The Search for Partners and the Path-Dependency of Trade

T.Huw Edwards
Loughborough University, UK
January 2015

Abstract

This paper investigates the implications of matching and searching in interfirm trade. From a schematic model, whereby firms find long-term trading partners by successive matches, we derive some important propositions. Trade between matched firms generates an expected economic profit, depending on match quality, while trade between searching firms may be conducted at a short-term loss, being a form of capital accumulation. Contract periods and the availability of finance will affect the growth of trade. Following trade liberalisation, countries with a large initial number of well-matched firms will show relatively low price elasticities of demand for imports and exports. Apparent home bias in current trade patterns may well reflect past, rather than present trade costs and protection. More importantly, today’s policy decisions become tomorrow’s history, implying that inappropriate phasing and sequencing decisions for trade deals can potentially have adverse consequences long into the future, if not indefinitely.

Match-searching theory strengthens the argument that global welfare is likely to be enhanced by multilateral, rather than by stepwise bilateral liberalisation, and that when deals are spaced too far apart, there is an increased risk that some countries will seek to block further liberalisation.

KEYWORDS: Trade, Search, Matching, Protection JEL Classification: F00, F12, F13
This paper investigates the implications of matching and searching processes, reflecting imperfect information in international interfirm trade. By setting up a schematic model, whereby firms find long-term trading partners by means of a series of successive matches, we derive some important, novel propositions. Trade between matched firms has different properties to that between searching firms. The former generates an expected economic profit, depending on match quality, while the latter may be conducted at a short-term loss, with the search process constituting a form of capital accumulation. If economies are seen as having been relatively closed initially, \(^1\) then contract periods and the availability of finance will have a significant effect on growth of trade. Countries with a large initial number of well-matched firms will show relatively low price elasticities of demand for imports and exports, and in particular for trade with new partners. Apparent home bias in current trade patterns may well reflect past, rather than present trade costs and protection. More importantly, today’s policy decisions become tomorrow’s history, implying that inappropriate phasing and sequencing decisions for trade deals can potentially have adverse consequences long into the future, if not indefinitely.

In this paper, we focus particularly upon the sequencing and timing of trade liberalisation decisions. Match-searching theory strengthens the argument that global welfare is likely to be enhanced by multilateral, rather than by stepwise bilateral liberalisation, and that when deals are spaced too far apart, there is an increased risk that some countries will seek to block further liberalisation.

In section 1, we review the relatively recent literature on matching models of trade. We then develop in section 2 a theoretical ‘match-searching’ framework: a basic, schematic representation of the search process, which I use to derive a number of key propositions. Section 3 investigates the significance of the path-dependency of match-searching models of trade for the dynamics of trade responses to liberalisation agreements. Section 4 considers potential policy endogeneity. Finally, I briefly discuss extensions to incorporate consumer search or networking between firms and to informational capital theory. Many of the basic properties of match-searching carry across to these situations.

1 Background: search and the path-dependency of trade

The notion of supply-side path-dependency in trade is a familiar one, developed from the infant industry argument and running through the more recent literature on learning by doing, scale and agglomeration economies, often labelled the New Trade Theory. \(^2\) However, economists have been slower to recognise that historicity is also a demand-side phenomenon, affecting both overall levels of trade and associated regional/sectoral patterns of trade, as confirmed in a number of gravity studies.

Some important stylised facts which may suggest trade historicity are:-

\(^1\) Trade increased from 6 per cent of global GDP in 1950 to 15 per cent by the mid 1990s (source: Madison, unpublished).

\(^2\) See, e.g. Grossman and Helpman (1993)
1) In general countries trade far less between each other than existing theory would predict even when account is taken of transport costs.\(^3\)

2) Trading between countries frequently follows historical patterns: for example, the UK trades relatively more with India and Australia, France with Algeria or Cote D’Ivoire. For general evidence on colonial ties, see Rauch (1999). For a dynamic gravity study of the slow erosion of colonial ties, see Head, Ries and Mayer, 2010.

3) There are wide variations in the export prices obtained by suppliers from different countries, at least for some classes of goods, even when correction is made for quality.\(^4\)

These observations are generally ascribed to either technical barriers to trade or to exogenous differences in demand patterns, or to the idea that distance in the gravity literature underestimates transactions costs.\(^5\) However, the idea of habit formation in preferences has gradually been introduced at least for aggregate import demand, as has the notion of hysteresis in exchange rate effects upon trade. In particular, this is linked to theories associating the entry of firms into new markets with the presence of fixed costs\(^6\), as borne out by firm-level studies.\(^7\) However, the precise nature of these fixed costs is not clearly defined, and neither are their policy implications.

The stylised facts above arguably reflect the rational response of firms and consumers to a situation where information on trading partners is incomplete, partly as a result of low historic trade volumes. This implies that import demand might best be seen in terms of matching and searching theory, where search imposes an anticipated fixed cost on firms wishing to trade with new partners. This assumes that each firm’s product has differentiated characteristics - however, unlike the ‘love of variety’ model, purchasers are not looking for variety of choice, but rather the best attainable match for their individual requirements. The obstacle to finding this is imperfect information. For example, in Rauch and Trindade (2003), firms are only able to tell whether a potential partner is better than a certain threshold match quality: if a firm already has local ties, or if there is common language or a historic trading link the threshold will be higher. Companies are more likely to set up trading ties with countries with which they have some initial familiarity, even if there are other, less familiar countries, where potential profits would be higher if perfect information were available. Another consequence of the one-off matching models currently discussed in the literature is that firms will not all initially find good potential matches in one country even when there is a change in the average factor prices in that country relative to other countries: in this way the relative inelasticity and persistence of trade patterns is explained.\(^8\)

\(^3\)Notably studies by McCallum (1995) and Trefler (1995). Other authors [e.g. Anderson and Wincoop, 2003] find smaller residual border effects.

