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Globalisation as a 'Good Times' Phenomenon: A Search-Based Explanation

T.Huw Edwards
CSGR, Warwick, and Loughborough University

Abstract

Globalisation is associated with long periods of sustained economic growth and credit expansion, whereas major recessions tend to lead to falling trade and protectionism. The sensitivity of trade to global economic conditions is not simply driven by policy: rather, in a model of costly search, firms who are engaged in a searching process are very sensitive to changing economic circumstances. In turn, this causes protectionism to be partly endogenous, since optimal noncooperative tariffs can be high during periods when the sensitive, searching firms have exited the market.

JEL: F15, F43

Keywords: Globalisation; trade; search

Correspondence

T.Huw Edwards, Economics, Loughborough University, Epinal Way, LE113TU Loughborough, United Kingdom; e-mail: T.H.Edwards@lboro.ac.uk

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Globalisation as a 'Good Times' Phenomenon: A Search-Based Explanation

1 Introduction

'Good times dampen anti-globalization attitudes, while bad times deepen them.' - Jagdish Bhagwati.[1]

Why do periods of prolonged global growth, such as 1980-2007, tend to be accompanied by even faster growth of World trade, particularly inter-firm, inter-industry trade? Why is the stalling of such growth traditionally associated with protectionism? In addressing these questions, I wish particularly to stress the two-way nature of the relationship between globalisation and Worldwide growth. Some characteristics of the boom years of the 1980s, 1990s and 2000s, which were associated with the integration of India, China and Eastern Europe into the World economy, are summarised in *Table* 1, below. Some of these features (though not the vertical fragmentation of production) replicate those of the pre-1929 globalisation boom. By contrast, the 1930s saw most of these trends go into sharp reversal (Crafts, 2004).

Table 1	*Stylised characteristics of the recent globalisation phase*
1.	Relatively rapid growth of the global economy.
2.	Fast credit expansion, international mobility of capital and ease of borrowing.
3.	Trade growing much faster than global GDP,[2] with a high income elasticity.[3]
4.	A growing extensive margin of trade.[4]
5.	Rapid churn of trading firms.[5]
6.	Trade growth based upon the expansion of traditional trading networks.[6]
7.	Interfirm, inter-industry trade growing faster still.[7] Vertical FDI/outsourcing.[8] Fragmentation.[9]
8.	Growth especially concentrated in areas of the South or former Communist bloc entering the outsourcing trade.
9.	Reduction in protectionist barriers.
10.	Countries which pursued open strategies outperformed less open economies.[10]

[1] 'In Defense of Globalization' (2004), OUP, p10.

[2] See the figure on www.imf.org/external/np/speeches/2006/pdf/0502, 06.pdf. In the period 1950 - 2005, only in 1958, 1953,

Some of the features in *Table 1* deserve special comment. In particular, the (not uncontroversial) conclusion that more open, market-orientated economies experienced faster growth stands rather contrary to standard economic thinking. After all, standard textbooks would argue that, while trade is good for all economies taken together, in most circumstances it is in the individual interests of 'large' countries (or those producing differentiated products) to impose a protectionist set of 'optimal' tariffs on imports and exports, in order to improve their terms of trade[11], so that there is a prisoner's dilemma situation, whereby the noncooperative outcome of tariff-setting games is against the collective interest. By contrast, one might tentatively view the evidence of the last 20 years or so as suggesting that there is little evidence of a prisoner's dilemma: open trade policies, which favour a country's neighbours, also seem in many circumstances to serve its self-interest. This is a feature which I particularly wish to investigate: is there some characteristic of globalisation booms which leads to a convergence of country and global welfare-maximising policies, and, if so, does such a convergence break down during prolonged recessions or depressions?

In this paper, I link this, in particular, with point 3. - the high observed income elasticity of trade during the economic 'good times'. The starting point is that this high elasticity represents a footloose element of supply, which is explicitly linked to the dynamics of a search process, and which may be the first thing to be eliminated during an economic downturn. Once that footloose element is eliminated, the economics of trade protection are turned on their head - essentially, the prisoner's dilemma is returned.

I start by discussing the phenomenon of rapid trade growth in the good times - building on the ideas of existing papers by Ishii and Yi (1997), Rauch and Trindade (2003) and Rauch and Casella (2003) and Grossman and Helpman (2002 and 2005). In the rest of this paper, I start by outlining a partial equilibrium model of a single industry with two-stage production, outlining the difference between growing and declining

1982-3 and 2001 did trade decline relative to GDP: in each case, during a recession year.

[3] Ishii and Yi (1997).

[4] Bernard *et al* (2009).

[5] Besedes and Prusa (2006).

[6] Rauch and Trindade (2003).

[7] Ishii and Yi (1997). Hummels, Ishii and Yi (2001).

[8] Markusen (1995).

[9] Feenstra and Hanson (1999).

[10] Wacziarg and K.H.Welch (2008). Dollar and Kraay (2002 and 2003). These studies are not without their critics - for example, Luebker *et al* (2002). Winters, McCulloch and McKay (2004) give a more overall survey of the benefits of trade liberalisation. Anderson and Winters (2008) give an excellent discussion on this.

[11] e.g. Gros (1987).

sectors and that between matched and searching firm pairs. I then set up a three-phase time schema,[12] whereby in phase 1 there is little trade, phase 2 sees globalisation and phase 3 sees an economic crisis. I develop an explanation of why optimal tariffs will be low during periods of economic growth, but high during periods of economic slowdown, particularly when credit shortage is a contributory factor. Finally, the role of credit in maintaining international trust and multinational trade agreements is examined in more depth.

1.1 Fixed costs, search costs and trade elasticities

It has become a commonplace that costs of market entry impede global trading patterns, such that economic integration, even in the good times of the 1990s and 2000s, falls far short of what neoclassical theory would predict (Trefler, 1995, Obstfeld and Rogoff, 2000). Since this primarily reflects limitations on the extensive margins of trade (in other words, the fact that most firms do not trade most products internationally), this is widely explained in terms of a fixed cost of market entry (Tybout, 2002) - firms need to make a particular level of profit in order to justify market entry, there are both selection effects in favour of large and successful firms (Bernard *et al*, 2007) and threshold effects on entry. The latter, threshold effect can also be explained simply in terms of a Ricardian model of comparative advantage (Yi, 2003): once trade costs fall sufficiently, the fragmentation of production becomes possible so that different stages can be carried out in different countries. Consequently, there is a rapid, nonlinear growth of market participation, particularly in terms of vertical tie-ups between firms (Yi, 2003). In addition, where tariffs are ad valorem, effective protection against individual stages of production is magnified (since a tariff may be paid more than once, as the goods cross and re-cross borders), and the same applies to transport costs - so exaggerating the apparent price-sensitivity of intermediates trade.

Many of these arguments are often summarised as the 'new, new' trade theory[13] - i.e. supplementing the models of Krugman, 1979 and Grossman and Helpman, 1992, with the incorporation of firm-level participation effects and production fragmentation. These elements are now acknowledged to have powerful

[12] This is partly inspired by Jacks *et al*'s (2008) history of global trade costs, showing rising trade costs in the interwar period, resulting from protectionism, and falling costs after 1945.

[13] To use Srinivasan and Archana's (2009) terminology.

implications for growth through firm selection,[14] distribution[15] and the observed volatility of trade.[16] By themselves, however, they offer only a partial explanation, containing no real evidence of the nature of the fixed costs of market participation, and under what circumstances they may become sunken rather than just fixed. To explain this, we need to turn to another branch of the literature - the evidence of informational barriers and a search process. This stems from stylised facts 5. and 6. in *Table 1*: the high turnover of trading firms (Besedes and Prusa, 2006) and the evidence of network effects (Rauch and Trindade, 2003), taken with strong evidence that clusters of low-cost producers can go unnoticed by traders for long periods (the noted example being surgical steel production in Sialkot, Pakistan[17]). Informational barriers can generate a search process, and I argue that this process is a primary cause of threshold effects, which in turn helps explain the dynamics of trade.[18] Search takes time and requires confidence and the availability of credit. Critically, firms need to incur a series of ongoing fixed costs during the search process, but once they eventually achieve a satisfactory match, the cost of the past search is sunken. This means that searching firms will indeed be very sensitive to price movements, as in Ishii and Yi (1997), but that, as the search process goes on, firms achieve matches and become more heterogeneous and less subject to threshold effects. This process indicates a sensitivity of trade during the process of globalisation to international traded prices, global aggregate demand and capital availability,[19] but the trading patterns of long-established firms, which are likely to be much less sensitive,[20] and it is this nonlinearity - missed by the existing literature - which may underlie the danger of policy shifts during and after economic crises.

