MULTIMARKET AND MULTIPROJECT COLLUSION***
WHY EUROPEAN INTEGRATION MAY REDUCE INTRA-COMMUNITY
COMPETITION

BY

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1 INTRODUCTION

European integration is expected to increase competition in the European markets. The common argument is that the White Paper's (CEC, 1985) reduction of trade barriers (physical, technical and fiscal) will intensify rivalry (Emerson et al., 1988) through two routes. The first (short-run) route involves increased potential competition and actual entry as a result of reduced barriers. The second (long-run) route implies increased cost efficiency after a process of rationalization so as to exploit scale economies. Both routes are assumed to be to the Community's benefit as cost and price levels may fall.1 This conclusion is reflected in, for instance, Schmitt's (1990) and Winters' (1991) recent overviews of the literature. This paper argues, however, that European integration may achieve the opposite for two, closely related, reasons.

Firstly, European firms may start to collude EC-wide, rather than on a per country basis. The multimarket collusion theory underlines this conjecture.2 Tacit collusion is usually related to internal conditions in a market. For instance, in a market with a small number of incumbent firms each firm recognizes that its actions induce reactions by rivals. Fear for retaliation facilitates tacit collusion which, for example, raises prices. Many firms, however, are multimarket firms.

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1 The literature discusses a third effect of European integration: changes in the number of product varieties offered. In this respect mutations may move both ways, depending on industry specifics (for example, the magnitude of post-integration demand differences across member states compared with the pre-integration situation). This paper has nothing to say on this issue.
2 Multimarket collusion theory is part of the broader theory of multimarket competition (Bulow et al., 1985; Van Witteloostuijn and Van Wegber, 1992; and Van Witteloostuijn, 1993). An application of multimarket competition theory to European integration can be found in Van Witteloostuijn and Van Wegber (1991).

Mutual awareness and collusion may spill over to the other markets where they meet. This is the core idea of the multimarket collusion theory, which goes by names such as mutual forbearance (Feinberg, 1985), spheres-of-influence (Scherer, 1980, pp. 340–342), and live-and-let-live philosophy (Kantarelis and Veendorp, 1988). Thus far the theory has only been tested on US data. We raise the issues for European integration. European integration will increase multimarket contact, which, according to the multimarket collusion theory, may induce decreasing competition! This controversial prediction warrants an interesting theme in this theory.

Secondly, the collusive nature of European product markets is facilitated by the increased incidence of cooperative R&D projects. For example, the 1980s witnessed a considerable increase in the number of private (that is, non-subsidized) technology alliances (Hagedoorn and Schakenraad, 1993). In addition, the number of cooperative R&D projects financed by the EC skyrocketed in the second half of the 1980s (Roscam Abbing and Schakenraad, 1991). This means that firms not only face increasing multimarket contacts, but are also increasingly engaged in multiproject encounters. This second trend fortifies the movement toward EC-wide collusive arrangements, which is a further argument in favour of the observation that European integration may decrease, rather than increase, competition.

To sum up: the effects of European integration come in three steps. The first-order effect is increased competition through potential rivalry and actual entry after lowering trade barriers. This is well-documented in the literature. The second-order effect – rationalization – can go both ways: on the one hand, increased cost efficiency may bolster price competition; on the other hand, increased concentration facilitates oligopolistic interaction. The third-order effect is decreased competition through multicontact collusion. This paper emphasizes the role of the third-order effect. In fact, the argument is that the second-order effect facilitates the sustainability of Community-wide collusive arrangements through oligopolistic behaviour in concentrated markets. Here the paper focuses on the interaction between joint R&D projects (in many cases EC supported) and product market conduct, and the intermediating role of the degree of concentration. So, the empirical question (and theoretical argument) really involve(s) the relative importance of the first-, second- and third-order effects. All this is not to say that the European Commission is unaware of the countervailing forces that derive from the trends toward increasing concentration and cooperation in Europe's product markets. Their awareness is manifest in the Commission's attempts to intensify anti-competition policies at the EC-level. However, not only is the implementation of a tougher antitrust policy in the EC a difficult task to accomplish (The Economist, June 8, 1991, pp. 15–16), but also this policy may contradict with the Commission's intentions to stimulate European R&D (Jacquemin, 1988).

So, the purpose of this paper is to counterargue the familiar prediction that
European integration will intensify competition. This is not to say that we assume that this prediction is fully beside the mark. However, a well-balanced judgment of the expected impact of European integration requires an investigation of forces pointing in either direction. By and large, the literature reflects a bias (exceptions are discussed in due course): the arguments presented are mainly in favour of predicting increased competition after the effectuation of the White Paper's 1992 programme. This paper seeks to correct this bias by admittingly overemphasizing counterarguments. Which prediction is closest to the truth, is largely an empirical question. However, this paper offers hypotheses, complementing the ones that dominate the current literature, which may be helpful in guiding future research into the effects of European integration on competition. A simple model is introduced to highlight the rationale of these hypotheses. A review of empirical work done in the Maastricht Economic Research Institute on Innovation and Technology (MERIT) and elsewhere presents data that underlie our conjectures. Since the aim of the paper is to guide future research, we do not claim to present clearcut evidence.

Section 2 reviews the literature on (multicontact) collusion from varying perspectives. First the theoretical results are summarized in propositions, and then, the major empirical results, if present, are listed. The review focuses on contributions from the literature on international trade, multimarket contact and joint R&D projects. The model in section 3 aims to illustrate the extension of multimarket collusio theory in the case where firms meet in joint R&D projects as well as in product markets. We derive three propositions which permit the theory to be applied to the case of European integration, which is subsequently done in Section 4. Section 4 identifies types of (product market and joint R&D) contact which may increase by European integration. Section 5 discusses the policy trade-offs the European Commission is facing, and offers an appraisal. Note in advance that the contribution in this paper is not so much the development of sophisticated new theoretical models or empirical tests, but rather the presentation of a thought experiment in the form of (i) reviewing three strands of literature, (ii) developing a preliminary model that integrates arguments from these bodies of literature and (iii) applying the propositions from the review and model to the case of European integration. This means that this paper is akin to an integrative review article.

2 LITERATURE ON MULTICONTEXT COLLUSION

2.1 Three Streams
Edwards (1955, p. 335) first discussed multimarket collusion: 'The interests of great enterprises are likely to touch at many points, and it would be possible for each to mobilize at any one of these points a considerable aggregate of resources. The anticipated gain to such a concern from unmitigated competitive attack upon another large enterprise at any point of contact is likely to be slight as compared
with the possible loss from retaliatory action by that enterprise at many other points of contact. ... Hence there is an incentive to live and let live, to cultivate a cooperative spirit, and to recognize priorities of interest in the hope of reciprocal recognition.' It is, ironically, the great competitive strength of conglomerate (large and diversified) firms, plus their awareness of this, which prompts tacit collusion. Edwards (1955) goes on to argue that contact can arise in multiple fields: regional markets, product markets, vertical stages of production, and technological partnerships.

Edwards' views received attention in the United States, especially because of their consequences for antitrust policy (Solomon, 1970; Adams, 1974; and Areeda and Turner, 1979). Conglomerate mergers should be opposed if they increase multimarket contact, even if the merger per se does not change the market power in a local market (Solomon, 1970, pp. 333–334). Recent theoretical contributions which, more or less explicitly, deal with the issues raised by Edwards (1955) are found in the literature on international trade (subsection 2.2), multimarket contact (subsection 2.3) and joint R&D projects (subsection 2.4). Although each literature contributes significantly to our understanding of multicontact collusion, application to the process of European integration requires painting a fuller picture (subsection 2.5). Note that applications in the literature to European integration with a multimarket flavour are discussed in more detail in section 4.

2.2 International Trade

Recent literature on international trade emphasizes the role of imperfect competition in general and oligopolistic interaction in particular (Krugman, 1989). The key argument is that intra-industry (and, for that matter, inter-country) trade can be explained, in a setting where all firms are equal, by pointing to strategic imperfect competition. For example, the arguments on reciprocal dumping are a case in point (Brander and Krugman, 1983; Pinto, 1986; Calem, 1988; and Van Wegberg and Van Witteloostuijn, 1992). Jacquemin (1989) and Venable (1990), for example, raise this issue in the context of European integration. Following the literature on industrial organization, this line of argument naturally extends to the issue of collusion (Jacquemin and Slade, 1989). The key point is that reciprocal dumping may be the outcome of a prisoner's dilemma: only if both parties can agree to refrain from dumping, is joint profit maximized (Pinto, 1986). Three contributions to the international trade literature explicitly deal with the question of (implicit) collusion: Davidson (1984), Pinto (1986), and Rotemberg and Saloner (1989). The three models are briefly discussed in turn.

