Université de Montréal
Faculté des arts et des sciences
Département de sciences économiques

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ON INTERTEMPORAL GENERAL-EQUILIBRIUM REALLOCATION EFFECTS OF EUROPE'S MOVE TO A SINGLE MARKET

Jean MERCENIER[1] and Bernardin AKITOBY[2]

1 Département de sciences économiques, Université de Montréal and Centre de recherche et développement en économique (C.R.D.E.).

2 Centre de recherche et développement en économique (C.R.D.E.), Université de Montréal.

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C.P. 6128, succursale A
Montréal (Québec)
H3C 3J7

Télécopieur (FAX) (514) 343-5831
Courrier électronique (E-Mail): econo@tornade.ERE Umontreal.CA

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RÉSUMÉ

Nous procédons à une analyse des conséquences pour le bien-être et l'emploi du marché unique européen à l'aide d'un modèle d'équilibre général, intertemporel, multipays et multisectoriel, avec rendements croissants à l'échelle, concurrence imparfaite et différentiation de produit. On suppose le jeu entre oligopoles de type Cournot-Nash. À court terme, des imperfections de marché peuvent exister, telles que rentes d'oligopoles et rigidités salariales. Celles-ci disparaissent dans le long terme caractérisé par l'équilibre stock-flux de croissance équilibrée. La réalisation du grand marché de '1992' est schématisée comme l'élimination de la possibilité pour les firmes non concurrentielles de pratiquer de la discrimination par les prix au sein de la CEE. Les évaluations sont faites sous différentes hypothèses de fixation des salaires. Nous montrons, entre autres choses, que les gains de bien-être restent modestes malgré la prise en compte des effets dynamiques et que tous les pays membres ne sont pas assurés de gagner à long terme du programme de '1992'.

Mots clés : équilibre général appliqué, intégration économique, Europe '1992'.

ABSTRACT

This paper provides intertemporal general-equilibrium investigation of the welfare and employment consequences of Europe's move to a unified market, using a multicountry, multisector applied model with imperfect competition, increasing returns-to-scale, and product differentiation at the firm level. The oligopolistic game between firms is assumed to be Nash in output. In the short-term, market imperfections (such as oligopolistic profits and wage rigidities) may exist. These imperfections vanish in the long run, characterized by stock-flow equilibrium consistent with steady-state growth. Europe '1992' is interpreted as the elimination of the possibility for oligopolistic firms to price-discriminate between client countries within the European Community. Investigations are performed under alternative wage determination mechanisms (flexible wages vs. wage indexation). We show, among other things, that the gains remain modest when dynamic effects are taken into account, and that all member countries are not sure to gain from European integration in the long run.

Key words : applied general equilibrium, economic integration, Europe '1992'.

1. Introduction *

Previous attempts to provide general equilibrium welfare estimates of Europe's move to a unified market conclude that though unambiguously positive for all countries, these should prove relatively modest; see Gasiorek *et al.* (1992), Mercenier (forthcoming *a*), Mercenier and Schmitt (1992). In any case, estimates are much more modest than the 2.5 percent to 6 percent suggested by the Cechini Report. These modeling efforts, however, are restricted to the analysis of static resource shifts, and it is often suggested that were the dynamic effects taken into account, these modest gains could turn into much larger numbers. This paper offers an exploration of the intertemporal reallocation effects of the '1992' program launched by the European Commission in its effort to promote European Integration. We provide estimates and sensitivity analyses of the welfare gains, employment changes and production-capacity accumulation that could result from the completion of the Single European market. For this purpose, we embed into an intertemporally dynamic framework the multicountry, multisector applied general-equilibrium model with imperfect competition, increasing returns-to-scale, and product-differentiation at the firm level, previously built by Mercenier (forthcoming *a*). We show, among other things, that though intertemporal reallocation effects are important, the estimated gains from 'Europe 1992' remain modest; furthermore, all member countries are not sure to gain from European integration in the long run.