2 An illustrative model of firm-level trade

I set up a simple, stylised, partial equilibrium model of a monopolistically competitive industy in a two-country world - the two countries being the North and the South, the former being characterised by higher

[14] Melitz, 2003.
[15] Feenstra and Hanson, 1999.
[16] Ishii and Yi (1997).
[17] Schmitz, 1999.
[18] Ishii and Yi (1997) use fixed costs of vertical specialization to explain the high observed income elasticities of trade - which they argue cannot plausibly reconciled with more orthodox models.
[19] In terms of a macroeconomic model, market search has elements of capital formation, and so it should be no surprise that it has many of the characteristics of investment demand - in terms of cyclical sensitivity.
[20] This reflects in part the heterogeneity both of firms (Melitz, 2003) and of trading match quality (Rauch and Casella, 2003).

skill endowments per head. The main market for final goods is in the North. Production requires two stages, which I name upstream (u) and downstream (d). Typically these are carried out by a pairing of firms (which may or may not be vertically integrated by merger), where u sells a semi-finished good to d, who then completes the manufacture and sells it on to final consumers. The two firms are of equal size and *ex ante* expected efficiency: however, productivity varies depending on the goodness of fit of the match, μ_i. As in Rauch and Casella (2003) or Rauch and Trindade (2003), μ, potentially follows a uniform, rectangular distribution between 0 and 1, and firms do not know μ_i before entering a match i, though they know its overall distribution.[21]

Trade between the North and South develops over time. The historical setup takes three phases. In phase 1, trade costs are high, so that there is little trade, and most goods are produced by pairings of firms type u and d within the North. However, the South is assumed to have a potential comparative advantage in upstream production, while the North has a comparative advantage in downstream production. We then enter phase 2: a period of growth and global integration, spurred by a technological or policy change reducing trade costs. Some Northern downstream firms (though not all) will now search for upstream partners in the South. For example, garments might be manufactured by an upstream firm in China, but according to designs from the downstream firm in a Western economy, which then completes the marketing and distribution worldwide. Phase 3 represents an unanticipated crisis, where credit ceases to be available and growth stalls for a protracted period.

Concentrating on phase 2, the period of globalisation, the growth of the outsourcing trade is impeded by search friction deriving from an assumed need for at least one firm to make a relationship-specific investment: in order to avoid a potential hold-up problem,[22] this generally requires a contractual relationship for at least some minimum period, which I characterise by a fixed contract period, t, during which the two firms have an exclusive relationship.

Firms employ labour in the form of fixed and variable elements. The cost of the latter is normalised at $C = C_N$ for North-North pairings, and at $C = C_S$ ($C_S < C_N$) for South-North pairings. The elasticity

[21] This setup is derived from Salop's circular cylinder, and is standard in firm-level matching models. Note that Grossman and Helpman's (2002) model is similar, except that firms know with certainty the location of potential partners, and always match with the nearest.

[22] See Hart (1995).

of substitution between final goods varieties is ε (> 1), which will also closely approximate the own-price elasticity for the output sold by firm pairings, at least as long as the number of firms, N, is large. Sales by pairing i will equal

$$Y_i = \overline{Y}(\frac{P_i}{P^*})^{-\varepsilon}, \tag{1}$$

where $\overline{Y}$ is the CES aggregate of sales by the industry and P^* is the CES aggregate price index, which declines as the number of firms in the industry rises, reflecting the love of variety. Details of equation derivations for the imperfectly competitive model are included in Appendix 2, at the end of this paper. Profits of the pairing, before subtracting fixed costs, will equal

$$\pi_i = \frac{\overline{Y}}{\varepsilon} P^{*\varepsilon} (\frac{\varepsilon}{\varepsilon - 1})^{1-\varepsilon} {C_i}^{1-\varepsilon} = k\overline{Y} P^{*\varepsilon} {C_i}^{1-\varepsilon}. \tag{2}$$

The model is driven by an assumed cost which is inversely linearly related to the quality of the match μ_i between firms in pairing i. For simplicity, I concentrate on a rather stylised model where quality of match affects fixed cost, rather than unit variable costs. More precisely, I assume that fixed costs are $F - \mu_i$, so that profits after subtracting fixed cost,

$$\Pi_i = k\overline{Y} C_i^{1-\varepsilon} P^{*\varepsilon} - F + \mu_i. \tag{3}$$

Note I am also assuming equal Nash bargaining weights between the upstream and downstream firms.

2.1 The matching process

We now want to look at the matching process in more detail. Appendix 1 explains the matching process in more detail. I assume firms take a series of blind matches, where match quality, μ_i, varies according to a uniform rectangular distribution between 0 and 1. Further, assume that firms are stuck with an existing partner for a fixed contract period, t, during which time firms face a discount rate r. Firm pairings are also subject to sudden, random death with a constant probability of d. For simplicity, I normalise the discount

rate in terms of the contract period, defining the discount rate and depreciation rate per contract period,

$$\rho = (1+r)^t - 1; \tag{4a}$$

$$D = \frac{1}{(1-d)^{2t}} - 1. \tag{4b}$$

Note that the depreciation rate reflects the probability of either firm in a pairing dying during the contract period.

At the end of each contract period, the firm may either stick with its existing partner (which it will do if match quality μ_i exceeds a reservation match quality, μ_R), or else seek a new partner (which it will do if $\mu_i < \mu_R$). Note that, as we have assumed a uniform, rectangular *ex ante* probability distribution of match quality, the probability that search will be renewed, after the initial match period will equal μ_R. However, over time, the probability of not having found a successful match will decline geometrically. By noting that, when $\mu_i = \mu_R$, a pair of firms will be indifferent between renewing search or staying together, we can derive the condition for equating discounted present value of searching and not searching, and so find a value for the reservation match quality. This can be shown to satisfy

$$\mu_R = 1 + \rho + D - \sqrt{(\rho + D)(1 + \rho + D)}, \tag{5}$$

which is declining as ρ or D increases.

From (5), we can conclude that, with zero discount rates and zero probability of firm death ($r = d = \rho = D = 0$), firms will be infinitely patient in their search, so that the long-run equilibrium is for all firms to be equally and successfully matched. By contrast (and more realistically), with positive time preference, the long-run equilibrium has a uniform distribution of surviving matches, of quality ranging from μ_R to 1, with profits likewise varying. A consequence is that firm pairings are heterogeneous in the long-run, both in terms of profits and trade volumes, with heterogeneity increasing when long-run interest rates are higher or contract periods are longer.

2.2 The role of monopolistic competition

I assume there is free entry and exit into the industry. Consequently, the number of firm pairings will vary, with competition forcing the industry aggregate price, P^* up or down so as to make the marginal firm indifferent as to whether to enter or exit.

It is also assumed that the industry as a whole (whose CES aggregate sales are $\overline{Y}$) is a small part of a Cobb-Douglas higher-level aggregate utility function. In this case, the aggregate demand for output by the industry has a unit price elasticity, so we can write

$$\overline{Y} = \frac{\overline{Y}_0}{P^*},$$

where $\overline{Y}_0$ would be aggregate sales by the industry if P^* were equal to 1.

I focus first on an expanding industry. In this case, the marginal firm is a new, searching firm. Again, see Appendix 2 for more details. The condition for determining the reservation match quality means that the expected present discounted profit of entering and engaging in a new search will equal that of a firm in a stable match of quality μ_R.

$$\begin{aligned} \Pi_i &= \frac{\overline{Y}}{\varepsilon - 1} N^{\frac{\varepsilon}{1-\varepsilon}} \overline{C} - F + \mu_i. \\ \Pi_i &= 0 \text{ when } \mu_i = \mu_R; \\ P^* &= \left(\frac{F - \mu_R}{k\overline{Y}\overline{C}^{1-\varepsilon}}\right)^{\frac{1}{\varepsilon}}. \end{aligned} \tag{6}$$

where $\overline{C}$ is the unit cost of the marginal pairing (so it will equal C_N during the pre-globalisation phase 1, and C_S during phase 2). In phase 1, all firms have the same unit cost $\overline{C}$, and if we also note that the CES aggregate price

$$P^* = N^{\frac{1}{1-\varepsilon}} \frac{\varepsilon}{\varepsilon - 1} \overline{C}, \tag{7}$$

where N is the number of pairings in the industry, then the initial number of pairings

$$N_1 = \left(\frac{(\varepsilon - 1)(F - \mu_R)}{\overline{Y}\overline{C}}\right)^{\frac{1-\varepsilon}{\varepsilon}}. \tag{8}$$

3 The stages of development of North-South interfirm trade

I discuss the three phases of the stylised time-scheme in turn.