Davidson (1984) deals with the case where an importing country may impose tariffs on the foreign firms in order to enhance domestic welfare. The government has to take account of the effect of a tariff policy on the sustainability of collusive arrangements, particularly cartels. Collusion is associated with low quantities and high prices in the importing country. If both domestic and foreign firms meet
in an infinitely repeated game in quantities (standard n-firm Cournot with segmented markets, perfect substitutes and constant returns to scale), the result is that "small" tariffs lead to an industry structure more conducive to collusion while "large" tariffs make cartels less stable (Davidson, 1984, p. 219). With small tariffs there is much to gain from collusion (Davidson, 1984, p. 220). An important assumption in Davidson's (1984) model is that entry (export) is one-sided: the domestic firms are not exporting into the foreign firms' home market.

Pinto (1986) analyzes a repeated game version of Brander and Krugman's (1983) reciprocal dumping model. The model is standard Cournot (segmented markets, perfect substitutes and constant returns to scale), with two firms having a home base in two different countries. The model deviates on two dimensions from Davidson (1984): competition is duopoly, and export can be two-sided. Not surprisingly, the result is that in a Cournot supergame context joint maximization (that is, implicit collusion) is a possible equilibrium outcome of a repeated prisoner's dilemma. The selected equilibrium critically depends on the (in)finite nature of the horizon, the size of the discount rate and the level of transportation (or, for that matter, exporting) costs. This result is in accordance with the Folk Theorem (Tirole, 1988). To be precise, infinite repetition, a low discount rate and high transportation costs facilitate (implicit) collusion, where both firms decide not to export and stay domestic.

Rotemberg and Saloner (1989) compare the effect of tariffs and quotas on limiting collusive conduct in an importing country where one domestic and one foreign firm are engaged in standard Bertrand competition (implying segmented markets, perfect substitutes and constant returns to scale) with one-sided export. So, the setting resembles Davidson (1984), apart from the Bertrand duopoly nature of competition. Again, (implicit) collusion is associated with low quantities and high prices (the monopoly outcome). The result is that a single domestic producer facing a single foreign firm acts more competitively with quotas than with tariffs. If Cournot rather than Bertrand rivalry is assumed, larger quotas actually enhance collusion. This result is in line with Davidson (1984), though in a different setting (quotas rather than tariffs).

The main results of the international trade literature, keeping the imposed assumptions in mind, can be summarized in a proposition.

**PROPOSITION 1.** In a two-country setting (implicit) collusion is facilitated by (A) infinite repetition in conjunction with low discount rates, and (B) 'small' tariffs, 'large' quotas and large exporting costs with Cournot competition.

Proposition 1A is the standard supergame result, whereas proposition 1B introduces international trade specifics. Note that the nature of collusion in Davidson (1984) and Rotemberg and Saloner (1989) on the one hand and Pinto (1986) on the other is different, which is due to the assumptions of one-sided versus
two-sided export, respectively: the former take collusion to be reflected in monopoly-like conduct by two firms in the domestic market, whereas in the latter collusion appears as a true monopoly in both markets as the result of the absence of trade.

The essential feature of international trade is that competition is usually not restricted to a single market, however. The current state of the art in the international trade literature, apart from Pinto (1986), ignores the impact of multimarket contact on the sustainability of (implicit) collusion. The key mechanism driving the results are conversely repeated contacts over time in the context of supergames, rather than simultaneous contacts in time over markets. Although the repetition argument is important, the influence of multimarket contact deserves further attention. Subsection 2.3 reviews the multimarket contact literature. Moreover, the argument is restricted to product market competition and collusion. Although attention to, for example, R&D rivalry is not absent (Spencer and Brander, 1983; and Reitzes, 1991), the issue of international R&D cooperation is not modelled in the international trade literature. Subsection 2.4 therefore summarizes the literature on joint R&D projects.

### 2.3 Multimarket Contact

The literature on multimarket contact consists of two types. The theoretical models study conditions that facilitate multimarket collusion (Feinberg, 1984; Harrington, 1987; Kantarelis and Veendorp, 1988; Bernheim and Whinston, 1990; Fung, 1991; and Kesteloot, 1992). The key argument is that punishment opportunities and profit potentials in a number of markets induce sustainability of collusive arrangements in cases where cooperation could not be obtained otherwise. The empirical studies test the hypothesis that multimarket contact facilitates collusive conduct (Heggestad and Rhoades, 1979; Scott, 1982, 1991; Alexander, 1985; Rhoades and Heggestad, 1985; Feinberg, 1985; Feinberg and Sherman, 1985, 1988; and Gelfand and Spiller, 1987). By and large the hypothesis is supported, particularly for concentrated industries. Both strands of literature are discussed in turn. For the sake of brevity, only the main results are discussed. For details we refer to a recent and representative contribution in each strand (Bernheim and Whinston (1990) and Scott (1991), respectively).

Bernheim and Whinston (1990) model the credibility of multimarket collusion in a repeated game framework. They show that in the case of symmetry of firms and markets multimarket collusion does not arise. The argument is that 'once a firm knows that it will be punished in every market, if it decides to cheat, it will do so in every market. This observation raises the possibility that increasing the number of markets over which firms have contact may simply proportionately raise the costs and benefits of an optimal deviation' (Bernheim and Whinston, 1990, p. 3). Thus only in the case of asymmetry multimarket collusion may arise in situations where, in its absence, single-market collusion would not occur (that is, the supergame mechanism alone does not suffice to sustain
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Single-market collusion. Bernheim and Whinston’s argument confirms economist’s intuition.\(^3\) Asymmetry may be due to, for example, different production costs. Symmetric advantages are a specific case, where each firm is most efficient in one particular product market. In the case of cost differences, the firms collude by establishing spheres-of-influence. For instance, in the case of symmetric advantages, they shift sales toward the more efficient firm in each market (Bernheim and Whinston, 1990, p. 13).

The models of Feinberg (1984), Harrington (1987), Kantarelis and Veendorp (1988), and Kesteloot (1992) support Bernheim and Whinston’s arguments. Firstly, Feinberg (1984) argues that each firm reacts to a competitor’s output expansion by increasing its own output levels in both the affected market as well as in any other market where both firms compete. Each firm anticipates this aggressive behaviour by means of intra- and cross-market conjectural variations. Feinberg shows in the two-market case that even if firms behave as standard Cournot duopolists, ‘an expectation of retaliation in market 2 is sufficient to induce restraint on the part of the two firms such that the monopoly level of output can be reached’ (Feinberg, 1984, p. 246). The more aggressive the cross-market reactions (i.e., the higher the cross-market conjectural variations), the more collusive the outcomes (i.e., the higher the profit margins). Secondly, Harrington (1987, p. 2) argues that firms can sustain the cooperative equilibrium in a finite horizon game by ‘export[ing] collusion from one market to another when the cooperative outcome could not be achieved otherwise.’ Thirdly, Kantarelis and Veendorp (1988) is a dynamic counterpart of Feinberg (1984). In their model a demand shock may induce a firm to expand output in a market in order to enhance profitability (‘live’ constraint). In order to alleviate the adverse effect on its competitor the first firm may then contract its output in the other market (‘let live’ constraint). In doing so, firms may manage to approach the joint maximization outcome. Finally, Kesteloot (1992) shows that introducing multimarket spillovers, particularly demand or cost linkages between markets, in Bernheim and Whinston’s (1990) framework does matter. For example, her model reveals that interfirm scope advantages facilitate tacit cooperation. Her conclusion is that ‘in order for Bernheim and Whinston (1990) to obtain the irrelevance result: multimarket contact will not affect cooperative

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3 The intuition in the strategic management literature on multimarket competition is that asymmetries offer scope for retaliation. Karnani and Wernerfelt (1985, p. 87) summarize this point by arguing that ‘[t]he underlying principle is: attack your competitor’s profit producer with your loser. By forcing your competitor to overinvest in his profit producer and underinvest in his high potential “question mark,” you are able to gain a major advantage in a high-growth market.’

4 Although Feinberg’s (1984) model is symmetric, his review of unpublished literature acknowledges asymmetry: ‘reactions in secondary markets may often be seen as a more credible threat than direct retaliation against rivals; intuitively, price-reducing threats by a firm across markets may be seen as less costly (hence more credible), as they put only a fraction of that firm’s own sales at jeopardy’ (Feinberg, 1984, p. 244).
opportunities if additionally there are no joint (dis)economies, due to demand (or cost) linkages between markets’ (Kesteloot, 1992, pp. 261–262).

Empirical multimarket contact research seeks to verify the prediction that multimarket contact facilitates collusive conduct. The evidence supports, though inconclusive, the multimarket hypothesis. Broadly speaking, the studies correlate a proxy of the intensity of multimarket contact with data on conduct (market share or profitability). An early example is Heggestad and Rhoades’ (1978) study of the US banking industry in 1966–1972. All but one study find a significant multimarket contact effect, the exception being Alexander’s (1985) study of the market for short-term business loans in 69 local American banking regions in 1975. His explanation is that banks in the short-term business loans markets were subject to outside competition. The banks may have practised a limit pricing strategy, thus forgoing profits (Alexander, 1985, p. 138). This explanation is consistent with the fact that all studies, apart from Scott (1991), are US based with data from the 1960s and 1970s. These markets may not have been subject to foreign, i.e. European and Asian, import competition.