The infinite time horizon is aggregated into two periods that are tight together by optimal factor accumulation, intertemporal budget constraints, and rationally formed expectations by households. For this, we make use of recent theoretical results on dynamic aggregation by Mercenier and Michel (forthcoming). Each period is meant to be representative of two different states of the economy which may be conceptually referred to as the short and the long run. In the first period equilibrium, market structure is fixed (*i.e.*, the

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number of oligopolists remains constant), and short-term market imperfections exist due to various forms of viscosities and time-to-build-type assumptions. Typical examples of such imperfections are oligopolistic profits and wage rigidities. The imperfections vanish in the long run, the second period being characterized by stock-flow equilibrium consistent with steady-state growth and Chamberlinian entry/exit of firms in the industry. Observe that this two-period comparative-static-type approach is particularly convenient to apprehend dynamic features for which adjustment mechanisms and speed are not fully understood and/or difficult to measure from data, as is the case for industry structure.

In the initial pre'1992' intertemporal equilibrium, national markets within the European Community are assumed segmented: because of various more-or-less pernicious forms of NTBs (such as norms, government-procurement policies, security regulations, etc.) which prevent consumers from cross-border arbitraging, noncompetitive firms are modeled as price-discriminating oligopolists. Following Smith and Venables' influential (1988) paper, the Europe '1992' trade experiment consists of forcing firms to adopt a single pricing rule within Europe, determined on the basis of their EEC-average monopoly power. The elimination of the possibility for firms to price-discriminate between client countries within the Community is interpreted as resulting from the removal of the NTBs implicit to the initial price-spread.[1] The (static) game played by firms in imperfectly competitive sectors is assumed to be Nash in output.[2]

Our investigations are performed under alternative labor-market characteristics. One scenario assumes full-employment and flexible wages in both periods. What is actually meant in this case is that wages are market-determined in order for the implicit base-year unemployment rate to remain unaffected by the European integration effort. Although useful, this is certainly not the kind of assumption European policymakers had in mind when they launched the '1992' program. With unemployment at a level of more than 10 percent, the major question raised by '1992' is: Can a move towards a more integrated European zone

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1 In addition to conferring to firms the power to practice different pricing strategies within Europe, NTBs obviously also affect the marginal cost of exports. In the European context, the first less-traditional consequence of NTBs has been emphasized, and the elimination of price-segmentation within the EEC is regarded as a major goal of the European Commission's '1992' package.

2 Though the model may be simulated with Bertrand-Nash competition, Mercenier (forthcoming *a*) has shown that this case is of little interest, because firms then enjoy almost no power to price-discriminate.

help mobilize some wasted resources represented by a large unemployed labor force?[3] A positive answer to this question implies that the welfare gains could be significantly higher than in the flexible wage case because of increasing returns-to-scale in production technologies. Alternatively, one may ask whether short-term labor-market imperfections in Europe will not, somehow, contribute to dissipate the gains that could otherwise result from the move to a unified market. Any attempt at modeling these imperfections is obviously bound to be questionable. One usually regards European real wages as fairly rigid in the short run though, which may be a source of hysteresis-type effects. Because of its two-period setting, our model could cast light on some interesting dynamic consequences of the European-integration program with hysteresis on the labor market. To capture these effects, we assume in a second scenario that wages are fully indexed in the first period, *i.e.*, fixed to consumer price indices, so that productivity gains are not absorbed by wage increases but rather by employment creation; in period two, wages adjust so as to maintain employment at the level inherited from the short run.

The present investigation differs from that of Mercenier's (forthcoming *a*), not only by its intertemporal nature. We also recognize here that products are typically more differentiated in intermediate than in final demands. Differences with other previous attempts to evaluate the general-equilibrium consequences of the '1992' program are significant. Gasiorek *et al.* (1991, 1992) do not account for intertemporal reallocations. Furthermore, their treatment of the input-output structure is somewhat simplistic because the proportions in which each industry in a specific country uses the products of other industries is assumed identical. Also, the pricing rule they adopt for intermediate goods is rather *ad hoc*: in the first paper, they arbitrarily impose these prices to equal average costs,[4] whereas in the second, firms charge the same prices on intermediate and final markets, though the pricing rule reflects monopoly power *on final demands only*.[5] Finally, their calibration procedure sets the burden on product-differentiation parameters rather than on scale elasticities, as is the case here. Burniaux and Waelbroeck (1992) do not account for intermediate goods; their calibration

3 Obviously, one may debate on the true significance of the concept of unemployment, and accordingly question the accuracy of the reported statistics. As will become clear, our analysis does not depend on such an estimate.

4 Haaland and Norman (1992) also make this assumption in their investigation of the effects of '1992' on the rest of the world.