3.1 Phase 1: the pre-globalisation, Northern economy

I start by concentrating on the initial phase 1 of our time-scheme, when trade costs are sufficient to ensure that there are no matches between Northern and Southern partners. I consider an equilibrium, where the industry in the North is initially static, with demand and prices constant.

I start by characterising firm pairs on this initial equilibrium growth path as 'established' or 'matched', if they are already in a settled match ($\mu_i \geqslant \mu_R$) at the start of a contract period - otherwise, we define them as 'searching'.

The basic situation is shown in *Figure 1*, below. Since unit variable cost with Northern pairings is 1, firm pairs will supply at a price of

$$P_1^* = (\frac{(\varepsilon - 1)(F - \mu_R)}{\overline{Y}_0})^{\frac{1}{\varepsilon - 1}} (\frac{\varepsilon}{\varepsilon - 1})^{\frac{\varepsilon}{\varepsilon - 1}}. \tag{9}$$

Searching firms will only engage in search if the price is at least P_1^* : free entry will keep the price to this level, as long as the industry is not shrinking. Matched firm pairings will also supply at this price, though most of these are intramarginal matches, which would continue to produce if the price were to fall (hence the upward-sloping supply curve for matched firms). The number of firms in the industry will satisfy (8), and also balance demand and supply at the price P_1^* : I will denote this initial demand level for the industry's products as Y_1^*.

If firms were infinitely-lived, the economy would tend towards a steady-state equilibrium where all firms were matched ($\mu_i \geqslant \mu_R$). However, if proportion D of firm pairings suffer in a given contract period from one or both firms randomly expiring, then there will be some new firms entering and searching. In equilibrium, I denote the number of matched firms in period 1 as N_{m1} and the number of searching firms as N_{s1}. In the next contract period, proportion D of existing matched pairings will expire, while proportion $(1 - \mu_R)$ of searching pairings will find established partners. In a static equilibrium, where N_m is constant over time,

this implies

$$\frac{N_{s1}}{N_{m1}} = \frac{D}{1-\mu_R}. \tag{10}$$

If the number of firms in the industry were growing at rate G, this would become

$$\frac{N_{s1}}{N_{m1}} = \frac{G+D}{1-\mu_R}. \tag{10a}$$

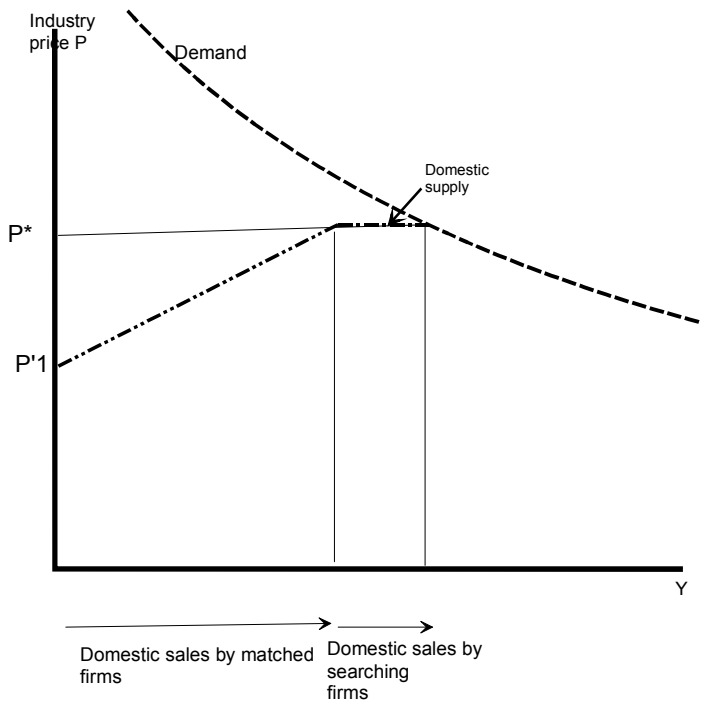

Figure 1: Equilibrium in the pre-globalisation Northern economy

This situation is shown in *Figure 1*, above. The price in equilibrium, P_1^*, is given by the entry price for new, searching pairings. However, there is a kink in the supply curve, since searching pairings will all enter or leave the market at $P_1 = P_1^*$, while matched firms are heterogeneous in the price at which they would exit the market. The most efficient firm pairing would potentially leave the market at $P_1 = P_1'$, as given in equation (9). The ratio of searching to matched firms in equilibrium is given by equation (10) or (10a).

3.2 Phase 2: The globalising economy

Now assume that trade costs fall, so that upstream production in the South becomes more competitive. In particular, assume that unit variable costs, including trade costs, for a South-North pairing are $\overline{C}_S$, as opposed to 1 for a North-North pairing. However to enter the market, foreign firms of type u have to engage in a costly search process, and so will only do so at a World reference price of

$$P_2^* = P_1^* \overline{C}_S, \tag{11}$$

at which a firm in a reservation-quality pairing breaks even.

The effect on existing North-North pairings is variable. The N_{S1} searching Northern pairings would not expect to break even at the new, lower price, and consequently will exit the market, except for a fraction who find their existing partners profitable and become matched.

The N_{m1} existing matched North-North pairings are heterogeneous, since they vary in match quality between μ_R and 1. The price at which a matched pairing of quality μ_i will exit the market is given by

$$\frac{P_{i1}'}{P_1^*} = (\frac{F - \mu_i}{F - \mu_R})^{\frac{1}{\varepsilon - 1}}. \tag{12}$$

The last firm will exit when

$$P_1' = P_1^* (\frac{F - 1}{F - \mu_R})^{\frac{1}{\varepsilon - 1}}. \tag{12a}$$

I assume South-North pairings are not sufficiently low-price to drive the price down to this level. At price $\overline{P}_2$, the proportion of firms in existing North-North pairings which will continue in the market is

$$\sigma_{N2} = \frac{1 - \mu_i}{1 - \mu_R} == 1 - \frac{(1 - \overline{C}_S^{\varepsilon - 1})(F - \mu_R)}{1 - \mu_R}, \tag{13}$$

which is declining as $\overline{C}_2$ falls. Output of these pairings will also be lower than before the start of globalisation by proportion $(\frac{P_2^*}{P_1^*})^{-\varepsilon}$, since the industry aggregate price has fallen. However, total industry output will be higher, due to the fall in prices: it is assumed the own-price elasticity of the aggregate industry good is

-1,[23] so that

$$\frac{Y_2^*}{Y_1^*} = \frac{P_1^*}{P_2^*}. \tag{14}$$

The residual will be made up by new, South-North pairings. Initially, these will be searching, but over time, in a model with static overall demand, the proportion of these still searching will decline, as some gain matches, until eventually the ratio of searching to matched pairs among the South-North pairings will equal that in equation (10).