\(^4\)A frequently-cited example [e.g. Schmitz, 1999] are the very low-cost high-quality surgical steel producers in Sialkot, Pakistan.

\(^5\)Obstfeld and Rogoff, 2000.


\(^7\)See Bernard and Jensen (1999) or Tybout (2002).

\(^8\)See Rauch and Casella, 2003.
Such ties, as well as existing patterns of networking, may potentially explain observed trading patterns. They also naturally generate a degree of imperfect competition and an element of bargaining in trade, since a firm which has a good match with a foreign partner possesses a degree of monopoly power, as does a country with good historic trade ties with a second country.

While these models provide insight into current trade patterns, arguably they do not go far enough, in the sense that they treat information as exogenous to the firm. In reality, information is a valuable commodity, for which people will search if the cost is low enough, and the history of search determines familiarity. Search costs may, of course, differ according to transport costs, language and other ties, as well as the nature of the good being traded, but they will also reflect the costs of borrowing and the flexibility of the trading partners. If transport costs and protectionist barriers were previously greater, then today’s observed border effects in trade will, at least partly, reflect the informational residue of past barriers.

2 Match-searching in trade

We assume that firms acquire information by a search process in the form of a series of successive matches with trading partners, each for a fixed contract period. This type of process has at least some empirical support: Besedes and Prusa (2006) estimate the median trading relationship between firms is around 1 year, and argue it supports a searching/matching process. I assume a firm knows, in advance of starting search, the probability distribution of potential matches. However, it does not know the quality of an individual match until it enters into it. At the end of the contract period it will decide whether to continue the existing partnership, or to start another search. The cost of searching is the risk of having a series of poor-quality partnerships, while the benefit is the possibility of eventually finding a much better match.

This initial model is deliberately simplified in that it concentrates on modelling the matching between firms rather than other elements of trade, and excludes important elements of networking which may affect the search process. The aim is to draw out the main properties of this basic model, some of which are quite powerful. I then consider to what extent they carry over to more complex models.

Definition 1: I define a match-searching model as one in which a firm searches for the most profitable partner by undertaking a succession of matches, each for a fixed contract period, until a satisfactory match is found.

Crucially, a firm will choose to search for a new partner if its existing match quality falls below a reservation level, which depends upon interest rates and the minimum contract period, as well as upon relative prices.

9For general theory on matching and searching, see Roth and Sotomayor (1990).
2.1 A simple model of match-searching

In a two-sided matching model, trade takes place between two firms, one of which I will characterise as upstream, $u$, and one downstream, $d$, and the extent and profitability of that trade is a direct function of the quality of match between those firms. Match quality, $\mu$, is assumed to be randomly drawn from an underlying probability distribution. In a single-stage matching model, such as Rauch and Casella, 2003, the firms make a single, random choice of match.\textsuperscript{10} A match-searching model, as in this paper, differs from this in the sense that a firm can only investigate a new partner by entering into a contract with it for at least one contract period of $t$ years, and burning its bridges with its former partner. However, after the first contract period, the firms are again free to repeat the random matching process if their initial match falls short of a reservation quality $\mu_R$.\textsuperscript{11}

Following Rauch and Casella's (2003) adaptation of Salop's (1976) matching model, we start by representing firms schematically, in terms of some key characteristics, by a uniform distribution along the perimeter of a circular cylinder, circumference 2 units. Each firm aims to match with the firm directly opposite on the circle; match quality is equal to the circumference distance between the two firms, and hence is distributed uniformly between zero and unity with $\mu = 1$ being the perfect match quality. We assume that both the volume of output and the level of profits of each of the two firms is proportional to this match quality. Hence

\begin{align*}
Y_u, Y_d &= \alpha \mu; \\
\pi_u, \pi_d &= \beta \mu;
\end{align*}

where $Y_u, Y_d$ represent real output of each firm (defined here to be equal, so that one unit of the final product requires one unit of production at both upstream and downstream stages). Trade between the firms in real terms will equal $Y_u$. $\pi_u, \pi_d$ are the profits of the two firms, which in the simple version of the model are equal, the proceeds from the match being split evenly.

Starting initially with a single-country model, in the first period, each firm type $u$ will seek a partner type $d$ selected randomly from the pool of available firms. Firm $u$ knows accurately the distribution of potential partners, but not the exact characteristics of any one firm, $d$ (and vice-versa). Since match quality is uniformly distributed between zero and unity, expected initial match quality is $\mu^e = \frac{1}{2}$. Expected output and profitability of firms in this initial period are therefore

\textsuperscript{10}Though Rauch and Casella do allow a firm to return to its original partner, if the new match is poor.