Four studies suggest that verification occurs in conjunction with intermediate concentration (Alexander, 1985) or high concentration (Scott, 1982, 1991; and Feinberg, 1985). On the one hand, Alexander (1985, pp. 131 and 135) argues that concentration should neither be low (because too much competition suppresses collusion) nor high (for in that case tacit collusion occurs in the market anyway) if multimarket collusion is to be facilitated in 69 local US banking markets for demand deposits in 1975. On the other hand, an overall positive correlation between multimarket collusion and concentration appears to hold for 437 firms among the largest 1000 US manufacturers in 1974 (Scott, 1982) and 391 firms in US manufacturing in 1976 (Feinberg, 1985). Scott (1991) re-examines Bain’s (1956) sample of firms to support his hypothesis that ‘Bain’s effect – of concentration, with barriers to entry, on profits – resulted because of multimarket contact among the firms in his sample’ (Scott, 1991, p. 228). The results are confirmed for an expanded sample of US manufacturing firms in 35 industries. The argument is that increased awareness of oligopolistic interdependence and larger probability of detection in a multimarket setting explain this result.

5 One can raise doubts on the methods used. For example, Heggestad and Rhoades (1978) indicate collusion by the stability of dominant firms’ market shares. The price-cost margin seems to be a better dependent variable to indicate collusion (Feinberg, 1985). As a proxy for the degree of multimarket contact, Heggestad and Rhoades (1978) use the number of contacts, i.e., markets where two firms meet. Other authors employ more sophisticated methods. Scott (1982, 1991) uses as a proxy the number of contacts going beyond a random number of contacts; Feinberg (1985) weights contacts by the sales level in the markets where retaliation may occur (‘sales-at-risk’).

6 The theoretical literature does not explore the effect of outsiders by simply ignoring their influence. This implies the assumption that multimarket firms compete or collude in markets where entry by outsiders is blocked (Bernheim and Whinston, 1990, p. 48).

7 Following Bernheim and Whinston (1990), asymmetry may also have had an effect upon the degree of multimarket collusion.
The main results of the theoretical and empirical studies of multimarket contact can, by and large, be summarized in a proposition, again keeping the imposed assumptions in mind.

PROPOSITION 2. If internal conditions alone fail to sustain cooperative conduct, multimarket contact facilitates collusion in markets where (A) firms and/or markets are asymmetric, (B) protection against outside competition is significant, and (C) concentration is intermediate or high.

The key point is that the multimarket contact studies complement the literature on single-market collusion by arguing that firms meeting in many markets can benefit from additional instruments to punish (and detect) firms defecting from the cooperative outcome. That is, apart from the well-documented internal market conditions (such as high concentration, infinite horizons and easy detection), multimarket contacts facilitate the sustainability of cooperative outcomes. Note, moreover, that proposition 1B may be interpreted as a specific case of proposition 2A, since tariffs, quotas and exporting costs introduce an asymmetry in favour of domestic firms (though tariffs and quotas are as yet largely analyzed in a setting with one-sided export).

The literature on multimarket contact recognizes the fact that both product and nonproduct market meetings can increase the sustainability of collusive arrangements. This is, for example, clear from Edwards' (1955, p. 344) original formulation: 'technological partnerships tend to grow into complex systems of mutual accommodation among large business enterprises, within which the permissible sphere of activity of each enterprise is defined with ever-increasing precision as one agreement after another establishes a boundary, or a mutually satisfactory joint occupancy, between that enterprise and some other enterprise with reference to additional products and additional markets.' However, the theoretical models and empirical studies in the multimarket contact literature focus on product market meetings and collusion in particular. Subsection 2.4 reviews the literature on an important instance of contacts outside the product markets which relates to Edwards' reference to technological partnerships: joint R&D projects.

2.4 Joint R&D Projects

The issue of joint R&D is in the current context interesting for at least two reasons: firstly, joint R&D is an important type of contact; and, secondly, R&D (and its output, innovation) is central in the discussion of the welfare features of economies in general and European integration in particular (section 4).8 The
economic literature on joint R&D activity, particularly from a theoretical perspective, is starting to be developed (Jorde and Teece, 1990, p. 79). Much of the existing literature is inspired by perspectives from, for instance, organization studies or strategic management. The literature on the internal processes of innovation (Jorde and Teece, 1990) and the (dis)advantages of cooperative strategies (Contractor and Lorange, 1988) are worth mentioning. A number of contributions to the economic theory of joint R&D activity are Ordover and Willig (1985), Grossman and Shapiro (1986), Katz (1986), D’Aspremont and Jacquemin (1988), Wu and DeBondt (1991), Baumol (1992) and Bhattacharya, Glazer and Sappington (1992). Jacquemin (1988) raises the issue in the context of European integration. The discussion in this paper is largely restricted to these contributions. For the sake of brevity, Katz’ (1986) analysis is taken as the point of departure.

Katz (1986) studies R&D cost sharing and cooperation in joint R&D projects. Firms in an industry may (or may not) choose to take part in the joint project. Cost sharing means that each firm has its R&D activity subsidized by the partners in the joint project. Crucial determinants of the incentives to cooperate are the size of inter-firm R&D spillovers (pre-introduction rivalry) and the nature of product market conduct (post-introduction competition). On the one hand, cooperation implies that the outcome of R&D spills over to the partners. R&D is a joint good, so that partners have the opportunity to free-ride by under-investing in R&D and benefiting from the partners’ activities. To counter this incentive to underinvest the cost-sharing rule provides an overinvestment incentive, as partners subsidize part of a firm’s R&D effort. On the other hand, the incentive to join an R&D project decreases with the intensity of product market rivalry. The end result is that both R&D cooperation by firms not competing in the product market and cooperation in basic research with significant R&D spillovers raise the effective R&D level, which in turn increases welfare; conversely, both R&D cooperation by competitors in the product market and R&D cooperation in development activities with insignificant R&D spillovers lower effective R&D and welfare.

The arguments of Ordover and Willig (1985) and D’Aspremont and Jacquemin (1988) confirm Katz’ (1986) results in a duopoly context, whereas Wu and De Bondt (1991) analyze R&D cartel stability in an n-firm context. Moreover, Ordover and Willig (1985), Grossman and Shapiro (1986), Jorde and Teece (1990), and Baumol (1992) apply the literature’s reasoning to assess guidelines for (American) antitrust policy. By and large, their argument is that increased willingness to permit firms to engage in joint R&D projects is to be advised, conditional upon an evaluation of both key determinants of R&D incentives (pre- and post-introduction rivalry) and their impact on welfare. For example,
Grossman and Shapiro (1986, pp. 333–334) argue that 'the first step requires definition of the relevant research and product markets, and assessment of the market power of the venture participants in these markets. Any bona fide research joint venture among firms having little or no power in either market should be promptly approved. If the parents to the proposed venture do have significant power in either the upstream, research market, or the downstream, product market, then the second step in our procedure is invoked. ... When appropriability problems are substantial, as they are likely to be for basic research activities ... the venture should be sanctioned.'

Bhattacharya, Glazer and Sappington (1992) argue that the negative incentive to join R&D efforts from intense post-introduction competition in the product market can be neutralized by imposing specific licensing arrangements. Their model is a three-staged game: the focus is on designing licensing mechanisms that credibly induce firms to share R&D-related knowledge in the first stage, being followed by noncooperative R&D behaviour in the second stage and Bertrand competition in the product market in the third stage. The result is that licensing mechanisms which lower the intensity of post-introduction rivalry – either by controlling entry into the R&D race or by making licensing fees contingent upon realized product market profit – prove to be able to stimulate information sharing. Put this way, the results of Bhattacharya, Glazer and Sappington (1992) are in accordance with earlier contributions to the joint R&D literature.

The main results of the literature on the economic theory of joint R&D projects is summarized in proposition 3 (with the usual disclaimer involving the assumptions imposed).

PROPOSITION 3. Joint R&D projects are facilitated by (A) large inter-firm R&D spillovers (a high intensity of pre-introduction rivalry), and (B) imperfectly competitive product market conduct (a low intensity of post-introduction competition).

So, the sustainability of joint R&D projects is promoted by imperfectly competitive conduct in the product market. This observation provides a link to the literature on collusion in international trade and multimarket contact. However, as yet literature has not explored this connection. To be precise, apart from Bhattacharya, Glazer and Sappington (1992) the models take the intensity of product market rivalry to be exogenous, and all models ignore the impact of multimarket contacts. Subsection 2.5 introduces, though in a preliminary way, prominent elements feeding the connection between the three streams of literature.

