion in the very last years. The disappearance of the trend inflexion suggests that it resulted from a composition effect between importers as described above.

To sum up, the observed re-concentration is robust to the decomposition of OECD imports by importing country. However, as results on the number of exporters show, it does not occur at the extensive margin, all of the action being at the intensive margin.

Considering the rising importance of OECD trade with China over the last decade, we must control for the role that China may play in that re-concentration. In column (7) of Table 3 the coefficient on time squared loses its significance when China is excluded from the sample, suggesting that China is indeed driving the observed re-concentration. Using our SITC data for China we calculated the contribution of the intensive and extensive margin to China-OECD imports growth over the 1963–2006 period. While in the early years (1963–1975) the extensive margin accounted for about 35% of China-OECD imports growth, this share shrank to almost zero in the 1993–2006 period. This confirms that the increased concentration of OECD imports on China occurs at the intensive margin: In recent years, no new product line opened between China and its OECD trade partners.

Thus, although their imports are increasingly concentrating on Chinese products, OECD countries continue to open new imports lines with extra-OECD countries. That is, China’s expanding exports to the OECD do not seem (yet) to crowd out the

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Fig. 4 OECD import concentration and number of partners, 1963–2006. a Theil index, b Number of exporters. Note: Data from COMTRADE. a Theil indices are simple averages over all products. b Numbers of exporters is import-weighted averages (weights = shares of each 5-digit level SITC product in OECD imports in given year)
<table>
<thead>
<tr>
<th>Repressors</th>
<th>Theil: all imports</th>
<th>Theil: extra-OECD imports</th>
<th>Numbers of countries exporting to the OECD</th>
<th>Theil: no China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>-0.013***</td>
<td>-0.023***</td>
<td>0.583***</td>
<td>-0.013***</td>
</tr>
<tr>
<td></td>
<td>(-34.03)</td>
<td>(-43.53)</td>
<td>(100.10)</td>
<td></td>
</tr>
<tr>
<td>Time, squared</td>
<td>-0.000***</td>
<td>0.000***</td>
<td>0.008***</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(4.72.3)</td>
<td>(28.13)</td>
<td>(7.05)</td>
<td></td>
</tr>
<tr>
<td>Post 2000</td>
<td></td>
<td></td>
<td>0.020</td>
<td>-0.228***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(47.64)</td>
<td>0.147***</td>
</tr>
<tr>
<td>Constant</td>
<td>2.913***</td>
<td>3.330***</td>
<td>4.336***</td>
<td>2.871***</td>
</tr>
<tr>
<td></td>
<td>(861.4)</td>
<td>(686.9)</td>
<td>(3363.6)</td>
<td>3.302***</td>
</tr>
<tr>
<td>Observations</td>
<td>54,030</td>
<td>53,770</td>
<td>1,154,420</td>
<td>1,154,420</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.671</td>
<td>0.570</td>
<td>0.180</td>
<td>0.570</td>
</tr>
<tr>
<td>Turning year</td>
<td>2001</td>
<td>1997</td>
<td></td>
<td>1997</td>
</tr>
<tr>
<td>Product FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

r-Statistics in parentheses; ***, **, * indicate significance at the level of 1, 5 and 10 % respectively. The time variable is an index starting as 1963 = 1. The post-2000 variable is another index starting at 2000 = 1.
entry of new exporter/product pairs on OECD markets. Overall, excluding China, OECD imports are becoming more diversified across time as predicted by our quality search model with an increasing number of potential suppliers.

4 Concluding remarks

Looking at the evolution of OECD imports at a high degree of disaggregation (over a thousand product lines) over the forty-year period where data is available, we find striking evidence of geographical diversification at the product level. That is, OECD countries have been sourcing each of their imported products from an increasingly large pool of suppliers. We also find evidence of a geographical re-concentration of imports in the last 5 years or so, but this trend reversal is entirely attributable to the growing share of China in OECD imports. Put together with Besedes and Prusa’s (2006a, b) findings of high churning rates among exporters, our results suggest that OECD markets seem to be increasingly contestable for developing-country exporters, at least at the source-country level.

As for the drivers of diversification versus re-concentration, we find that when temporary geographical concentration takes place, it tends to be on higher-priced national varieties. It is also more volatile for those goods which may be highly differentiated quality-wise where quality presumably matters more and is more heterogeneous across suppliers. Put together, these observations lend support to a model of quality search by OECD buyers generating alternating periods of concentration and diversification, discussed in Sect. 2 of this paper. Our quality-search approach suggests that the contestability of OECD markets varies across time and products, with periods of closed doors, characterized by strong incumbency advantages, alternating with periods of open door, characterized by contestability. In terms or policy implications, our results highlight the importance of raising exporter quality-management capacities in developing countries, as periods of open door appear to be essentially periods of quality search.

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Appendix

The expression for the expected period-3 gain, as of the beginning of period 2, given that the buyer kept only one supplier, $x$, is

$$E(V_3|I_2) = q_2^xE(V_3|\hat{\epsilon}_2 = 1) + (1 - q_2^x)E(V_3|\hat{\epsilon}_2 = 0)$$

(14)

where the probability of no defect in period 2 given information at the beginning of period 2, $q_2^x$, is
\[ q_2^x \equiv \Pr(\xi_2^x = 1 | I_2) = p_2^x \lambda^G + (1 - p_2^x) \lambda^B, \]

and the expected gain in period 3 is

\[ E(V_3 | \xi_2^x = 1) = p_3^x (\xi_2^x = 1) (2\pi^G) + [1 - p_3^x (\xi_2^x = 1)] (2\pi^B) \]

given no defect in period 2 and

\[ E(V_3 | \xi_2^x = 0) = p_3^x (\xi_2^x = 0) (2\pi^G) + [1 - p_3^x (\xi_2^x = 0)] (2\pi^B) \]

given a defect in period 2. Finally, the probability of supplier \( x \) being of the good type is, by Bayes’ rule,

\[ p_3^x (\xi_2^x = 1) = \Pr(G | \xi_2^x = 1) = \frac{\lambda^G p_2^x}{\lambda^G p_2^x + \lambda^B (1 - p_2^x)} \]

given no defect in period 2 and

\[ p_3^x (\xi_2^x = 0) = \Pr(G | \xi_2^x = 0) = \frac{(1 - \lambda^G) p_2^x}{(1 - \lambda^G) p_2^x + (1 - \lambda^B) (1 - p_2^x)} \]

given a defect. Substituting these expressions into (14) and simplifying gives expression (7) in the text.

References