\textsuperscript{11}Unless relative prices change, if a firm had accurate information about the distribution of potential match quality, then if it once decided to abandon a partner it will never return to that partner, except perhaps temporarily.
\[ Y_w^e, Y_d^e = \frac{\alpha}{2}; \]
\[ \pi_w^e, \pi_d^e = \frac{\beta}{2}. \]

The first contract period lasts for \( t \) years, after which each firm can either renew its contract or start afresh with a new, randomly-chosen match. No firm is inherently superior to any other: match quality alone determines efficiency. A firm which fails initially to find a good match therefore has as good a chance as any other firm if it renews search. It is also assumed for simplicity that firms have infinite lives.

We assume the industry comprising all firms types \( w \) and \( d \) is small in comparison to the economy as a whole, and that wages and prices can be taken as exogenous and constant, as are interest rates, \( r \) per annum. These partial equilibrium assumptions simplify the analysis: in particular, they imply that \( \mu_R \) will be constant over time, as long as economic circumstances do not change. In addition, the symmetry of the two firms and the equal split of profits indicates that the decision to stick together or renew search will be mutual, and that once firms have found a suitable partner they will stay together permanently.\(^{12}\)

The series of consecutive search or stick decisions can be represented as nested probabilities. At the end of each search period, a firm which had still been searching in the previous period will assess whether its latest match is worth sticking with \( (\mu \geq \mu_R, \text{ which will occur with probability } 1 - \mu_R) \) or whether it should again renew search \( (\text{probability } \mu_R) \). After \( n \) periods, the probability that it has still not found a satisfactory match is \( 1 - \mu_R^n \), so in period \( n + 1 \), a proportion \( 1 - \mu_R^n \) will still be searching.

Looking in more detail at period \( n + 1 \), the expected profit for those firms which are still searching can be written as \( \phi \beta / 2 \), where \( \phi \) \( (\phi = \frac{1}{1 - (1 + \rho)^{-1}}) \) is a conversion factor for the length of the contract period. Expected profit for those firms who start initially by searching but which have found a satisfactory partner will equal \( \phi \beta \frac{1}{2} (1 + \mu_R) \). Expected profit over all firms in period \( n + 1 \) will therefore be

\[ \pi_{S_n+1} = \frac{\phi \beta}{2} \{1 + \mu_R - \mu_R^{n+1}\}. \]

By contrast, if initial match quality is \( \mu \), then if the firm chooses from the beginning to stick with its initial partner, its profit in each period will be \( \phi \beta \mu \). The net expected benefit \( B_{S_{n+1}}^c \) in period \( n + 1 \) of having started by searching rather than not searching is

\[ B_{S_{n+1}}^c = \frac{\phi \beta}{2} \{1 + \mu_R - 2\mu - \mu_R^{n+1}\}. \]

\(^{12}\)The analysis might be considerably complicated by introducing circumstances where jilting might occur.
Assuming a constant reservation match quality $\mu_R$, and constant interest rate $r$ per annum, which, crucially, can be converted to an interest rate $\rho$ per contract period, where

$$\rho = (1 + r)^t - 1,$$

it is possible to derive the expected net present value (to the beginning of the search process) of profits for a firm which chooses to start by searching, $N^e_S$. This is a geometric progression, which can be summed to yield discounted present values

$$N^e_S = \frac{\phi\beta}{2\rho} (1 + \mu_R - 2\mu_{ud}) - \frac{\phi\beta}{2} \frac{\mu_R}{1 + \rho - \mu_R}.$$  \hspace{1cm} (7)

When $\mu = \mu_R$, $N^e_S = 0$. Carrying out a little manipulation, it is possible to show that this is a quadratic equation in $\mu_R$. Of the two solutions, only the smaller one will fall below unity. Hence, after a little more manipulation we can write

$$\mu_R = 1 + \rho - \sqrt{\rho(1 + \rho)}.$$  \hspace{1cm} (8)

Our first proposition follows.

**Proposition 1:** The reservation match quality, $\mu_R$, depends only on interest per contract period, $\rho$, which is a function of the interest rate $r$ and contract period $c$. Specifically, the shorter the contract period and the lower the interest rate, the nearer $\mu_R$ will be to unity.

**Proof:** Differentiating (9),

$$\frac{\partial \mu_R}{\partial \rho} = 1 - \frac{1 + 2\rho}{2\sqrt{\rho(1 + \rho)}} = \frac{2\sqrt{\rho(1 + \rho)} - 1 - 2\rho}{2\sqrt{\rho(1 + \rho)}}.$$  \hspace{1cm} (9)

There is no real root to the quadratic which sets $\frac{\partial \mu_R}{\partial \rho} = 0$, and it is easy to show that $\frac{\partial \mu_R}{\partial \rho} < 0 \forall \rho > 0$. QED

The implications of this in practice can easily be calculated. For example, with $t = 1$ year and $r = 5$ per cent per annum, $\mu_R$ will equal 0.82, and average match quality in the long run will be $\frac{1 + \mu_R}{2} = 0.91$. By contrast, with $t = 10$ years and $r = 15$ per cent per annum, $\mu_R = 0.54$ and average long-run match quality is 0.77.