2.5 Multidimensional Contact
The literature on international trade, multimarket contact and joint R&D projects is clearly complementary. A brief characterization of the contribution of the three streams of literature will illustrate this.
(1) The international trade literature studies the effect of changes in trade conditions – particularly infinite repetition, discount rates, transportation costs, quotas and tariffs – to the sustainability of collusive conduct and the latter’s impact on welfare (proposition 1). The models ignore the influence of horizontal multImarket contacts, in product markets, and vertical multiproject encounters, in joint R&D projects.

(2) The multImarket contact literature studies the impact of multImarket encounters on collusive conduct, and traces conditions facilitating multImarket collusion – firms’ and markets’ asymmetry, concentration and outside protection (proposition 2). The literature does not, however, explicitly model the particulars of multicity (international trade) and multiproject (joint R&D) contacts.

(3) The literature on joint R&D projects focuses on the incentives for and welfare implications of joint R&D ventures. Two key determinants are identified – pre-introduction rivalry (inter-firm R&D spillovers) and post-introduction competition (imperfectly competitive conduct in product markets) (proposition 3). The models, however, take no notice of the specifics of international trade and multImarket contact.

A common denominator of the three bodies of literature is the emphasis on the positive impact of the multiplication of the number of contact points – either in periods, markets or projects – on the incentives to collude. Firms meeting in many periods, markets and/or projects recognize their increased interdependencies: both the payoff of collusion and the potential of punishment is increased.

A combination of the three contributions can be usefully applied to the process of European integration: European integration is associated with reducing barriers to intra-Community trade (1), so increasing the number of multImarket contacts (2), and stimulating joint R&D projects (3). More on the application to European integration is included in section 4. First section 3 offers a preliminary model that explores elements of the connection between the three types of literature: the interaction between multImarket contacts (in product markets) and multiproject encounters (in joint R&D projects) in a multi-period context.

3 MODEL OF COLLUSION

3.1 Multiperiod, Multimarket and Multiproject Contacts

The sustainability of collusive arrangements can be facilitated by an increased number of contacts. Increased contact may occur through three avenues. Firstly, in the well-documented supergames arguments multiperiod contacts increase the sustainability of collusion. Secondly, the theoretical and empirical literature on multimarket contact have explored the case of firms which, by meeting in several product markets, are able to sustain multImarket collusion where single-market cooperation would fail. Thirdly, as noted in subsection 2.3, the original dis-
cussion by Edwards (1955) and Adams (1974) suggests that any form of contact may induce collusion. Firms compete in product markets, but also in input markets. In fact, they may cooperate in developing technology (Edwards, 1955, p. 344). To be precise, Edwards suggests that R&D cooperation may spill over to the product market. This argument is consistent with the multimarket collusion thesis, if we widen its scope to a multicontact collusion theory which includes multiproject encounters. A joint R&D project provides firms with a contact point. This facilitates collusion by offering firms an additional means of retaliating defection. This section investigates the implications of an increased number of contacts along those three lines – multiperiod, multimarket and multiproject – for competition and collusion.

The key argument is that the first-, second- and third-order effects of European integration on competition are interconnected. To facilitate exploring these interconnections, this section presents an illustrative model. For the sake of convenience, the model is kept simple. Although the model elements are coupled loosely, the model suffices to reveal the economic intuitions relevant in the current context. Moreover, the analysis focuses primarily on the duopoly case, although remarks on the n-firm setting (n > 1, where n denotes the number of firms) are included when convenient. The model is used to derive three propositions, which partly restate Propositions 1 to 3 in terms applicable to European integration. We use the model to suggest rather than to prove the propositions. Moreover, the model does not imply the claim that an institutionally correct description of a real-world market is pictured. To be precise, the model is limited to exploring four issues: firstly, subsection 3.2 links product market competition to R&D motives; secondly, subsection 3.3 indicates the crucial role of product market collusion; thirdly, subsection 3.4 applies the multicontact argument to multiproject encounters in joint R&D ventures; and fourthly, subsection 3.5 briefly goes into the influence of outside (that is, non-European) competition. Section 3 is concluded subsection 3.6, which points to policy trade-offs.

3.2 Product Market Competition and R&D Motives

There are two firms, 1 and 2. For the sake of convenience, assume that a new product market is opened in period 1. An alternative interpretation, not explicitly explored here, is that in period 1 a cost-reducing innovation is introduced. For simplicity reasons, inter-firm R&D spillovers are not included in the model (proposition 3A). Demand evolves through time t, such that the monopoly profit \( \pi^M_t \) changes with a constant factor \( g (> -1) \). So,

\[
\pi^M_t = \pi^M_{t-1}/(1 + g),
\]

(1)

where \( t > 1 \) and \( \pi^M_t \) is the first-period profit (a positive number). Note that \( g > 0 \) indicates a declining market, whereas \( g < 0 \) represents growing demand.

Entry by a firm requires a fixed R&D outlay \( F (> 0) \) in period 0. There is no
technical uncertainty. The firms are identical. Their products are perfect substitutes. Firms have unit costs, and face no capacity constraints. Payoffs are as follows. If one firm enters the product market, it earns the monopoly profit \( \pi^M \). The present value \( P \) of the flow of profits in period 0 equals

\[
P^M = \alpha \cdot \left( \pi^M / (1 + r) \right),
\]

(2)

where \( \alpha = [(1 + r)(1 + g)] / ((1 + r)(1 + g) - 1) \). If \( r > 0 \) and \( g > 0 \) (that is, \( (1 + r)(1 + g) > 1 \)), then \( \alpha / (1 + r) > 0 \). Innovation is feasible if the net profit is positive. That is,

\[
P^M - F > 0.
\]

(3)

If two firms enter, competition can be of two types: the firms compete either in prices (Bertrand) or in quantities (Cournot). With Bertrand competition each firm is willing to slightly underprice the competitor, thus capturing the entire market while forgoing a small profit margin. Consumers switch to the lowest-priced supplier. In case of a tie (equal prices), they buy from the suppliers on a fifty-fifty basis. Anticipating this, each firm realizes that the unique equilibrium prices are equal to the unit (marginal) costs. This is standard Bertrand competition. Thus their gross profits are zero. The present value, \( P^B \) (\( B \) for Bertrand competition), likewise equals zero. With Cournot competition the standard duopoly outcome \( P^C \) is attained, implying that \( P^R = 0 < P^C < P^M \). Table 1 shows the payoff matrix with net profits \( P^R \), where \( R = B \) indicates Bertrand and \( R = C \) Cournot.

### TABLE 1 - PAYOFF MATRIX OF A SIMULTANEOUS R&D GAME

<table>
<thead>
<tr>
<th>Firm 1</th>
<th>Innovate</th>
<th>Do not innovate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovate</td>
<td>( (P^R - F, P^R - F) )</td>
<td>( (P^M - F, 0) )</td>
</tr>
<tr>
<td>Do not innovate</td>
<td>( (0, P^M - F) )</td>
<td>( (P^R, P^R) )</td>
</tr>
</tbody>
</table>

Sc., post-introduction rivalry in the product market is associated with a Chicken game for \( P^M > F \) and \( P^R = P^B = 0 \) (Bertrand competition) or \( P^C - F < 0 < P^R = P^C < P^M - F \) (Cournot rivalry), implying that only a monopoly can innovate profitably (condition (3)): one firm can make profits \( P^M - F > 0 \), but two firms cannot \( P^R - F < 0 \). For the sake of brevity, except if indicated otherwise, we start from the Bertrand case. This means that – in line with, for example, Rotemberg and Saloner (1989) – defection from the cooperative outcome in a period \( t \) by firm \( i \) can be punished by firm \( j \) (\( i \neq j \)), where
by returning to the noncooperative Bertrand-Nash equilibrium in all
periods \( t \geq x \) (\( x > 0 \)). Note that the argument can be easily extended to the \( n \)-firm
case: then \( P^B - F < 0 \) for any \( n > 1 \).

There are two Nash equilibria in pure strategies, where one firm enters
the product market whilst the other does not. Thus a unique equilibrium outcome
does not exist. A supply coordination failure may arise (Smith, 1981, p. 3) if both
firms innovate or both rivals fail to do so. As we will see, this failure induces
private or public coordination of the R&D effort. In the absence of coordination
two noncooperative solutions exist. One is the maximin solution, which implies
that each firm acts on the basis of a worst case scenario (Sherman and Willett,
1967). Each firm, fearing that its rival will innovate, decides not to innovate. As
a result, the new product market is not served. Both firms forgo the profit
opportunity offered by the new product market.