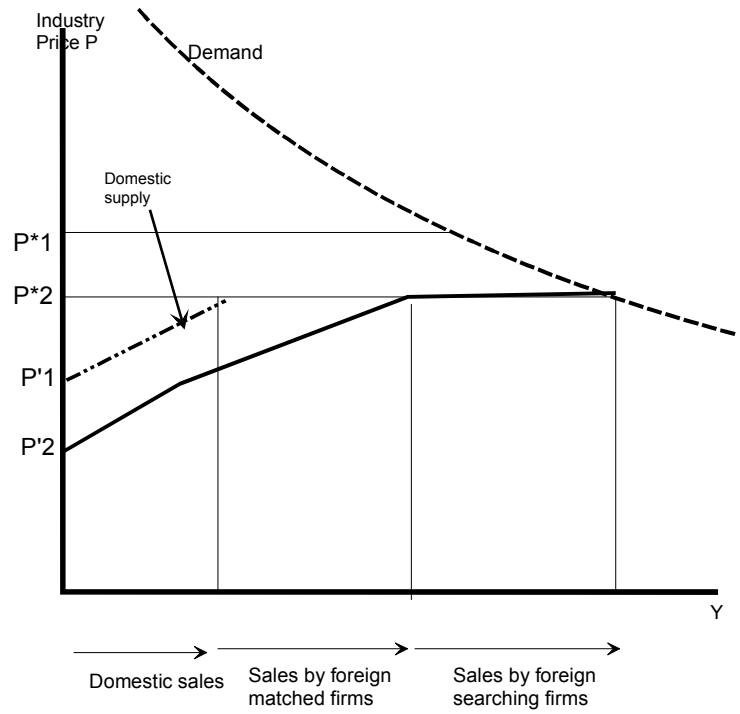

Figure 2: Demand and supply in the globalising Northern economy

Figure 2, above, shows the situation in an economy during the globalisation phase. Searching South-North (foreign) pairings are prepared to enter the market at price P_2^*, which is lower than P_1^*, but assumed to be above P_1'. Consequently, all North-North (domestic) searching pairings exit the market, as do some matched North-North pairings. Once some South-North pairings find successful matches, the result is a supply curve with three segments (i.e. two kinks). First, between P_2' and P_1' (the left segment), only the most successful South-North pairings will be prepared to supply. Between P_1' and P_2^* we are summing horizontally the supply

[23] This assumption is consistent with a small industry in an economy where the representative consumer has a Cobb-Douglas higher-level aggregate utility function.

curves of North-North and South-North matched pairings, so the gradient is somewhat less steep. Finally, when the industry aggregate price is P_2^*, there is a horizontal segment made up of searching South-North pairings.

The kinks in this supply curve are an important element in explaining the differential effects of economic shocks, and the potential change in policy following such shocks - as explained in the subsequent sections.

Figure 3, below, summarises some simulations on the evolution of the proportions of different types of firm pairings over time, following a 10% reduction in the cost of South-North pairings. These are based upon the following parameter assumptions:

Time preference per contract period	ρ	0.08
Death rate of one firm in pairing	D	0.02
Implied reservation match quality	μ_R	0.768.

Simulations are carried out for underlying demand growth rates of 2%, 5% and 8%. After 20 periods, the proportions of searching SN pairings vary between $15-30$ per cent, depending on demand growth, while matched SN pairings are $56-62$ per cent and NN pairings $8-29$ per cent of the market.

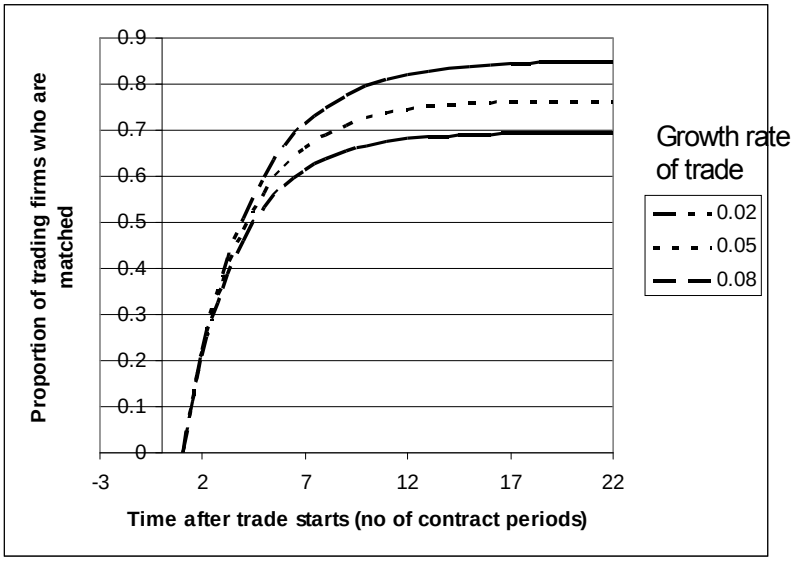

Figure 3: Evolution of the share of matched pairings over time after trade liberalisation

4 The impact of a negative economic shock

4.1 A demand shock

We now want to conside the effect of shocks to an economy which has been undergoing the process of globalisation (in the sense of entry by searching foreign upstream firms, and the gradual development of successful, importing partnerships). Take the situation in *Figure 2*, and assume that there is a sudden inward shift in the demand curve, caused by a recession. The situation is shown in *Figure 4*, below: essentially, searching foreign firms are footloose, and will simply exit the market at the end of their existing contracts (except for the minority who find profitable contracts). This is a component of import supply which is very sensitive to demand changes. Consequently, unless the demand shock is very large, it can be accommodated simply by the exit of these firms: the remaining foreign and domestic firms see very little change in their demand or prices. Only larger shocks will force established firm pairings back down their supply curves.

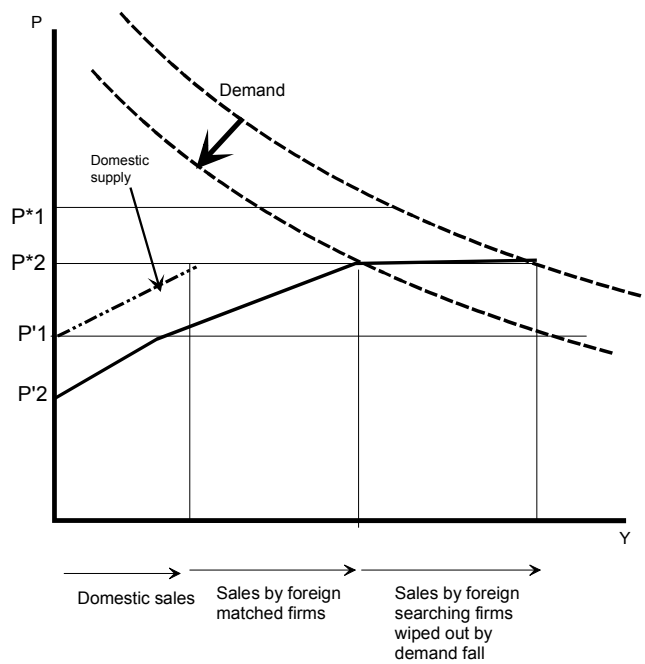

Figure 4: A negative demand shock which wipes out searching firms, leaving matched firms unchanged

Note that, at the point where searching South-North pairings have been eliminated, the elasticity of imports with respect to the industry aggregate price falls from infinite to $\frac{\varepsilon}{\mu_R}$, and continues to rise thereafter, as more firms are driven out.

The situation with a larger negative demand shock is that, only after seaching firms have been eliminated will prices be driven down. At this point, existing domestic pairings, as well as established importing pairings will be faced with falling prices, and the least efficient will be eliminated (so driving the firms down their supply curves). This is shown in *Figure 5*, below.

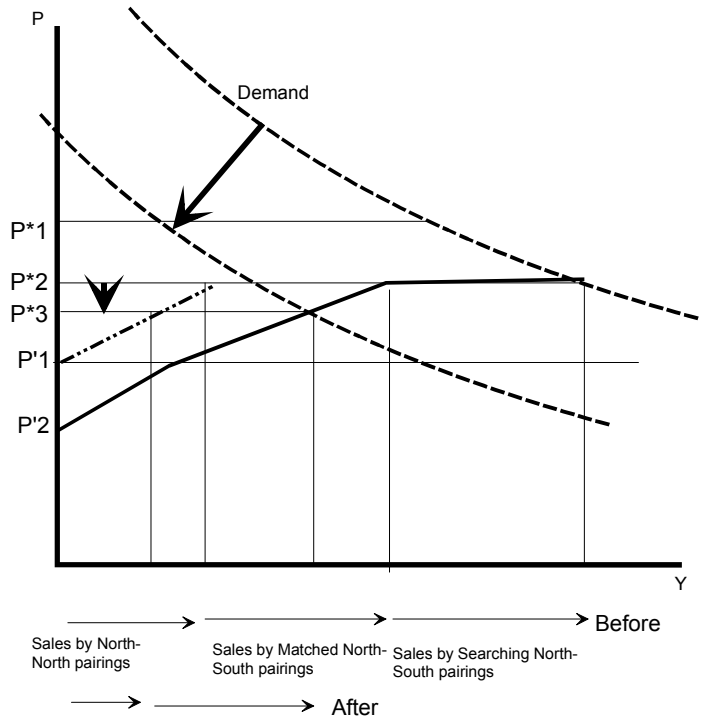

Figure 5: A larger negative demand shock

Note that an implication is that the first firm pairings to exit the market are searching, South-North pairings, so that trade is especially vulnerable to a medium shock. In the larger shock in *Figure 5*, matched North-North pairings will exit faster than matched South-North pairings in the ratio

$$\frac{\sigma_{N3}}{\sigma_{S3}} = \frac{P_2^* - P_1'}{P_2^* - P_2'} < 1. \tag{15}$$