While total profits and output in the first period of search for those firms who choose initially to search are the same for all values of $r$ and $t$, in the long run both will be higher the lower are $r$ and $t$. Subsequent average match quality increases over time. Average output per firm and profits also increase correspondingly, and in the long run both are higher the lower is $r$ and the lower is $t$. We would also expect, of course, that convergence to the long run value will be faster the shorter is the contract period $t$. 
2.2 Implications of match-searching for trade

We will concentrate first on the opening up of a formerly autarkic economy to international trade. Specifically, we allow upstream and downstream firms for the first time to seek matches in a second country. We will assume that the potential maximum profit of an international pairing is \( \pi^{13} \), which exceeds the maximum feasible for domestic-only partnerships by a factor \((1 + \epsilon)\). If a pairing with a foreign firm is made at random, the match quality for a trading firm will again range from 0 to 1, and annual profits for an individual firm will be evenly distributed between 0 and \((1 + \epsilon)\frac{2}{2}^\beta\).

We initially assume that this extra profitability opportunity applies equally to both upstream and downstream firms in the home country (which we will denote by \(u_h\) and \(d_h\)), and that there is a ready supply of foreign partners. These assumptions maintain the symmetry of the supplier/purchaser relationship, so that with an even profit split, firms \(u_h\) and \(d_h\) are in agreement over whether to maintain their current relationship or to start searching abroad. In the previous, one country case, the expected present value of future profits of a searching firm was shown to be equal to the profits from a match quality \(\mu_R\). By analogy, a firm which searches abroad will have an expected present value of future profits equivalent to a firm which has a constant foreign match quality \(\mu_{RF}\), also satisfying equation (9).

However, the expected profits of a foreign match of quality \(\mu_{RF}\) will equal \((1 + \epsilon)\) times the expected profits of the marginal existing match at home, \(\mu_R\). If the economy had reached autarkic equilibrium before starting to trade, no firms have initial match quality less than \(\mu_R\). In this case, if \(\epsilon \leq 0\) (so there is no profit advantage to trade) then no firms will seek overseas partners.

A key conceptual difference in this analysis is between firms who have already found match partners, and those who are initially searching.

**Definition 2:** A firm is defined as initially searching if at the start-point of our analysis it has not found a satisfactory partner, \(\mu > \mu_R\). Otherwise it is defined as initially matched.

We refer to an economy as mature if all or most firms have found satisfactory partners.

Of initially matched firms, a small potential profit advantage from a foreign partner, \(\epsilon\), will only outweigh the advantages of avoiding the costs of search for those firms whose matches were only marginally better than the initial reservation match quality, \(\mu_R\). Most other firms will not find it worthwhile starting a search unless \(\epsilon\) is considerably larger than this.

**Proposition 2:** For \(\epsilon > 0\), all initially searching firms will choose their next partner from abroad. By contrast, among initially matched firms, the proportion choosing to abandon their existing partner to search abroad will only gradually increase as \(\epsilon\) increases.

\(^{13}\)I am ignoring transport costs and tariffs in this initial example.
Proof. Firms will choose to search abroad if their initial domestic match quality

$$\mu_h < \frac{\mu_{RF}}{1 + \epsilon}. \quad (10)$$

If $\mu_h = \mu_{RF}$, then a firm will search abroad for any positive $\epsilon$. If matched firms are initially uniformly distributed between $\mu_R$ and 1, and if $\mu_R = \mu_{RF}$ then the proportion of firms which will abandon their home partner will be

$$S_F = \frac{\epsilon \mu_R}{1 + \epsilon \mu_R}. \quad (11)$$

This is increasing with respect to $\epsilon$. QED.

The last firms will abandon home pairings only when

$$\epsilon \geq \frac{1}{\mu_R} - 1. \quad (10)$$

Figure 1, below, represents diagramatically the proportion of firms seeking a foreign partner when a mature autarkic economy opens up to trade. In the initial case, shown by the bold diagonal line, the share of firms seeking foreign matches increases steadily as $\epsilon$ increases from 0 to $\epsilon^*$, where $\epsilon^*$ is the value which makes equation (10) an equality.

Figure 1: proportion of firms seeking a foreign partner.

If we allow the per-contract-period discount rate $\rho$ to fall from $\rho_0$ to $\rho_1$, due either to a fall in the interest rate or a shortening of the contract period, then
the value of $\epsilon$ at which all firms look abroad will fall from $\epsilon^*_0$ to $\epsilon^*_1$, and the curve showing the proportion of firms seeking foreign matches in response to changes in $\epsilon$ becomes much steeper.

One implication of this is that:

**Proposition 3:** Assuming $\epsilon \mu_R < 1$, the price sensitivity of imports and of exports increases the less ‘lumpy’ foreign contracts are (the lower is $t$), and also the lower the interest rate, $r$.

**Proof.** Lower $t$ or lower $r$ will reduce $\rho$. From Proposition 1, we know that $\frac{\partial \mu_R}{\partial \rho} < 0 \forall \rho > 0$.

From equation (12), the price sensitivity of the share of firms seeking foreign partners is

$$\frac{\partial S_F}{\partial \epsilon} = \frac{(1 + \epsilon \mu_R) \mu_R - \epsilon \mu_R^2}{(1 + \epsilon \mu_R)^2} = \frac{\mu_R}{(1 + \epsilon \mu_R)^2}. \quad (12)$$

The effect of reservation match quality on this is

$$\frac{\partial^2 S_F}{\partial \mu_R \partial \epsilon} = \frac{(1 + \epsilon \mu_R)^2 - 2 \epsilon \mu_R^2 (1 + \epsilon \mu_R)}{(1 + \epsilon \mu_R)^4} = \frac{1 - \epsilon \mu_R}{(1 + \epsilon \mu_R)^4} > 0,$$

as long as $\epsilon \mu_R < 1$.