A second solution to the coordination problem is a mixed equilibrium (Nti,
1989). In the mixed equilibrium, each firm randomizes its strategy such that the
other firm is indifferent about entry (that is, innovation). As a result the expected
payoff is zero. Each firm decides to enter with a probability \( (P^M - F)/P^M \) and
to stay out with probability \( F/P^M \). In this equilibrium there is a positive probabil-
ity that no firm innovates, that either firm innovates, or that both rivals innovate.
The firms (optimally) anticipate the possibility of a supply coordination failure.
Both the maximin solution and the mixed equilibrium imply zero (expected) net
profits. This is the noncooperative outcome. These results are in line with the
well-documented literature on R&D rivalry, provided that a priori first-mover
advantages are absent and innovation, if introduced by both firms, cannot be
monopolized (Reinganum, 1989). Equivalently, equations (1)–(3) link product
market competition and R&D motives in accordance with the literature on joint
R&D projects (subsection 2.4, proposition 3B). Although the model is simple
and ignores numerous aspects of innovation (such as uncertain outcomes), it
does bring out one genuine problem: the firms are unable to prevent a supply
coordination failure if they act noncooperatively. Next, we turn to cooperation.

3.3 R&D Cooperation and Product Market Collusion

For one, and ignoring other motives (Jorde and Teece, 1990), R&D cooperation
is a form of cost sharing. Cost sharing alone, however, does not solve the above
coordination problem. Say, the firms share the cost \( F \) on a fifty-fifty basis. Both
enter the product market. In the subsequent product market competition both
rivals will try to steal consumers away from the other by price cutting (Bertrand
competition). Since both anticipate this post-introduction competition, they
quote prices with zero gross profits. Thus the net profits are \( 0 - F/2 \) (or, in the
general case, \( P^R - F/2 \)), which is negative (\( P^R < F/2 \)). So, with post-intro-
duction rivalry potentially being Bertrand, sustainability of joint R&D requires
product market collusion. This is proposition 3B. This result implies that a
trade-off exists between dynamic efficiency (i.e., R&D cooperation in order to
avoid the supply coordination problems of deterred and duplicated R&D) and static efficiency (i.e., competitive price rivalry in the product market).

Product market collusion can be promoted in at least two ways: repeated market contact over time and multimarket contact in time (which only adds an effect if repetition occurs in the first place). Firstly, infinitely repeated market contact over time facilitates the sustainability of collusive arrangements (subsection 2.2, proposition 1A). This is the well-established supergame explanation of (tacit) collusion. The argument runs as follows. Competitors cooperating in the product market require tacit collusion not to undercut each other's price. As a result, both firms can quote the monopoly price, $p^M$. If consumers buy from the firms on a fifty-fifty basis, each firm will earn gross profits of $\pi^M/2$, with a present value of $P^M/2$. Since $P^M > F$ (feasibility condition (3)), $P^M/2 - F/2$ is positive. Thus cooperation does pay off. Product market collusion, however, suffers from the free-rider problem.

If one firm quotes the monopoly price $p^M$, the other firm may defect by quoting a price slightly below this price (say, $p^M - \varepsilon$, where $\varepsilon$ is arbitrarily small). All consumers will turn to this supplier. Thus the defector earns approximately the full monopoly profit, $\pi^M$. Cooperation requires the ability for each firm to punish a defector. This is possible if competition occurs on a regular basis. Defection can now be punished in the future, and can thus be deterred. If, say, firm 1 defects at period 1, it earns $\pi^M$ in the first period. In the subsequent periods the defector is punished by firm 2, which suspends the cooperation. They revert to the Bertrand equilibrium with zero profits and stay there forever. Thus the present value in period 1 of future profit equals $\pi^M$. The present value in period 1 in the case of cooperation is $(1 + r)P^M/2$. Firm 1 cooperates if $(1 + r)P^M/2 > \pi^M$. That is, cooperation is the equilibrium outcome if

$$\alpha \cdot (\pi^M/2) > \pi^M,$$

which implies the condition that $(1 + r)(1 + g) \leq 2$. If $r$ and $g$ are sufficiently large (that is, if $(1 + r)(1 + g) > 2$), each firm will defect if the rival offers to cooperate. Anticipating this, neither is willing to cooperate in the first place, and both prefer the Bertrand price competition outcome. Intuitively, apart from the role of infinite discounting (proposition 1A) a high rate of market decline $g$ invites defection by implying that the cost of punishment, in the sense of future profits forgone, is small relative to the current profit (Bernheim and Whinston, 1990, pp. 8–9). In the case of short-lived or rapidly declining markets collusion is

---

10 Once in a punishment phase, the firms may try to escape from the grim trigger strategy to punish defection forever by renegotiating a return to cooperation (Tirole, 1988, p. 253). We ignore this complication.

11 For example, if the monopoly profit declines by more than a half each period (i.e., if $g \geq 1$), defection occurs for any discount rate, since then $(1 + r)(1 + g)$ exceeds 2, irrespective of the value of $r (> 0)$. 
unlikely to occur. This result is in accordance with the findings of models studying the stability of collusion over the business cycle (for example, Rotemberg and Saloner, 1986).

Extension to the \(n\)-firm case is not trivial. Cooperation implies cost sharing among \(n\) firms: \(P^n - F/n < 0\) for any \(n > 1\). Equation (4) transforms into

\[
\alpha \cdot (\pi_i^M/n) > \pi_i^M
\]

(4)

Equation (4') implies that the well-documented result that increased concentration (decreased \(n\)) facilitates collusion is supported. The combined effect of \(g, n, r\) and \(s\) gives regimes where either competition or coordination is the equilibrium outcome. Note, however, that this result may not hold. If not only the benefit of cooperation (the left-hand side of equation (4')) but also the (expected) payoff of defection (the right-hand side of equation (4')) decreases in the number of firms, the outcome is not obvious. The point is that with the number of potential cooperators (\(n\)) the number of expected defectors (\(d\)) may increase as well (\(d > n\)). In equation (4') the payoff of cheating (suppressing time indices) then is \(\pi(d)\), where \(\partial \pi/\partial d < 0\) and \(d = f(n)\) with \(\partial f/\partial n > 0\). (Note, however, that the Nash equilibrium logic requires that only one firm defects.)

A second route to cooperation is multimarket contact in time (subsection 2.3, proposition 2). Then, the interpretation is as follows. Initially, firm 1 and 2 have different home (country) markets. So, \(\pi^{M-A} AB\) is the sum of the monopoly profits in both markets, market \(A\) being the home base of firm 1 and market \(B\) reflecting firm 2's home market: \(\pi^{M-A} AB = \pi^{M-A} + \pi^{M-B}\). From the reciprocal dumping models (subsection 2.2, particularly Pinto (1986)) we know that a one-sided exporting strategy may induce a noncooperative two-sided dumping outcome if competition is in quantities: then competition is Cournot in both markets, which gives \(2\pi^C > 0\) for both firms. Alternatively, the cooperative outcome gives either reciprocal trade with (implicit) collusion in both markets \(-\pi^{M-A} AB/2 + \pi^{M-B} AB/2\) for both firms - or the absence of trade - \(\pi^{M-A} AB\) and \(\pi^{M-B} AB\) for the domestic firm in market \(A\) and \(B\), respectively. Multimarket contact theory predicts that the sustainability of collusive outcomes is facilitated by asymmetry (proposition 2A) and high concentration (proposition 2C). The second condition, high concentration, is satisfied, as we have only two firms competing for the market share. The first condition can be introduced by either assuming a positive transportation cost, so that firms 1 and 2 face a cost advantage in their home markets \(A\) and \(B\), or taking both markets to be of unequal size, so that one of both rivals can benefit from larger home demand.

For the sake of the argument, take the following case: exporting from the domestic to the foreign market requires a setup cost \(s > 0\). It is \(s\) that introduces a 'symmetrical asymmetry,' since both firms face an identical cost disadvantage in their respective export markets. Both markets are symmetric: that is, \(\pi^{M-A} AB = \pi^{M-B} AB\). The nontrade solution (with \(\pi^M\) for both firms) Pareto-
dominates the collusive market-sharing arrangement (with $\pi^M - s$ for both firms), as the first outcome spares the setup cost $s$. Cheating implies that one firm unilaterally decides to enter the rival's market, so capturing the domestic monopoly profit in its home market ($\pi^M$) plus the Cournot duopoly payoff minus setup cost in its entry market ($\pi^C - s$), $\pi^M + \pi^C - s$, leaving the 'honest' rival with domestic Cournot duopoly profit, $\pi^C$, only. The threat of one-sided entry is credible if $\pi^C > s$.\textsuperscript{12} In conjunction with infinite repetition two-market collusion maximally generates $\pi^M$ for both firms, which is the discounted payoff of the repeated nontrade outcome. In this case both firms refrain from exporting, saving setup cost $s$. Reciprocal entry would give $2\pi^C - s$ for both firms. Two-market collusion Pareto-dominates reciprocal entry in the one-shot game if $\pi^M > 2\pi^C - s$. Now two-market collusion is the equilibrium outcome if

$$\pi^M > \pi^M + \pi^C - s. \tag{5}$$

Only if condition (5) is satisfied (and, of course, $\pi^C > s$ and $\pi^M > 2\pi^C - s$), are spheres-of-influence created: each firm monopolizes its home market, and saves the exporting setup cost $s$. This result resembles a prediction of multimarket contact theory (subsection 2.3, propositions 2A and 2C). For example, Bernheim and Whinston (1990, p. 13) argue that ‘[t]he fact that the optimal collusive outcome here involves the development of spheres of influence is not terribly surprising, since such a move directly raises profits for the firms. What is interesting, however, is that the development of spheres of influence also enables firms to collude more effectively on price. By shifting sales toward the more efficient firm in each of the two markets, profits on the equilibrium path rise, while the possible gains from deviation fall.’ Moreover, note that the role of the exporting setup cost ($s$) in the multimarket contact argument (subsection 2.3, proposition 2A) closely resembles the impact of transportation costs in the international trade literature (subsection 2.3, proposition 1B): both setup costs and large transportation costs facilitate the sustainability of international collusion.