4.2 A credit shock

A credit shock is somewhat harder to model - particularly where it results in shortages of cash, rather than a rise in headline interest rates. Nevertheless, I will assume that firms suddenly face a rise in risk premia on

their interest rates, so that the interest rate per contract period rises to

$$\rho' > \rho.$$

I consider the unlikely phenomenon of a pure credit shock (one which affects supply, but does not result in a recession shifting the demand curve inwards). It is worth noting that this type of shock hits different firms disproportionately. In particular, by raising the *de facto* interest rate facing firms, a credit shortage will make the search process costly. As a result, the reservation match quality will fall (firms will accept lower-quality reservation matches than previously, when they were more patient). The implication of this is that the reservation match quality falls to

$$\mu'_R = 1 + \rho' + D - \sqrt{(\rho' + D)(1 + \rho' + D)} < \mu_R. \tag{16}$$

However, since the reservation price which overseas firms type u will demand in order to enter into search is

$$P^{**} = \frac{\mu_R}{\mu'_R} P_2^*, \tag{17}$$

this will now be higher than previously. However, while the supply price of searching firms is raised, the supply curves of established firms are unchanged. *Figure 6*,. below, shows a pure credit shock, just sufficient to drive searching foreign firms out of the market, while raising prices at home (hence leading to established domestic and foreign firms supplying marginally more than before). Note that the price does not rise as far as P^{**}, so that search is halted entirely in the short/medium run.[24] Existing firms can supply somewhat more than previously, as the market price, P^*, rises, in accordance with equation (1). However, new firms cannot enter unless the price rises to P^{**}, so below that level supply is relatively inelastic.

[24] In the longer run, depreciation of the stock of existing matched firms at rate D will gradually raise the supply cost and price, until it reaches P^{**} and new firms start to enter and search again.

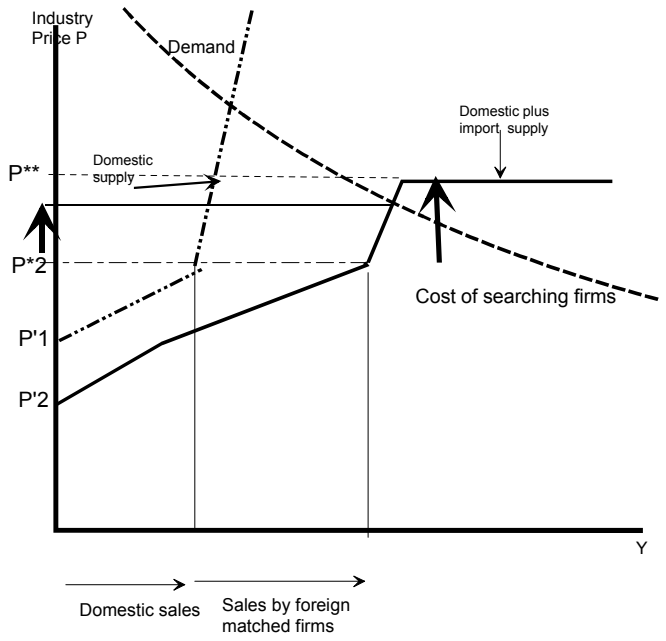

Figure 6: Effect of a credit shock increasing the cost for searching firms

In reality, we should perhaps consider that, at least in their initial stages, credit shocks are usually associated with demand shocks as well. However, in both cases we should note that it is the searching importing firms (and their domestic partners) which are the most sensitive to macroeconomic shocks: established pairings, whether domestic or international, are far more robust.

The conclusion should be that, in the event of a combined credit and demand shock hitting an economy which had been undergoing a process of steady growth and increasing trade openness, there will be a relatively large proportion of trading firms and their partners (as implied by equation (15)) which will exit the market relatively quickly.

One should perhaps not be surprised by this finding. Trade search can be viewed as a kind of capital formation, with firms prepared to undergo losses in the early years of search, in order to make an expected positive return thereafter, once they are established. Like any form of capital formation, we would expect search capital formation to be sensitive, both to changes in the cost and availability of credit, and to accelerator-type changes in overall demand growth. That is what this model indicates.

5 Endogenous policy responses to a boom or a shock

We have so far established that, during a globalisation boom, where demand and imports are rising fast, there will be at any one time a relatively high proportion of trade which is accounted for by searching firms, whose presence in the market is footloose, and who are vulnerable to either demand and/or credit shocks. This, by itself, implies that the globalisation process can be suddenly halted by unexpected shocks, regardless of any policy response. Moreover, since search is necessary for the long-run growth of trade, a shock may have a prolonged negative impact upon trade.

We now want to consider how trade policy might respond to economic circumstances, given a search model, where different components of foreign supply differ greatly in terms of their price sensitivity.

Figure 7, below, shows schematically the effects of imposing a tariff on an economy with a large amount of initial importers who are searching (and hence price-sensitive). The elastic portion of the supply curve, accounted fo by the initial searching importers, means that a tariff has to be substantial before it can begin to lower the import price. Consequently, the transfer from foreign firms to the government imposing the tariff (area D) is small relative to the loss of domestic surplus (A+B+D), and it is highly unlikely a non-zero tariff can improve national welfare.

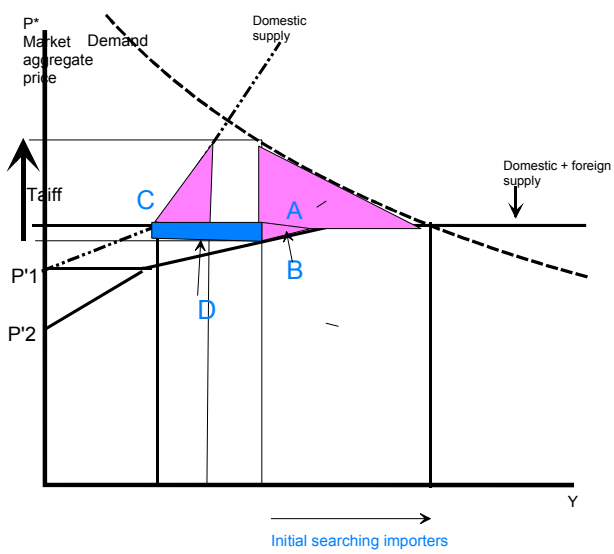

Figure 7: Only if the transfer from foreigners, D, exceeds A + B + C will a tariff improve national welfare.

Now compare this with *figure 8*, where there are no searching firms initially. In this case, it is relatively

easy to set an optimal tariff, which improves national welfare by forcing down import prices.

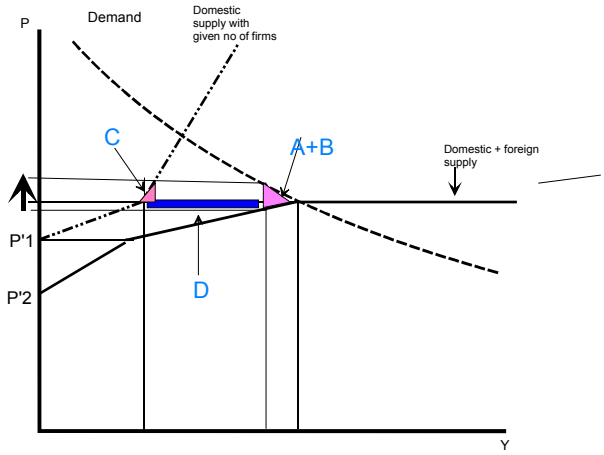

Figure 7: Setting of an optimal tariff when there are no initial searching firms

The implication is that there is likely to be a discontinuity in tariff-setting: when the sector is shrinking, or growing slowly, optimal tariffs are positive, while, when the sectoral rate of import growth exceeds a threshold rate, optimal tariffs fall to zero.

The analysis here is somewhat simplified, since in reality one needs to consider tariffs in a dynamic setting. In due course, even with a tariff, the natural death of existing matched firms will lead the economy back to a position where searching firms begin to reenter the market - under some circumstances, we would expect this to lead to a cycle of optimal tariffs over time. Nevertheless, the situation with stalled growth indicates a significant difference between eras of prolonged trade growth, where protection is not favoured, and eras of stagnation, where it is.