The effect of $\rho$ is

$$\frac{\partial \mu_R}{\partial \rho} \frac{\partial^2 S_F}{\partial \mu_R \partial \epsilon} < 0.$$

Hence a fall in $\rho$ will increase the price sensitivity of exports. QED

Note that $\mu_R < 1$, and it is sensible to restrict ourselves to values of price difference less than 1.

Next, consider what happens if the country is not in a long-run equilibrium prior to liberalisation. In this case, some firms were initially searching, so they need only compare the potential profits from a foreign partner with the expected return from the next hypothetical domestic partner if they were to continue to search at home. Consequently, while matched firms have relatively low price sensitivity for imports, all searching firms will switch abroad if the average price advantage of foreign versus domestic partners is positive.

A related conclusion is that the greater the rate of new firm startups in an economy, the greater the price-sensitivity of imports. Economies which are experiencing rapid economic change may well be more price-sensitive in their trading patterns than those which are mature.

## 3 Dynamics of trade liberalisation

Following trade liberalisation, a firm will face a decision whether to stick with its existing domestic partner or to enter into search, and unless relative prices
subsequently change that decision will not alter. Consequently, a firm which is
going to enter trade will do so quickly.\footnote{However, this result could be altered if information were to spread across firms by imitation or networking.}

**Proposition 4:** All firms who are going to enter into trade following removal of trade barriers will do so as soon as their current contracts expire. However, after the initial increase in trade volumes from firms entering search, trade will continue to increase more gradually until a new equilibrium is reached.

**Proof.** The first part of the proposition reflects the fact that there is no assumed gain in renewing a contract if it yields a lower expected profit than a search abroad. The latter proposition\footnote{Note that this proposition may not hold where there are networking effects or informational spillovers present.} is because expected output volumes increase as search proceeds, as an increasing proportion of firms finds satisfactory matches. QED.

It can be shown that, when $\epsilon < \frac{1}{\mu_R} - 1$, total output in the first period of entering trade will only increase if\footnote{The proof is this is that, if the economy is in a long-run equilibrium pre-trade, then only firms whose (pre-trade) match quality lies between $\mu_R$ and $(1 + \epsilon)\mu_R$ will choose to search. Average pre-trade output of these firms is $\alpha(2 + \epsilon)\mu_R/2$. By contrast, average match quality for the first post-trade match is $1/2$ and average output is $\alpha(1 + \epsilon)/2$.} $\epsilon > \frac{2\mu_R - 1}{1 - \mu_R}$.\footnote{For larger values of $\epsilon$, total output in the first period will only increase if $\epsilon > \mu_R$.}

\begin{equation}
\epsilon > \frac{2\mu_R - 1}{1 - \mu_R}.
\end{equation}

As $r$ and/or $t$ are reduced to zero, $\mu_R$ will tend towards 1 and first period output is more likely to increase for any price advantage to trade.\footnote{For larger values of $\epsilon$, total output in the first period will only increase if $\epsilon > \mu_R$.}

If we define the critical value of $\epsilon$ which equals the right hand side of (16) as $\epsilon^*$, then it is straightforward to show that $\epsilon^*$ is increasing with respect to $\mu_R$, and therefore is decreasing in $r$ or $t$. Noting that the short run impact of trade liberalisation on output for a country which is in equilibrium before engaging in trade will be a reduction if $\epsilon < \epsilon^*$, which will be the case if the price advantage to trade is relatively small and if interest rates are high and the contract period long. However, we would expect global output to rise in the long run, as average match quality improves again.

### 3.1 Path dependency and the sequencing of trade liberalisation

The difference in behaviour between initially matched and initially searching firms underlies the path dependency of import demand. Once a search process has gone on for long enough, a high proportion of established firms will have found partners and become matched, making them much less sensitive to the arrival of new potential trade partners. This result is supported empirically.
by Besedes and Prusa (2006): ‘if a country is able to survive in the exporting market for the first few years it will face a very small probability of failure.’

The implications for the sequencing and timing of trade liberalisation are important. If country $A$ liberalises trade initially only with country $B$, which has a price advantage $\epsilon_B > 0$, some or all of the firms in $A$ will start looking for partners in $B$. Now consider that $A$ subsequently decides also to liberalise trade with country $C$, which has an even larger cost advantage $\epsilon_C > \epsilon_B$. If this second liberalisation takes place very quickly after the liberalisation with $B$, due to the presence of contract periods, many firms in $A$ may not even have reached the stage of starting their foreign search, and will start their search in $C$.

If the second liberalisation is delayed, then, as time progresses, fewer firms in $A$ would still be searching $B$ for a partner: more would be matched. Consequently, the later is the second liberalisation, the greater the lasting trade advantage country $B$ has over country $C$.

**Lemma 1**: Other things equal, the proportion of firms in a pair of countries which are searching will fall over time following a trade liberalisation between them.

**Proof.** The proportion of firms which will engage in search following liberalisation will be $S_F$ as in equation (12). At the end of the first contract period, proportion $\mu_{RF} (< 1)$ of these will search again, and after $n$ contract periods, the proportion still searching will be $\mu_{RF}^n$, which is declining with respect to $n$. QED.