5 We shall provide estimates of the welfare bias that results from such an assumption, and will show that it is not innocuous.

procedure relies on conjectural variations and their model is static. Furthermore, their implementation of the single market involves an arbitrary mixture of changes in consumer preferences and of perceived elasticities of demand by noncompetitive firms so that the true meaning of their experiment is unclear. Mercenier and Schmitt (1992) introduce barriers to entry in the form of sunk costs in an otherwise similar static framework as Mercenier's (forthcoming *a*). Finally, Baldwin (1989) uses a one-sector endogenous growth model to illustrate the potential dynamic gains from the '1992' program; the initial impetus is, however, exogenously imposed.

The paper is organized as follows. The structure of the model is outlined in the following section, the formal description of the instantaneous equilibrium being confined to Appendix A. Section 3 provides a discussion of the trade experiment and its implications. The calibration procedure is sketched in section 4. The results of our numerical experiments are reported and discussed in section 5. The paper closes with a brief conclusion.

2. The Model

2.1 The instantaneous equilibrium

In order to focus on the intertemporal dimension of the model, we only provide here a verbal description of the instantaneous equilibrium, and refer the reader to Appendix A for a formal presentation.

The world economy consists of six countries/regions: Great Britain (*GB*), the Federal Republic of Germany (*D*), France (*Fr*), Italy (*It*), the rest of the EEC (*RE*), and the rest of OECD (*ROW*).[6] All countries are fully endogenous and have the same structure. Each country has nine sectors of production of which four are of the perfectly-competitive-type (see Table 1, section 4). In these sectors, countries are linked by an Armington system implying that commodities are differentiated in demand by their geographical origin.[7] The other five industries are modeled as noncompetitive. In the latter sectors, firms are assumed

6 The model is calibrated on a 1982 data base, and region *RE* actually represents the rest of the EEC-10 partners, and not the twelve present members of the Community.

7 The Armington assumption has been a standard feature of competitive general-equilibrium trade models [see, *e.g.*, Shoven and Whalley (1984), Srinivasan and Whalley (1986)]. Although it is increasingly criticized --see, *e.g.*, Norman (1990)-- it has been adopted here in order to keep the treatment of the competitive side of the model as standard as possible.

symmetric within national boundaries. They operate with fixed primary factor costs and therefore face increasing returns-to-scale in production. They have no monopsony power on any market for inputs, primary or intermediate. Each individual oligopolist produces a different good. Industry structure is assumed fixed in the short run; oligopolistic firms may then experiment nonzero profits. In the long run, however, entry and exit of competitors in a Chamberlinian fashion ensure that these rents vanish. The competitive game between oligopolistic firms is Cournot-Nash. The instantaneous GE concept adopted is a compromise in terms of informational requirements between the primitive conjectural-Cournot-Nash-Walras equilibrium introduced by Negishi (1961) and the objective-Cournot-Nash-Walras equilibrium first introduced by Gabszewicz and Vial (1972).[8] Indeed, noncompetitive firms are endowed with full knowledge of preferences and technologies of their clients, which they use to maximize profits, neglecting, however, the feedback effect of their decisions on their profits through income (known in the theoretical literature as the Ford effect). This compromise advocated, among others, by Hart (1985, p. 121) is important to reduce the risk of nonexistence of equilibrium, as stressed by Roberts and Sonnenschein (1977), in addition to being realistic and computationally convenient. Because of the presence of various forms of nontariff barriers (NTBs) within Europe, national economies are assumed segmented, with noncompetitive firms acting as price-discriminating oligopolists.

Final demand decisions are made in each country by a single representative utility-maximizing household. (Although the static aspect of the decision problem may be conceptually made into a 'consumer problem' and an 'investor problem'.) A detailed country- and sector-specific system of price-responsive intermediate demands is specified. All components of demand --final as well as sector-specific intermediate-- recognize differences in products from individual oligopolistic firms *à la* Dixit-Stiglitz-Ethier. Both production factors are assumed to move freely across sectors, but remain country-specific on the whole time horizon.