6 Implications: return of the Prisoner's Dilemma in trade liberalisation?

Trade liberalisation is often portrayed as a prisoner's dilemma situation: liberalisation benefits countries collectively, but large countries, individually, have an incentive to cheat and impose optimal (terms-of-trade-improving) tariffs.

The argument of this paper is that, in a rapidly changing, globalising world,. the incentives to impose protection in this way would be greatly reduced by the presence of a relatively large share of footloose trade, associated with searching firms. In such circumstances, the incentives of individual countries are not far out of line from those of the global economy, which benefits from free trade.

This conclusion might raise some eyebrows: few involved in trade negotiations over recent decades would argue that they were pushing on an open door (as the failure of the Doha Round talks indicates). Nevertheless, trade liberalisation has undoubtedly made substantial strides - particularly with respect to developing countries abandoning previous autarkic developmental strategies, but also in terms of successive rounds of tariff reduction by the advanced countries. Perhaps most significantly, where protection has been maintained, or liberalisation has been resisted, the reasons have tended to be argued in terms of distributional impact, or in terms of damage to countries within trade blocs which were dependent on trade diverted from poorer countries outside the bloc (for example, Portugal or Italy resisting EU liberalisation of textiles and footwear industries). In general, the argument that high tariffs benefit national income -at least, when based upon terms of trade arguments - has rarely been used. An exception may be in agricultural commodities.

Part of the reason may be a trend towards accepting that the price elasticity of demand for traded commodities is perhaps higher than we used to think - for example, Anderson and van Wincoop's (2004) survey cites elasticities of between 5 and 10 for many commodities: a far higher number than traditionally used in Armington CGE models of the 1980s and 1990s.[25] These higher trade elasticities are seen as fitting the data because of Ricardian, fixed-factor elements in trade,[26] including firm heterogeneity, which mean that supply elasticities are reduced. However, a search-based interpretation would say that supply elasticities differ considerably *ex ante* and *ex post*, and that expanding supply may be more elastic than contracting supply.

In addition, the recent wave of globalisation has essentially involved connecting a large workforce in China, India, Asia and Eastern Europe to global markets from which they were previously isolated by autarkic policies and/or by their location in pre-industrial societies. The supply of labour to the globalising

[25] Anderson and Winters (2008) provide an excellent discussion of the effects of moving from traditional to more modern CGE models in assessing trade policy.
[26] Eaton and Kortum, 2002.

cities of Asia has been elastic at a low wage, so ensuring that, once search and other capital costs are met, there is an elastic supply of unskilled labour-intensive goods, meaning that optimal tariffs for large, advanced countries are likely to be much less than at some other stages of global development.[27]

A prolonged global recession - perhaps especially one where credit is short - is likely to change this situation for the worse (as memories of the 1930s indicate).[28] In terms of the very schematic analysis of this paper, we are moving from the situation in *figure 6*, where there is a substantial volume of footloose trade, to that in *figure 8*, where the supply of price-elastic, searching trade is insufficient to maintain the incentive to keep tariffs low. In such a situation, the interests of individual countries (which may wish to try to manipulate their terms of trade by protection) and those of the global economy are no longer aligned, hence raising the risks of triggering a round of beggar-thy-neighbour policies. Given the recent advances in understanding the interaction between trade integration and growth,[29] there must be a danger that protection could trigger a self-perpetuating circle, whereby trade growth is reduced, increasing incentives to protect.

A secondary element, which must be of particular concern when countries are credit constrained, is the potential effect on the stability of existing agreements, where these are sustained by the threat of retaliation in a trigger strategy. Such a strategy depends upon people weighing the loss of future welfare, from the collapse of trade agreements, more highly than the short-term gain from imposing a terms-of-trade-improving tariff. Again, if credit constraints shorten national time-horizons, the prisoner's dilemma will be restored.

In sum: the recent wave of globalisation has been sustained and strengthened by the coming-together of national and global interests, when trade is relatively footloose and credit is available. The removal of those conditions, once a shock drives out the more price-elastic elements of trade, creates a totally new set of incentives, where national interests are to protect, yet the global interest still requires a liberal trade regime. If cooperation is allowed to fall, it may be very difficult to restore global trade to its recent Golden Age.

[27] The situation described here in some ways mimics Sir Arthur Lewis's model of the development of trade, whereby large supplies of Indian and Chinese labour in the late 19th and early 20th centuries pushed down prices of unskilled-intensive commodities. Ironically, this led Lewis towards pessimism about export-led development in developing countries, on the grounds of elasticity pessimism.

[28] Eichengreen *et al* (2009) summarise the trade experience of the current economic crisis, with a roughly 20% fall in World trade (April 2008 to a year later).

[29] Not just the standard comparative advantage effects, but the pro-competitive, choice-widening and scale-exploiting effects identified by the New Trade Theory (Krugman, 1979), as well as the firm selection effects of the New New Trade Theory (Melitz, 2003). The starting premises of this paper - that search costs, even in phase 2 of our time-schema, maintain trade at below the level which would be favoured in the presence of full information, rather emphasise that trade-impeding policies will push the World further from optimality.

Appendix 1: The matching setup

The paper follows Rauch and Trindade (2003) and Rauch and Casella (2003) in using a matching framework based upon Salop's circular cylinder (note that Grossman and Helpman, 2002, use a similar setup). This is shown in *Figure A1*, below. Position on the circle refers to some firm-specific characteristics. The essence of the Salop model is that firms are *ex ante* equal in efficiency, but that firm performance is determined by the degree of fit with the match partner: the aim is to match with a firm directly opposite on the cylinder. Hence, match quality, μ_i, is measured by the circumference distance between the two firms. Firms only have a single partner at any time.

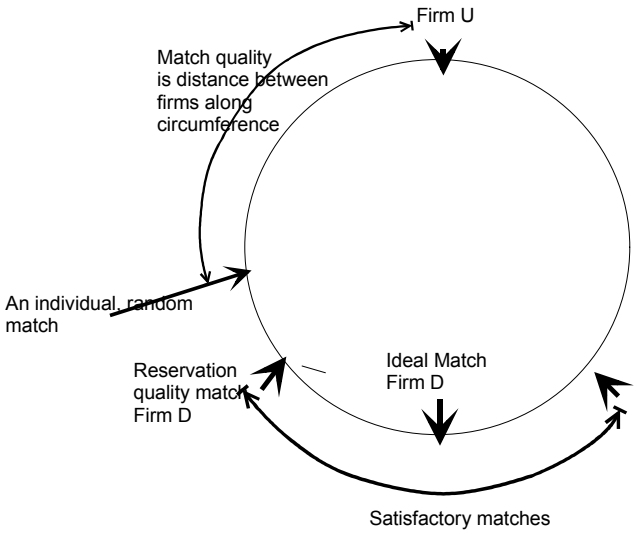

Figure A1: The Salop matching framework

The key difference between the match-searching model employed here and the models in the earlier papers is the ability of a firm in an unsatisfactory match to renew search, after a given contract period. This determines the generation of a reservation match quality, μ_R. The decision process of the firm is shown in *Figure A2* below.

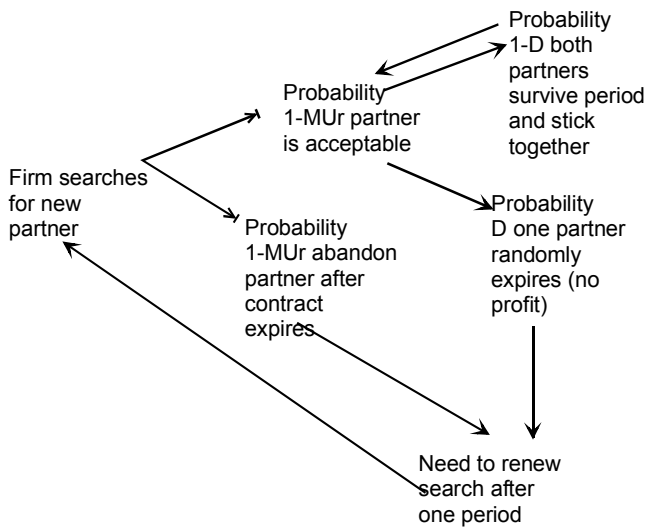

Figure A2: The match-searching decision setup

Any match with a circumference length greater than μ_R will yield a profit great enough for the firms to choose to continue. This gives a probability of acceptance of $1 - \mu_R$. However, of these pairings, proportion D will naturally expire anyway during the first contract period, so any surviving firm will have to renew search. By contrast, proportion μ_R of initial pairings will be unsatisfactory, and be dropped after one contract period.