From this follows:

**Proposition 5**: The price sensitivity of a country’s trade share with another country, and its vulnerability to being displaced by a new partner, is less the more established is trade between the initial partners.

**Proof.** If $\epsilon_C > \epsilon_B$, then, when trade with $C$ is liberalised, all firms which are not satisfactorily matched will seek their next partner in $C$. By contrast, then extending the result in (12), only proportion

$$S_{FC} = \frac{\epsilon_C - \epsilon_B)\mu_R}{1 + (\epsilon_C - \epsilon_B)\mu_R} < 1$$

will start seeking partners in $C$. QED.

If a trade liberalisation is anticipated in advance, there can potentially be changes in the dynamics of trade. First, search for domestic partners prior to the liberalisation may be deferred, since the potential gains from such a search are reduced. The second possibility is ‘anticipatory search’, where firms start
moving into the new market for search purposes in advance of trade liberalisation. This will only happen where the protection prior to the trade liberalisation is not prohibitive.

We set up a slightly more detailed variant on the model above. All firms operate in pairs of one upstream and one downstream partner, producing 1 unit of output between them, and there is a sufficiently large number of firms that no pair of firms can affect the final price of the joint good \( i \) in any market. The overall price \( P_{ic} \) of the final good \( i \) in country \( c \) - which is the product of pairs of firms \( \{u, d\} \) - consists of the upstream price, \( P_{uc} \) plus the downstream price \( P_{dc} \). There is one factor only, labour, whose wage is set at unity in both countries. Each matched firm employs \( \theta_{ic} \) units of labour, where \( \theta_{ic} \) varies according to the country and industry. Output is equal to match quality, \( \mu \). This setup ensures that both firms in a match pairing produce the same output, though they may employ different amounts of labour and make different profit. The setup also means operating profits are a linear function of match quality \( \mu \), since

\[
\pi_f = \mu P_{ic} - \theta_{ic}.
\]

We also assume free entry and exit of firms. In the long run, in a closed economy, where output prices \( P_{ic} \) equal 1, the firm with reservation match quality, \( \mu = \mu_R \), will obtain profits which just cover its labour cost \( \theta_{ic} \). Initial prices in equilibrium are proportional to labour input

\[
P_{ic} = \frac{\theta_{ic}}{\mu_R}.
\]

Assume that in state 0 the tariff is high enough to deter any trade. In this initial state, we assume both upstream and downstream firms in country \( A \) sell goods at prices of 1. In country \( B \), the initial upstream and downstream prices vary, but they still sum to 2 for each domestic match. Trade is subsequently liberalised completely with \( B \) and then with \( C \).

Consumer utility is derived from consumption of composite good \( h \) and another far larger good \( g \). Assuming a constant elasticity, \( -\eta \), of demand for \( h \) with respect to price,

\[
U_{hc} = \frac{\eta}{\eta - 1} \frac{P_{hc}^{\eta - 1}}{\eta}.
\]

where in the initial autarkic economy consumption equals production. For utility to be increasing with respect to consumption implies \( \eta > 1 \). Consumer surplus from consumption of \( h \) is best expressed as a function of the joint price to consumers of good \( h \):

\[
V_c = \frac{1}{\eta - 1} \left( \frac{-\eta}{\eta - 1} \right)^{-\eta} P_{hc}^{1-\eta}.
\]

Assume that for \( A \), \( \theta_{uA} = \theta_{dA} = \mu_R \). By contrast, country \( B \) has a cost advantage in industry \( u \) and a similar cost disadvantage in industry \( d \). We can represent this by defining a cost differential \( \epsilon \), so \( \theta_{uB} = (1 - \epsilon)\mu_R \); \( \theta_{dB} = \)
(1 + ϵ)μR. Since $P_{ic} = \frac{\rho_{ia}}{\mu_{R}}$, in autarkic equilibrium, it is clear that the joint selling price of the combined output, $P_{ic}$, is two in both countries.

After the trade liberalisation, prices are set by the most efficient pairing now allowed: namely, a firm $a$ in $B$ with a firm $d$ in $A$. Existing domestic firm pairings will continue only if they have a match quality greater than or equal to $\mu'$, which exceeds $\mu_{R}$. We can show that

$$\mu' = \frac{\mu_{R}}{1 - \frac{\epsilon}{2}},$$

(18)

and that prices within existing matched pairs will be set such that

$$P'_{ua} = P'_{da} = 1 - \frac{\epsilon}{2},$$

(19)

which means that consumers gain from the liberalisation.

3.2 Extension to anticipated liberalisation

The analysis above assumes that the trade liberalisation comes as a shock when it happens at $T$. Consider now that liberalisation actually announced in advance at time $T - 1$ (measured in terms of contract periods, so $T - 1$ is one contract period before the liberalisation).

I will consider first the position where foreign trade is initially totally prohibited, and where all firms are initially matched at $T - 1$. In these circumstances, anticipation of the liberalisation will not lead to any changes in prices or search behaviour prior to $T$. The joint price of the combined good will remain constant, and all existing matches will continue to produce up to time $T$, at which point those with match quality less than $\mu'$ will choose to shut. There will be no new entry within either country prior to $T$, since the expected fall in prices makes the returns on any search investment prior to that date lower than previously.