The result in this subsection confirms propositions 1A, 1B (for exporting costs), 2A, 2C and 3B, in particular. Adding the positive influence of growing markets (assuming $g^A = g^B = g$), proposition 4 summarizes the results.

**Proposition 4.** Product market collusion – promoted by (A) infinite discounting (proposition 1A), (B) asymmetric multimarket contact (propositions 1B and 2A), and (C) growing markets – facilitates the sustainability of joint R&D (proposition 3B).

\textsuperscript{12} With Bertrand competition this threat is not credible, as entry gives a negative profit ($\pi^B = 0 < s$). Therefore, the argument assumes Cournot rivalry.
Proposition 4 describes the positive influence, under particular conditions, of multiproduct market collusion on the sustainability of joint R&D. The next subsection deals with the opposite causality: how far does joint R&D facilitate product market collusion?

3.4 R&D Cooperation on a Regular Basis

R&D cooperation may start for a number of reasons (Jorde and Teece, 1990). However, whatever the precise motivation of the firms, note that the European Commission promotes firms to cooperate in R&D on a regular basis (section 4). According to the multimarket and multiperiod collusion theory this widens the opportunities for sustainable cooperation. Firstly, if a firm defects, the other partner can punish in some or all of their other current R&D projects. Secondly, punishment can occur by a refusal to start new R&D ventures with a defector in the future. So, the two main forces driving product market collusion, infinite repetition over time (subsection 2.2, proposition 1A) and multiple contacts in time (subsection 2.3, proposition 2), are important in determining the stability of joint R&D projects as well. By suspending all cooperation, now and in the future, punishment is made more severe, and thus more effective. It may be argued that firms are unlikely to break off current R&D projects, because of their commitments to these projects. The model in this subsection illustrates this argument. For the sake of brevity, only the supergame argument is modeled explicitly.

We model this intuition as follows. Say, every \(T \geq 1\) periods a new product appears that offers a profit opportunity to the two firms in one market. For the sake of convenience, assume that these opportunities are otherwise identical. One can think of overlapping generations of a product, examples being new generations of chips and television screens. If the firms fail to cooperate, the expected value of these projects is negative (subsection 3.2). If the firms succeed in cooperating, the net present value of a project at time \(T, 2T, 3T, \ldots\) is \((P^M - F)/2\). The net present value of a flow of such projects in period \(0\) equals \([(P^M - F)/2] \cdot [(1 + r)^T]/((1 + r)^T - 1)\). If firm 1 defects, it earns (approximately) the monopoly profit in period 1, \(\pi^M_1\). With Bertrand competition punishment by the other firm leads to zero profits for ever after. The net present value of this flow in period 1 is \(\pi^M_1\). If firm 1 cooperates from period 1 onwards, its present value in period 1 is \((1 + r)P^M/2\) for the current project, and \(\beta \cdot [(P^M - F)/2]\) for future projects, where \(\beta = [(1 + r)/(1 + r)^T - 1]\). Firm 1 cooperates if

\[
\alpha \cdot \left(\pi^M_1/2\right) + \beta \cdot \left[(P^M - F)/2\right] > \pi^M_1.
\]  

(6)

(The reader may wish to transform equation (6) into the \(n\)-firm analog along the lines of the arguments in subsection 3.3). If \((1 + r)(1 + g) \leq 2\), the left-hand side (LHS) exceeds the right-hand side (RHS) for any value of \(T\) [condition (4)]. Thus in this case the ability to start other joint R&D projects in the future makes no difference as to the motivation to cooperate. If, however, \((1 + r)(1 + g) > 2\),
condition (6) allows for collusion in cases where a single R&D project would induce defection. Whether collusion will indeed occur depends upon \( T \), i.e., the lag between product innovations. The LHS decreases in \( T \). Define \( T^* \) such that the LHS equals the RHS. Since the LHS decreases in \( T \), we can conclude that for \( 1 \leq T \leq T^* \) collusion is possible (i.e., LHS > RHS). For \( T > T^* \) collusion is unsustainable. Larger lags invite defection as they shift the reward for cooperation further away into the future. If \( T^* < 1 \), collusion cannot be sustained for any \( T \).

We can interpret \( T \) as a product life cycle. The appearance of new product generations (introduced \( T \) periods apart) causes the older products to wither away (hence, \( g > 0 \)). This leads to proposition 5.

**Proposition 5.** Short product life cycles stimulate both R&D cooperation and product market collusion.

Proposition 5 extends propositions 1 and 2 to the case were firms meet in R&D cooperation as well as in product markets. Proposition 5 may account for the fact that joint R&D projects, both private and public, appear in industries with short product life cycles. These are called *core technologies*, because they are expected to spawn many new products. The information technology industry is a case in point (Norton and Bass, 1992). Norton and Bass (1992) have a sophisticated model of overlapping product generations where new generations reduce demand for previous ones. If European firms drop out now (for instance, if they fail to develop High Definition Television), they may be unable to catch up later. Proposition 5 points to an economic motive for cooperation in core technologies, rather than a technical one (for example, exchange of complementary technologies) or a financial one (for instance, cost sharing). The prospect of a series of new products induces European firms both to cooperate in R&D and to collude in the product markets. So, not only does (multi)product market collusion facilitate the sustainability of joint R&D projects (proposition 4), but R&D cooperation also promotes the stability of (multi)product market collusion (proposition 5): the causality is reciprocal.

This intuition can be complemented by introducing the multi-contact argument. Firms cooperating in multiple R&D programmes may subsequently proceed to divide markets (the 'boundary' option in Edwards' (1955, p. 344) quotation in subsection 2.3). This solution is feasible for multimarket firms. This may explain the large number of R&D cooperation programmes that exist between leading European firms in, for example, the information technology industry (Van Wegberg and Van Witteloostuijn, 1993). Market-sharing arrangements abound. For

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13 There is a literature that relates the incidence and nature of (technology) cooperative arrangements to life cycle arguments, two recent examples being Auster (1992) and Cinarca, Colombo and Mariotti (1992).
example, Philips and Siemens cooperated in the MEGAbit project on the understanding that Philips would produce static RAM-chips and Siemens dynamic RAM-chips. This reflects collusion by establishing spheres-of-influence in the product market through innovation division in the joint R&D project (proposition 4). The division of innovation within the joint R&D venture may well be (partly) based on asymmetric capabilities of the partners (proposition 2A). To summarize: multiproduct market contacts (in and over time) reinforce the positive influence of multi R&D project encounters (in and over time) on the sustainability of collusive arrangements in both product and research markets, and vice versa.

3.5 Competition by Non-European Firms
Proposition 2B points to the influence of outside competition on cooperation. In the European context this translates in the hypothesis that the prospects for European integration depend crucially on the impact of non-European firms' strategies. We will explore this effect indirectly with reference to the above models. Firstly, take the case where the non-European firms imitate European firms. Following a European innovation in period $T$, the non-European firms build up market share gradually by expanding low-cost production processes. The quicker they do so, the faster they erode the profit potential of the European firms (that is, the higher $g$ in condition (4)). Entry barriers, such as output quotas, may, however, deter their entry process. Thus rapid imitation and low entry barriers in combination raise the rate of profitability decline ($g$), which facilitates defection.

Secondly, non-European firms may also be innovators. If innovation is a winner-takes-all (patent) game, at least within the European Community, entry by non-European innovators diminishes the number of successful innovations by European firms. Easy entry by non-European innovators will increase the time lag ($T$) between successful hits for European firms. We have seen that larger lags invite defection, as they shift the reward for cooperation further into the future. Proposition 6 summarizes the effects in both cases of entry by imitative and innovative non-European firms.