We note that the profit of a reservation quality match ($\mu_i = \mu_R$) is zero. Profit increases linearly with respect to match quality, so that the expected profit of a successful match (where $\mu_R < \mu_i < 1$) is $\frac{1+\mu_R}{2}$ minus the profit of a reservation quality match. This yields an expected profit of $\frac{1-\mu_R}{2}$. Likewise, an unsatisfactory match qill have an expected profit of $-\frac{\mu_R}{2}$. Finally note that a renewed search will yield a present discounted value of zero.

Table A1		Probability	Expected profit
Match			above reservation
Satisfactory	Both firms survive	$(1-\mu_R)(1-D)$	$\frac{1+\mu_R}{2} - \mu_R = \frac{1-\mu_R}{2}$
	One or more dies	$(1-\mu_R)D$	0
Unsatisfactory		μ_R	$\frac{\mu_R}{2} - \mu_R = -\frac{\mu_R}{2}$

We wish now to solve this problem, based upon the knowledge that monopolistic competition will equate the expected return from entering a search process to zero.

Discounted profit with a successful match = one period expected loss with a poor match;

$$
\begin{aligned}
\frac{(1-\mu_R)^2}{2\Phi} &= \frac{\mu_R^2}{2(1+\Phi)}, \text{ where } \Phi = \rho + D; \\
(1+\Phi)(1-2\mu_R+\mu_R^2) &= \Phi\mu_R^2; \\
\mu_R^2 - 2(1+\Phi)\mu_R + (1+\Phi) &= 0; \\
\mu_R &= \frac{2(1+\Phi) \pm \sqrt{4(1+\Phi)^2 - 4(1+\Phi)}}{2}, \\
&= 1+\Phi-\sqrt{\Phi(1+\Phi)},
\end{aligned}
$$

since only the negative root lies between zero and unity.

Appendix 2: the thick industry 'love of variety' partial equilibrium model with match-searching.

The industry is described as 'thick' in the sense that the number of firms producing differentiated goods is large.

Competitive structure

The industry is assumed to be monopolistically competitive, on the lines of Krugman (1979). There are both fixed and variable costs. Subject to these, firms can enter or exit the market, although they need a partner (existing or new) in order to produce saleable goods. The elasticity of substitution between final goods varieties is ε (> 1)[30], which closely approximates the own-price elasticity for the output sold by firm pairings, at least as long as the number of firms, N, is large.

To summarise the love of variety model, we start with a Dixit-Stiglitz utility function for utility from consumption of the industry's good:

$$\overline{Y} = \Omega \left(\sum_{i=1}^{N} Y_i^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{a}$$

Y_i is sales by firm pairing i. ε is the elasticity of substitution in consumption and Ω is a scale parameter, which we can set at 1 without loss of generality, since utility is basically ordinal. Hence we derive

$$\overline{Y} = \left(\sum_{i=1}^{N} Y_i^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{b}$$

The first order condition for an optimum is

$$\frac{\partial \overline{Y}}{\partial Y_i} = \left(\sum_{j=1}^{N} Y_j^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{1}{\varepsilon-1}} Y_i^{\frac{-1}{\varepsilon}} = \frac{P_i}{P^*}; i \in j, \tag{c}$$

where P^* is the aggregate CES price of utility. We can replace the term in brackets by rearranging (b), so that

$$\frac{\partial \overline{Y}}{\partial Y_i} = \overline{Y}^{\frac{1}{\varepsilon}} Y_i^{\frac{-1}{\varepsilon}} = \frac{P_i}{P^*}; \tag{d}$$

[30] The restriction $\varepsilon > 1$ is associated with consumers' assumed 'love of variety', and also helps ensure finite pricing by firms.

Or, by rearranging,

$$Y_i = \overline{Y}(\frac{P_i}{P^*})^{-\varepsilon}. \qquad \text{(e = equation (1))}$$

Defining $A = U$, (e) is equation (1) in the paper.

When the number of firms, N, is large, then a change in Y_i will have negligible impact upon U, in which case

$$\frac{\partial \ln Y_i}{\partial \ln P_i} = -\varepsilon. \qquad \text{(f)}$$

Applying the standard profit-maximising formula for a firm with constant demand elasticity and a constant marginal cost, C_i, firm pairing i will charge a price of

$$P_i = \frac{\varepsilon}{\varepsilon - 1} C_i. \qquad \text{(g)}$$

Substituting from (e) into (b)

$$\begin{aligned} \overline{Y} &= \overline{Y} P^{*\varepsilon} \left(\sum_j P_j^{1-\varepsilon} \right)^{\frac{\varepsilon}{\varepsilon-1}}; \\ P^* &= \left(\sum_{j=1}^{N} P_j^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}. \end{aligned} \qquad \text{(h)}$$

When all firms are identical, $P_j = \overline{P}\ \forall j$. Consequently,

$$P^* = N^{\frac{1}{1-\varepsilon}} \overline{P} = N^{\frac{1}{1-\varepsilon}} \frac{\varepsilon}{\varepsilon - 1} \overline{C}, \qquad \text{(i)}$$

which is decreasing with respect to N for $\varepsilon > 1$, demonstrating the love of variety effect.

Firm profits

Taking (e), we note that profit of firm i, before taking account of fixed cost, is

$$\begin{aligned}
\pi_i &= (P_i - C_i)Y_i = \frac{1}{\varepsilon - 1}C_iY_i = \frac{1}{\varepsilon - 1}C_i\overline{Y}(\frac{\frac{\varepsilon}{\varepsilon-1}C_i}{P^*})^{-\varepsilon}, \\
&= \frac{1}{\varepsilon - 1}C_i\overline{Y}P^{*\varepsilon}(\frac{\varepsilon}{\varepsilon - 1}C_i)^{-\varepsilon} = \frac{\overline{Y}}{\varepsilon}P^{*\varepsilon}(\frac{\varepsilon}{\varepsilon - 1})^{1-\varepsilon}C_i{}^{1-\varepsilon}, \qquad \text{(equation (2))} \\
&= k\overline{Y}P^{*\varepsilon}C_i{}^{1-\varepsilon},
\end{aligned}$$

where

$$k = \frac{1}{\varepsilon}(\frac{\varepsilon}{\varepsilon - 1})^{1-\varepsilon}.$$

We assume the firm's fixed costs

$$fc = F - \mu_i, \text{ where } F \geqslant 1. \tag{k}$$

μ_i is a random match quality parameter, where $0 \leqslant \mu_i \leqslant 1$ .Hence, profit after fixed cost

$$\Pi_i = k\overline{Y}P^{*\varepsilon}C_i{}^{1-\varepsilon} - F + \mu_i. \qquad \text{(l = equation (3))}$$

Where all firms have identical marginal costs

$$\begin{aligned}
\Pi_i &= kP^{*\varepsilon}\overline{C}^{1-\varepsilon} - F + \mu_i, \\
&= k\overline{Y}N^{\frac{\varepsilon}{1-\varepsilon}}(\frac{\varepsilon}{\varepsilon - 1})^{\varepsilon}\overline{C} - F + \mu_i, \\
&= \frac{\overline{Y}}{\varepsilon - 1}N^{\frac{\varepsilon}{1-\varepsilon}}\overline{C} - F + \mu_i. \qquad \text{(m)}
\end{aligned}$$

Monopolistic competition with free entry and exit and search

In the monopolistically competitive model, a firm pairing with the reservation match quality, $\mu_i = \mu_R$, will just break even after its fixed costs. Hence, in an equilibrium where all firms have the reservation match

quality,

$$\begin{aligned}
\frac{\overline{Y}}{\varepsilon-1}N^{\frac{\varepsilon}{1-\varepsilon}}\overline{C}-F+\mu_R &= 0; \\
N &= \left(\frac{(\varepsilon-1)(F-\mu_R)}{\overline{YC}}\right)^{\frac{1-\varepsilon}{\varepsilon}}. \qquad \text{(n = equation (8))}
\end{aligned}$$

Substituting into (i), we obtain P^*,

$$\begin{aligned}
P^* &= N^{\frac{1}{1-\varepsilon}}\frac{\varepsilon}{\varepsilon-1}\overline{C}, \qquad \text{(equation (7))} \\
&= \left(\frac{(\varepsilon-1)(F-\mu_R)}{\overline{YC}}\right)^{\frac{1}{\varepsilon}}\frac{\varepsilon}{\varepsilon-1}\overline{C}, \\
&= \left(\frac{\overline{Y}}{(\varepsilon-1)(F-\mu_R)}\right)^{-\frac{1}{\varepsilon}}\frac{\varepsilon}{\varepsilon-1}\overline{C}^{\frac{\varepsilon-1}{\varepsilon}}. \qquad \text{(o)}
\end{aligned}$$

Note that, in a model with constant and identical marginal cost, all firms will be of the same scale, so all will set prices and output at the level that a firm pairing with reservation match quality would set. Hence (n) and (o) describe the equilibrium with identical firms.