However, if trade is blocked prior to $T$ by a tariff rather than a quota, then there may be some anticipatory search for partners in $B$.

**Definition 3:** Anticipatory search is the search carried out by firms within a trade bloc for partners in a country outside that trade bloc, in anticipation of trade liberalisation taking place.

This is because the critical tariff required to block trade, when no future liberalisation is expected is lower than that which will block trade when liberalisation is expected shortly. For the borderline case, where the initial tariff is just sufficient to block trade, anticipatory search will happen at time $T - 1$ for firms with initial match quality less than

$$\mu_A = \mu_{R}/[2\mu_{R} - \frac{\epsilon}{2} - (1 - \mu_{R})(1 + \frac{\epsilon}{2}) - 2\mu_{R}] - \frac{2\mu_{R}}{\rho}. (20)$$

There is some evidence of anticipatory search in practice - for example Freund and McLaren (1999) found that the adjustment process for EU accession states typically began four years before accession.
When trade is blocked prior to a deal, but there are still firms initially searching for partners, then the announcement of liberalisation may lead to searching firms postponing their search. Given the long-run fall in expected returns on domestic matches, firms will only continue to search if the short run price attained by domestic matches rises sufficiently to compensate them. If there are initially searching firms, then the withdrawal of some of these from the market will lead to a fall in supply and rise in prices in the short run. This will lead to some of these firms (who had found matches of quality less than $\mu_R$, but not too far below it) to remain temporarily with their current partners, so increasing supply somewhat above that from matched firms only. Only if the number of firms with match quality between $1/2$ and $\mu_R$ is small will the price rise sufficiently for some firms to continue searching during the period prior to liberalisation.

### 3.3 Sequential trade liberalisation

Now consider the dynamics of sequential trade liberalisation. I will concentrate again on the case where countries move from autarky to forming a bloc, within which there is free trade. For simplicity, I will assume that an initial deal between $A$ and $B$ is announced and implemented instantaneously in period 1. However, there is a subsequent round of liberalisation with country $C$, which occurs $T$ contract periods later. I assume that country $C$ has a larger upstream cost advantage than $B$: $\epsilon_C > \epsilon_B > 0$. A key issue is at what point the second trade deal is anticipated.

If there is no prior anticipation of the second deal, the analysis is simple. Following the first trade deal, downstream firms in $A$ or upstream firms in $B$ whose initial domestic match quality falls short of

$$\mu^* = \frac{\mu_R}{1 - \epsilon_B}, \tag{20}$$

will ditch their domestic partners and engage in a search with the new trading partner. After time $T$, proportion $(1 - \mu_R)^T$ of those firms in $A$ who start searching in $B$ will still be searching there: these will immediately switch to searching in $C$ after the second deal. Of the remainder of those who started searching in $B$, only those whose match quality exceeds $\mu^{**}$ will leave their partners in $B$ to start search in $C$, where

$$\mu^{**} = \frac{(1 - \frac{\epsilon_C}{2})\mu_R}{(1 - \frac{\epsilon_C}{2})(1 - \epsilon_B)}. \tag{21}$$

Of firms in initial partnerships in $A$, at time $T$ those in matches of quality less than $\mu^{***} = \frac{\mu_R}{1 - \frac{\epsilon_B}{2}}$ will start searching in $C$.

I assume the second deal is anticipated only following an announcement at $T - a$. If $T - a > 1$, then the initial search decisions of firms in $A$ and $B$ following the first liberalisation will not be affected. However, from time $T - a$, it is likely there will be a rise in the price within the $A/B$ trade bloc, since firms searching
in A and B who have not yet found a satisfactory matching will now see a fall in
the expected returns on their search, and unless there is a rise in the short-run
price, they will pull out of the search. This effect is likely to be larger, the closer
we are to time $T$.

Where the second deal is already anticipated at the time of the first deal,
then we would expect fewer firms in initial domestic pairings in A and B to
abandon their partners and seek A/B matches, compared to where no second
deal is anticipated. Consequently, the initial trade liberalisation will have less
effect on trade, and the fall in prices prior to the second deal will be less than if
the second deal is unanticipated. I will refer to this situation as deferred search:

**Definition 4:** *Deferred search may occur when a second trade liberalisation
is already anticipated at the time of an initial trade liberalisation, leading to less
search between the initial partner countries than would have occurred had the
second liberalisation not been anticipated.*

If no firms at all start searching for A/B partnerships at the date of the
first trade deal (because the second deal is already anticipated), then prices in
all countries will remain at their pre-deal levels. This will happen if the time
interval between the two deals is shorter than a critical threshold, $T^*$. For
intervals greater than this, there will be some entry, leading to some fall in the
combined goods price in A and B after the first liberalisation, though not as
great as when the second liberalisation is unanticipated.

4 Match-searching, welfare and endogenous trade policy

There is a strong parallel between the path-dependent effects of trade liberalisation,
as discussed in the previous section, and the classic, Vinerian literature on
trade creation and diversion. In this view, trade can be only be seen as totally
undistorted if the effects are removed, not just of current trade barriers, but
also of past trade barriers. These can be summarised as ‘informational trade
diversion’.

**Definition 5:** ‘Informational trade diversion’ is the trade which takes place,
when trade with a third party is potentially more profitable, because the costs of
searching for information on partners in the third party outweigh the potential
profits from comparative advantage.