PROPOSITION 6. Low entry barriers to non-European firms prevent collusion by innovatory European firms through increasing $g$ (proposition 4) and increasing $T$ (proposition 5).

Proposition 2B is in accordance with proposition 6. Entry by non-European firms improves the competitive functioning of product markets. The ensuing breakdown of collusion may, however, prevent the European firms from innovating in the first place. If they go for the maximin solution, they do not innovate unless they expect to be able to cooperate in the product market. So, easy (imitative) entry by non-European firms may not be in the best interest of the European Community. This brings us to the policy implications of the model's results.
3.6 Policy Trade-offs for the Commission of the European Community

The Commission of the European Community (CEC) aims at improving European competitiveness and increasing R&D efforts. In terms of our model the CEC faces a political choice between two options. The first one seeks to induce European firms to coordinate their R&D efforts. The CEC may use subsidies in order to facilitate these joint efforts. The R&D cooperation may, however, both require as well as facilitate product market collusion. To be consistent, therefore, the CEC would have to accept product market collusion (propositions 3 and 4). It may even face the need to facilitate product market and R&D collusion by increasing barriers to non-European entry (proposition 6).

The second option entails that the CEC takes a firm anti-collusion stance. In order to suppress product market collusion the CEC may reduce entry barriers to (imitative) non-European firms. In this case product market competition may approach (static) efficiency, as prices fall toward marginal costs and profits move to zero. There is, however, one drawback. The CEC should subsidize the entire R&D effort (that is, the outlay $F$). These two options are, therefore, widely diverging. In core technologies where collusion is likely to occur (proposition 5) the former option (supporting product market collusion) will be easier to achieve, i.e., with less friction, than the latter (opposing product market collusion). Moreover, dynamic efficiencies are more apparent in the associated industries.

The policy dilemma the CEC is facing, being embodied in the trade-off between R&D project cooperation and product market competition, is recognized by the literature on joint R&D projects (subsection 2.4) in the context of American antitrust law. Jacquemin (1988) translates the results of this discussion into European terms. The trade-off is clear: on the one hand the 'situation involves extended collusion between partners, resulting from their action in R&D and creating common policies at the product level' (Jacquemin, 1988, p. 557); on the other hand, 'a regulation of R&D cooperation excluding any cooperation at the level of final markets could discourage or destabilize many valuable agreements' (Jacquemin, 1988, p. 557). In fact, the CEC's dilemma resembles the R&D innovation-competition trade-off which patent agencies are facing (Cohen and Levin, 1989). A solution may be found in a procedure similar to the one Grossman and Shapiro (1986) suggest in the American context. This means that specific joint R&D ventures have to be carefully evaluated as to their effect upon the Community's welfare, broadly defined. The arguments presented in sections 2 and 3 of this paper reveal the factors and mechanisms that have to be taken into account while executing such evaluations.

4 EVIDENCE OF CONTACT

4.1 Impact of Lower Barriers

The CEC aims at increasing competition through the 1992 European integration programme. EC member states must open their markets for other European
MULTIMARKET AND MULTIPROJECT COLLUSION

firms. Protection is reduced. Moreover, new product markets of strategic importance, often in high technology areas, must be opened up for European firms. The first-order effect of European integration is well-documented (section 1): the force of potential competition and actual entry will increase following the reduction of international trade barriers. This is true not only for intra-EC potential rivalry and actual entry, but also for outside competition. For example, in anticipation of 1992 Japanese direct investments in the EC, and so actual entries by Japanese firms, have increased considerably (Heitger and Stehn, 1990). The favourable welfare effect to the Community is, by and large, expected to be reinforced by the second-order competitive effect through cost-reducing (and subsequently, price-reducing) rationalization processes in important European industries. In fact, this line of reasoning can plausibly be applied to argue that European integration may also benefit outside firms and countries (Smith and Venables, 1991).

However, European integration measures may well decrease competition through the interaction between the second- and third-order effect. That is, increasing concentration and increasing multimarket contact among European competitors may oppose the first-order effect. Indeed, the CEC is well aware of the danger implied by the decreasing rate of concentration which accompanies the rationalization processes. For example, in response to the recent acquisition and merger wave in Europe the Commission has intensified its antitrust policy (The Economist, June 8, 1991, pp. 15–16). As far as the third-order effect is concerned, European integration measures may prompt firms to collude. Sections 2 and 3 have extensively argued that the reinforcing effect of both product market and joint R&D contacts – and the facilitating role of increasing concentration – in promoting collusion may well be important. This section gathers tentative evidence increasing contacts at both product and R&D levels as a result of the process of European integration. Subsection 4.2 deals with multiple contacts in product markets. Subsection 4.3 summarizes evidence of contacts through technology alliances.

4.2 Increased Multimarket Contact
The European integration programme requires that protected markets, such as the Italian car market and national markets for government orders, will be opened up. As firms will enter these markets, multimarket contact increases. Completion of the internal market implies the very multiplication of multimarket contacts (Van Witteloostuijn and Van Wegberg, 1991). (Reciprocal) entry, both from inside and outside the EC, increases the number of markets in which firms operate and meet. This hypothesis is supported by studies of the impact on international trade of trade liberalizing measures in general and European integration in particular (for example, Smith and Venables, 1988; Schmitt, 1990; and Winters, 1991). This means that the European integration programme may well facilitate collusive arrangements within the EC. One reason is that collusion (in
particular, in the form of (tacit) agreements regarding the sharing of markets, proposition 2) softens price competition in many markets.

A second mechanism increasing multimarket contacts (and stimulating multemarket collusion) is the expected increase of concentration in many European industries. This second-order effect of European integration facilitates the force of the third-order effect (proposition 3C). Three contributions to the literature on European integration are worth mentioning by way of illustrating the argument that concentration and multimarket contacts, and their influence on conduct, are increasing: Sieuwaegen and Yamawaki (1988), Yamawaki et al. (1989), and Kay (1991). Sieuwaegen and Yamawaki (1988) and Yamawaki et al. (1989) show — by comparing concentration indices in 1963 and 1978 for Belgium, France, Italy, The Netherlands, West Germany and the Community as a whole — that '[o]ver time, concentration increased in each country separately and in the EEC as a group, but it grew more slowly at the EEC level than at any national level except The Netherlands. ... We found evidence on the influence of EEC-wide concentration margin for larger EEC countries — West Germany, France, and Italy. These findings imply ... that the largest manufacturing corporations from West Germany, France and Italy may have recognized oligopolistic interdependence after the creation of the Common Market' (Yamawaki et al., 1989, pp. 131–132). Kay (1991) reports, on the basis of CEC's data, that the number of mergers and acquisitions in the EC rapidly rose from 155 in 1983 to 383 in 1988. This too points to increased concentration.

In fact, increasing concentration and multimarket contact are not only likely to raise the incidence of collusion in general (that is, both implicit and explicit), but may also be linked to the observation that European integration is associated with an increased incidence of explicit collusive product market arrangements. The increase in the number of explicit collusive arrangements in the EC is well-documented in the literature. An important motive for cooperation emphasized in the literature is efficiency gains. The benefit of cooperation in (or, in anticipation of) a unified Europe is recognized by, for example, Buigues and Jacquemin (1989) and Magee (1989). The former stipulate that 'co-operation arrangements, with or without the setting up of a joint venture, can also facilitate the exploitation of new opportunities afforded by an open Internal Market. They promote synergies, avoid costly duplication, make it possible to disseminate technological information more widely, and reduce the time required to put a new product or process on the market; they also ensure that risks are more widely distributed among partners' (Buigues and Jacquemin, 1989, p. 63).14 Kay (1991) provides data (from the CEC) on the increasing number of joint ventures in the EC in the period 1983–1988: from 1983 to 1988 the number of newly established joint ventures in the EC increased from 68 in 1983 to 111 in 1988.

14 The recent strategic re-orientation in the market for financial services reflects a telling example of the trend toward cooperation (Walter, 1989).
The fact is that the EC's integration programme provides structures, embedded in Community law, for intra-European cooperation (Slot and Van der Woude, 1988). The CEC's White Paper (1985) proposes 23 measures that seek to embed intra-EC cooperation in European law. For example, the 'use of legal structures as the European Economic Interest Grouping ... make it possible to set up specifically European legal entities' (Buigues and Jacquemin, 1989, p. 66). Moreover, the CEC has installed research programmes for transnational cooperation projects (for example, ESPRIT and RACE) which stimulate setting up technology alliances within Europe. Subsection 4.3 presents data on the increasing number of worldwide technology alliances in general and in Europe in particular.