Another way of writing (o) is to take

$$\begin{aligned}
\pi_i &= k\overline{Y}P^{*\varepsilon}\overline{C}^{1-\varepsilon} = F-\mu_R; \\
P^* &= \left(\frac{F-\mu_R}{k\overline{YC}^{1-\varepsilon}}\right)^{\frac{1}{\varepsilon}}. \qquad \text{(p = equation (6))}
\end{aligned}$$

Higher-level demand

Consumption of the industry good, at price P^*, leads to utility of $\overline{Y}(P^*)$. This is assumed to be isoelastic, so that

$$\overline{Y} = \overline{Y}_0 P^{*-\upsilon}, \qquad \text{(q)}$$

where $\upsilon > 0$. Hence, substituting into (o),

$$
\begin{aligned}
P^* &= P^{*\frac{\upsilon}{\varepsilon}}(\frac{\overline{Y}_0}{(\varepsilon-1)(F-\mu_R)})^{-\frac{1}{\varepsilon}}\frac{\varepsilon}{\varepsilon-1}\overline{C}^{\frac{\varepsilon-1}{\varepsilon}};\\
P^{*\varepsilon-\upsilon} &= \frac{(\varepsilon-1)(F-\mu_R)}{\overline{Y}_0}(\frac{\varepsilon}{\varepsilon-1})^{\varepsilon}\overline{C}^{\varepsilon-1};\\
P^* &= (\frac{(\varepsilon-1)(F-\mu_R)}{\overline{Y}_0})^{\frac{1}{\varepsilon-\upsilon}}(\frac{\varepsilon}{\varepsilon-1})^{\frac{\varepsilon}{\varepsilon-\upsilon}}\overline{C}^{\frac{\varepsilon-1}{\varepsilon-\upsilon}}. \qquad \text{(r)}
\end{aligned}
$$

For utility to be decreasing with respect to $\overline{C}$, we need the parameter restriction that $\varepsilon > \upsilon$.

Assuming a Cobb-Douglas higher-level nesting of the economy, then, as long as the industry is 'small' in proportion to the overall economy, we can take overall national income as given, and hence assume $\upsilon = 1$. Hence, (r) becomes

$$
P^* = (\frac{(\varepsilon-1)(F-\mu_R)}{\overline{Y}_0})^{\frac{1}{\varepsilon-1}}(\frac{\varepsilon}{\varepsilon-1})^{\frac{\varepsilon}{\varepsilon-1}}\overline{C}. \qquad \text{(s)}
$$

Ranges of firm threshold prices

An existing, successfully-matched firm pairing will have a match quality $\mu_R < \mu_i < 1$. The reservation market price for a firm with match quality μ_i, P_i', is the value of P^* at which a firm with match quality μ_i will break even. From (l) this condition is

$$
\begin{aligned}
k\overline{Y}P^{*\varepsilon}{C_i}^{1-\varepsilon} - F + \mu_i &= 0; \qquad \text{(l)}\\
P' &= (\frac{F-\mu_i}{k\overline{Y}{C_i}^{1-\varepsilon}})^{\frac{1}{\varepsilon}} \qquad \text{(t)}
\end{aligned}
$$

When $\mu_i = \mu_R$, this is satisfied by P^* as calculated in the previous section. By contrast, when $\mu_i = 1$, this corresponds to

$$
P' = (\frac{F-1}{k\overline{Y}{C_i}^{1-\varepsilon}})^{\frac{1}{\varepsilon}}, \qquad \text{(u)}
$$

which is lower than P^*, firstly because $F-1 < F-\mu_R$, and also because the term on the denominator, is an increasing function of $\overline{Y}$, which should improve as P falls. The intuition is that the most efficient matched firm pairings will withdraw from the market at a lower price than the threshold for new firm entry, and this difference is greater the lower is μ_R, and hence the more heterogeneous are existing matched pairings..

We really want to substitute for k in (u) as a function of P^*. Since

$$k = \frac{1}{\varepsilon}(\frac{\varepsilon}{\varepsilon - 1})^{1-\varepsilon},$$

assuming a top-level own price elasticity of unity for the aggregate industry produce, and substituting into (t), we can write

$$\begin{aligned} P_i' &= (\frac{F-\mu_i}{kC_i^{1-\varepsilon}})^{\frac{1}{\varepsilon}} \overline{Y}_0^{-\frac{1}{\varepsilon}} P'^{\frac{1}{\varepsilon}}; \\ P_i' &= (\frac{F-\mu_i}{kC_i^{1-\varepsilon}})^{\frac{1}{\varepsilon-1}} \overline{Y}_0^{-\frac{1}{\varepsilon-1}} = (\frac{F-\mu_i}{kC_i})^{\frac{1}{\varepsilon-1}} \overline{Y}_0^{-\frac{1}{\varepsilon-1}} C_i. \end{aligned} \tag{v}$$

Hence, we have a situation where P_i' is proportional to C_i. Also note that the reservation prices for market withdrawal when $\mu_i = \mu_R$ and $\mu_i = 1$, in the case where marginal cost, $C_i = \overline{C}$ are

$$\begin{aligned} P^* &= (\frac{F-\mu_R}{kC_i})^{\frac{1}{\varepsilon-1}} \overline{Y}_0^{-\frac{1}{\varepsilon-1}} \overline{C}; \\ P^{'} &= (\frac{F-1}{kC_i})^{\frac{1}{\varepsilon-1}} \overline{Y}_0^{-\frac{1}{\varepsilon-1}} \overline{C}; \\ \frac{P^{'}}{P^*} &= (\frac{F-1}{F-\mu_R})^{\frac{1}{\varepsilon-1}}. \end{aligned} \tag{w}$$

The model with alternative supply sources

Phase 1 pre-globalisation: We start assuming the only pairings available are NN, who supply at a combined cost of $\overline{C} = 1$. Consequently, the entry price is given by substitution into equation (s):

$$P_1^* = ((\varepsilon - 1)(F - \mu_R))^{\frac{1}{\varepsilon-1}} (\frac{\varepsilon}{\varepsilon - 1})^{\frac{\varepsilon}{\varepsilon-1}}. \qquad \text{(s = equation (9))}$$

Phase 2 globalisation: SN pairings are now available, at a marginal supply cost of $\overline{C}_S$ (< 1). This means they will enter at any aggregate price greater than P_2^*, where

$$P_2^* = ((\varepsilon - 1)(F - \mu_R))^{\frac{1}{\varepsilon-1}} (\frac{\varepsilon}{\varepsilon - 1})^{\frac{\varepsilon}{\varepsilon-1}} \overline{C}_S = P_1^* \overline{C}_S. \qquad \text{(x = equation (11))}$$

The price at which a given NN pairing of quality $\mu_i > \mu_R$ will withdraw from the market is given by

$$\frac{P'_{i1}}{P^*_1} = (\frac{F-\mu_i}{F-\mu_R})^{\frac{1}{\varepsilon-1}}, \qquad \text{(y = equation (12))}$$

so that at price P^*_2, the critical match quality at which existing matched NN pairings which will withdraw is

$$\begin{aligned} \mu_i &= F - (\frac{P^*_2}{P^*_1})^{\varepsilon-1}(F-\mu_R) = (1-\overline{C}_2^{\varepsilon-1})F + \overline{C}_S^{\varepsilon-1}\mu_R; \\ \mu_i - \mu_R &= (1-\overline{C}_S^{\varepsilon-1})(F-\mu_R). \end{aligned}$$

at which price the proportion of firms which will continue in the market is

$$\begin{aligned} \sigma_{N2} &= \frac{1-\mu_i}{1-\mu_R} = 1 - \frac{\mu_i-\mu_R}{1-\mu_R}, \\ &= 1 - \frac{(1-\overline{C}_S^{\varepsilon-1})(F-\mu_R)}{1-\mu_R}. \qquad \text{(z = equation (13))} \end{aligned}$$

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