We can deduce:

**Proposition 6:** Long-term informational trade diversion will be greater, the
later the relative date of entry into a trade bloc of the members with the greatest
comparative advantage in upstream or downstream production.
**Proof.** This follows from Proposition 5: the later the relative date of liberalisation between A and C, the fewer firms in A with partners in B will abandon their partners and start searching in C. QED.

In the case above, the sooner A and B form a trade bloc, and the later they admit C (which has the lowest potential costs in u), the more downstream firms in A will have found long-term matchings in B before liberalisation with C, and so the less will be the long-run trade between A and C.

As far as consumer welfare is concerned, we can note:

**Lemma 2:** Prices and consumer welfare are determined by the potentially lowest-cost producers in a trade bloc.

**Proof.** This follows from the analysis in 2.2. In the example, prices for the joint good in A and B fall from $2 - \epsilon_B$ to $2 - \epsilon_C$ when C joins the bloc. Equation (21) shows that consumer surplus depends simply upon these consumer prices, and so depends upon the costs of production in the lowest-cost pair of bloc members. QED.

Also note

**Lemma 3:** Where there is free entry and exit and all price changes are correctly anticipated, the net expected value of future profits for firms which start searching in the most profitable pair of countries will be zero.

**Proof.** This is essentially just a statement of the zero profit condition, given free entry and exit. It follows that, when all trade deals are correctly anticipated, the dates of enlargement do not affect the expected net present value of future profits (since these will be zero). QED.

Hence

**Proposition 7:** When there is free entry and exit, and all trade liberalisations are anticipated in advance, then the costs of informational trade diversion caused by delaying accession to a trade bloc of a lower-cost member are borne by consumers in the period prior to the enlargement.

**Proof.** This follows from Lemma 3. If all trade deals are correctly anticipated, then the zero expected profit condition ensures that consumers, not producers, will bear the cost of delays in trade liberalisation.

In the example above, consumers will lose due to the prices being higher than they need be until the date when C joins the trade bloc. Delaying C’s accession means that less search investment will be carried out when it does join the trade bloc, yielding a lower eventual profit. The present value of the fall in search investment is minus that of the fall in long-term profit.
5 Conclusions

Observed trade patterns do not fit well with what theory would suggest in the presence of perfect information, suggesting the need to take account of matching and searching. Observed 'home bias' and two-way trade in the same commodity class may well represent, at least in part, the vestiges of past changes in alternative production efficiency, transport costs, trade protection and exchange rate movements. Many firms which developed a market foothold at a time when their home market was relatively sheltered may well be able to maintain it even when that protection is removed. Likewise, firms will gain export and import markets at times when comparative advantage, exchange rate fluctuations or bilateral trade deals favour them may well continue to export or import even when patterns of competitiveness change drastically.

While recent studies have acknowledged verbally the existence of historical factors in influencing trade, there is perhaps a failure to emphasise that today's policy decisions are tomorrow's historical factors. Trade diversion from a preferential trading agreement may well persist as informational diversion well after the preferential agreement has been scrapped. This is perhaps an important argument in favour of multilateral over bilateral trade liberalisation.

Some of the static and dynamic features of match-searching are shared by other related models, such as habit-formation or informational capital models. However, I suggest there are distinctive features of match-searching models which may have significance for understanding trade policy. In particular, there is a key difference between import demand by firms still searching for a satisfactory partner, and demand by firms who have already found such a good partner. In the former case, their demand is very sensitive to changes in prices of relative supply sources, while in the latter demand may be much less price-sensitive. A consequence is that long-standing trade blocs may well have lower import price elasticities than newer trade arrangements. Countries which are attempting to break into new export markets may find themselves needing to compete keenly on price with other new entrant countries, while established producers may not have the same price-sensitivity.

While some of the assumptions of the basic match-search model here are simplified (such as infinite firm life), and may overstate the degree to which firms can benefit by entering into a match-searching process of trade, on the other hand, there may be incentives for firms to use alternative information-acquiring processes, such as employing agents\textsuperscript{18}, or copying known competitors with similar characteristics, or by firms in one country congregating in one section of the market, in order to speed the match-search process. Multinational firms, which move into a new country with a list of pre-existing preferred suppliers and purchasers may also be by-passing the match-search process by making use of existing information (though with some costs, in the sense that they will be importing parts from existing overseas suppliers rather than finding potentially cheaper local sources), and presumably gaining a rent from their ability

\textsuperscript{18}See Rauch and Watson (2004)
to re-use existing information across the world. Networking between firms is an
important variation on the match-searching process: on the one hand there is
potential for reducing search costs and improving eventual match. On the other
hand, many types of network structure will introduce a free-rider problem, so
that firms are reluctant to initiate a search process, and trade will be suboptimal
in the absence of positive trade promotion policies.

References
tions on the theoretical implications of regional trade agreements curiosa,
and should they guide policy’, Journal of International Economics, 68(1),
January 2006, 59-78.
Solution to the Border Puzzle.’ American Economic Review, March 2003,
93, 170-192.
Canadian Journal of Economics, 39 (1) 266-95, Jan 2006.
Trade Flows’, in J.A.Frankel (ed) ‘The Regionalization of the World Econ-
product variety in trade: evidence from South Korea, Taiwan and Japan’,
works in international trade’, Journal of International Economics, 48(1),
1-6.