4.3 Contact through Technology Alliances
An important and intense mode of contact is the strategic alliance. A number of studies has demonstrated that the incidence of strategic alliances has increased considerably during, say, the past decade. Two examples of such studies are Hergert and Morris (1988) and Hagedoorn and Schakenraad (1993). The CATI-database of MERIT presented by Hagedoorn and Schakenraad (1993) is particularly illustrative. Figure 1 shows that the worldwide growth of newly

![Graph](image)

Figure 1 – Growth of newly established technology alliances worldwide in 1980–1989. Source: MERIT-CATI reported in Hagedoorn and Schakenraad (1993)
established technology alliances is significant, particularly during the years 1983–1989. For example, in 1989 600 new technology alliances have been established. Note that alliances subsidized by the EC are excluded from the data.

The distribution of technology alliances over industries is uneven. Particularly the incidence of alliances in the information technology (IT) industry is striking: about 41% of the 4200 technology alliances in the CATI-databank originates in the IT-industry (with biotechnology ranking second with about 20%). In fact, about 70% of the technology alliances established in the 1980s is located in core technology industries. The data in Figure 1 are related to the arguments in sections 2 and 3 (particularly propositions 4 and 5): the trend is clearly toward an increasing number of contacts through technology alliances – particularly in core technology industries with shortening product life cycles (Norton and Bass, 1992) – which may increase the sustainability of product market collusion.

Apart from the distribution over industries, the origin of the partners in technology alliances is of interest. Table 2 reports the number of technology alliances per industry category for two periods (1980–1984 versus 1985–1989) differentiated by the home market of the partners.

The data reveal that the absolute and relative number of intra-European alliances has increased from 1980–1984 to 1985–1989. In fact, the trend favours intrablock technology alliances in general. This is particularly clear from the presentation of the data in Figure 2.

![Figure 2](image-url)

Source: MERIT-CAT1 reported in Hagedoorn and Schakenraad (1993)
<table>
<thead>
<tr>
<th>Biotechnology</th>
<th>New materials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80–84</td>
</tr>
<tr>
<td>Europe</td>
<td>47</td>
</tr>
<tr>
<td>Europe–US</td>
<td>58</td>
</tr>
<tr>
<td>Europe–Japan</td>
<td>5</td>
</tr>
<tr>
<td>US</td>
<td>125</td>
</tr>
<tr>
<td>US–Japan</td>
<td>45</td>
</tr>
<tr>
<td>Japan</td>
<td>11</td>
</tr>
<tr>
<td>other</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>318</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Information technology</th>
<th>Other industries*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80–84</td>
<td>85–89</td>
</tr>
<tr>
<td>Europe</td>
<td>85</td>
<td>13.3</td>
</tr>
<tr>
<td>Europe–US</td>
<td>158</td>
<td>24.6</td>
</tr>
<tr>
<td>Europe–Japan</td>
<td>57</td>
<td>8.9</td>
</tr>
<tr>
<td>US</td>
<td>142</td>
<td>22.2</td>
</tr>
<tr>
<td>US–Japan</td>
<td>133</td>
<td>20.7</td>
</tr>
<tr>
<td>Japan</td>
<td>29</td>
<td>4.5</td>
</tr>
<tr>
<td>other</td>
<td>37</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>641</td>
<td>100%</td>
</tr>
</tbody>
</table>

* The category other industries includes mainly automotive, aviation/defense, chemicals, food and beverage, heavy electric/energy and instruments/MT.

Source: MERIT/CATI-database reported in Hagedoorn and Schakenraad (1993).
Particularly interesting is the observation that in the years after the publication of the CEC's *White Paper* (1985) the number of technology alliances with European partners has increased significantly. For example, in technology industries the number of technology alliances with European partners almost doubled from a total of 722 in 1980–1984 to a total of 1272 in 1985–1989. Again, this relates to the arguments in sections 2 and 3 (propositions 4 and 5) by suggesting that European firms have increased their number of contacts in the second half of the 1980s which, according to the model, favours the sustainability of collusive arrangements in product markets.

5 APPRAISAL

The quality of the competitive process is of major concern to the European Community. To the extent that this implies a concern with competition in the product market, multimarket collusion will be opposed by the CEC. In this case, the CEC faces a policy dilemma (subsection 3.6). Product market collusion, if this is the outcome of multiple contacts, may be the price to pay for R&D cooperation. The latter has some good reasons, which warrant support and subsidization (Jacqueumin, 1988; and Jorde and Teece, 1990). Due to the public good character of knowledge, firms may underinvest in research activities when they cannot capture the external benefits. Cooperation may help firms to internalize at least some of these externalities. Moreover, R&D coordination abates costly entry rivalry. Lack of coordination may instead lead to coordination failures if firms duplicate R&D or, anticipating this, do not start with R&D at all (subsection 3.2). R&D subsidization may overcome severe competition by third-country firms and quickly dissipating monopoly rents in high-technology industries (proposition 5).

Of course, there are global competitive factors that may moderate the factors facilitating the sustainability of (explicit or implicit) collusion within the EC. By way of illustration, three issues are worth noting. Firstly, European product markets will continue to be competitive if third country (Asian, US) firms are allowed to continue operating in these markets. European alliances may in fact indicate intensified competition between European and non-European firms. For example, 'the very threat that non-EC telecommunication companies might derive the major benefit from an integrated European telecommunications market may have prompted the recent unprecedented cooperation among the major European IT-telecommunications enterprises' (Thimm, 1988–1989, p. 67). Secondly, European firms with most R&D contacts also have many links with third-country firms. Thus, if the former exclude the latter from the European

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15 To name but a few links: Philips with AT&T and Matsushita; ICL with Fujitsu and ITT; Siemens with Toshiba and Sony; Bull with Honeywell and NEC; and Olivetti with Toshiba and AT&T.
market, they may face retaliation in other markets (particularly Asian and/or US markets). Moreover, non-Europeans may step up the search for links with European firms. Magee (1989, p. 82) points out that, apart from acquisition, a 'second approach open to the American Company with a European subsidiary is to seek an alliance with some company in a related industry for joint R&D or cross-marketing of products.' Moreover, this strategy can be undertaken so as to bypass the disadvantages of being an outsider. That is, '[o]ne response to Community preference [for EC firms] is for a non-Community firm to establish a joint venture with a Community firm, thus obscuring national origins' (Peck, 1989, p. 297). This means that global rather than EC-collusion may have the future in particular industries. Thirdly, intra-European collusion may support global competition. Cooperation provides European firms with financial means for investments without which they might be forced to exit from R&D-intensive product markets. In the global arena competition would diminish if European firms are eliminated.

Where the game (competition or collusion; on country, EC or global basis?) will stabilize is an open question. This paper concludes, however, that there are sound theoretical and empirical arguments to believe that multimarket collusion may increase in post-1992 Europe. It seems meaningful, therefore, to recommend future research on this issue in the context of European integration. Both theoretical and empirical work may aim at systematically identifying conditions which further or impede multimarket collusion. From an empirical angle future research may focus on providing direct evidence involving the hypotheses in section 3 by testing whether an increased number of R&D contacts goes hand in hand with increased product market collusion. The tentative evidence reported in section 4 only indicates an increased number of contacts, without providing any evidence on the consequences for product market competition. From a theoretical perspective we note that a crucial determinant that is ignored, with the notable exception of Kesteloot (1992), in the literature on both multimarket or multiproject collusion (section 2) and in this paper's model (section 3), involves multimarket spillovers (Bulow et al., 1985; Van Witteloostuijn and Van Wegberg, 1992). For example, Bernheim and Whinston, 1990, p. 2) explicitly exclude the role of such spillovers by stating that 'to highlight the strategic linkages between markets, we assume away demand- and cost-based linkages that motivated their [Bulow et al.'s] analysis.' Since R&D, with and without contacts, more often than not is closely associated with multimarket spillovers (subsection 2.4), this lacuna is especially relevant in the current context. To be precise, following the lines of Kesteloot (1992), intra- and inter-firm spillovers may be introduced in a multimarket framework where both explicit cooperation (through joint R&D ventures) and implicit collusion (in the form of tacit product market cooperation) may occur. Therefore, the argument and model presented in this paper only offer a first step by reviewing and comparing different, though related, strands of literature, and elaborating on interconnections between multi-
product market and multi R&D project contacts (in and over time) and their reciprocal influence on the sustainability of (explicit and implicit) collusion.

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MULTIMARKET AND MULTIPROJECT COLLUSION


Summary

If firms meet in a number of markets, they may respond to an action in one market by reacting in another market. Fear for such retaliation may induce multimarket firms to collude across markets. The paper assesses available theoretical and empirical evidence on the multimarket collusion theory. Moreover, the paper suggests that the theory can be fruitfully applied in the context of European integration. The focus is on collusion by firms which meet in product markets as well as in joint R&D projects. A model develops three propositions, which shed light on the subsequently provided (tentative) evidence on multidimensional contact in an integrating Europe. The discussion may serve as a framework for future research into both the theoretical and the empirical domain with applications to the issue of European integration.