2.2 The dynamic structure

We now describe how capital is accumulated in this economy. For notation ease, we neglect the country subscript i: all variables and parameters are country-specific except when

8 See, *e.g.*, Gary-Bobo (1989), Bonnano (1990), Hart (1985) for a discussion of these concepts.

otherwise explicitly stated. We abstract from leisure decisions and population growth so that labor is in fixed supply L^{sup}. We assume constant elasticity of intertemporal substitution in consumption:

$$(2.1) \quad \sum_{t=1}^{2} \beta(t) \frac{C(t)^{1-\gamma}}{1-\gamma} .$$

The discount factors $\beta(t)$ are exogenous and identical across countries. They account for both impatience and time aggregation. They are chosen so as to satisfy the property of *steady-state invariance* introduced by Mercenier and Michel (forthcoming). This property requires that the stationary solution of the 'true' (say, yearly) infinite horizon optimization problem also be a constant solution of the more aggregated finite horizon approximation. Mercenier and Michel have shown that if the accumulation constraints have the Euler form (2.2) as below, this highly desirable property imposes simple, necessary and sufficient restrictions on the choice of the discount factors, consistent with steady-state restrictions at period two. (We shall expand on the underlying dynamic aggregation theory in the discussion of model calibration.)

Competitive households have free access to international financial markets. They own physical capital $K(t)$. Both factors are rented to firms at competitive prices $w(t)$, $r(t)$. (Remember, firms have no monopsony power.) In the short run, because of unexpected shocks to imperfectly competitive industries (sectors $s \in \overline{C}$), abnormal profits ($\Sigma_s \pi_s(t)$) may add to capital rental earnings. The household's intertemporal problem consists of maximizing (2.1) subject to:

$$(2.2) \quad K(2) - K(1) = \Delta\big[I(1) - \delta K(1)\big], \quad K(1) \textit{ given} \;;$$

$$(2.3) \quad I(2) = \delta K(2) \;;$$

$$(2.4) \quad \sum_{t=1}^{2} [p_c(t)C(t) + p_I(t)I(t)] \leq \sum_{t=1}^{2} \left[w(t)L(t) + r(t)K(t) + \sum_{s \in \overline{C}} \pi_s(t)\right] + F(0) .$$

Equation (2.2) accounts for capital accumulation. A time-to-build assumption is made implicitely here: first-period investment decisions have no effect on short-term productive capacities. Δ is a scalar factor that converts net investment flows into stock increments.

Equation (2.3) imposes steady-state restrictions on capital accumulation. Equation (2.4) is the household's intertemporal budget constraint. It specifies that the discounted sum of current-price absorption spending (consumption and investment) cannot exceed the discounted sum of revenues earned from primary factor ownership, plus initial holding of foreign assets $F(0)$. Note that L^{sup} does not enter into the budget constraint: indeed, depending on the chosen labor-market specification, excess supply may exist.

3. The Trade Experiment

The numerical experiment consists of enforcing individual firms to switch from their initial segmented-market pricing strategy to an integrated-market strategy determined from their average EEC-wide monopoly power.

Formally, in the initial segmented equilibrium, the optimal price p_{isj} charged in market j by an oligopolistic firm operating in country i, sector s, with marginal costs v_{is}, is given by the Lerner formula:

$$\frac{p_{isj} - v_{is}}{p_{isj}} = \frac{-1}{E_{isj}} \qquad s \in \overline{C},$$

where E_{isj} is the perceived price elasticity of aggregate (final and intermediate) demand in country j. The experiment consists of enforcing, for all i, $s \in \overline{C}$, the restriction

$$E_{isj} = E_{isEEC} \qquad j \in EEC \quad ,$$

where E_{isEEC} is the perceived price elasticity of aggregate demand, computed on the EEC-wide market.

This experiment may be rationalized as follows. Although tariffs within Europe are negligible, significant NTBs subsist, taking various more-or-less pernicious forms such as norms, government-procurement policies, security regulations, etc.[9] These barriers confer to firms the power to price-discriminate between national markets. The objective of the '1992' program is to restore cross-border arbitraging by suppressing all forms of NTBs. Firms

9 See, *e.g.*, CEC (1988) for an extensive identification of these barriers.

would then be forced to charge a unique price within the Community.[10] Modeling this is difficult because NTBs are essentially unobservable.[11] The modeling strategy adopted therefore consists of treating these NTBs in the manner of latent variables, underlying the existence of price-discrimination opportunities for firms in the pre'1992' equilibrium. Once this is recognized, it suffices to infer from the data set the price system consistent with the optimal price-discrimination strategies of oligopolistic firms, and to interpret these as resulting from the implicit structure of nontariff barriers. The experiment then consists of enforcing individual firms to adopt single- pricing within Europe, determined from their average EEC-wide monopoly power, and to interpret this behavioral change as the optimal strategic reaction to the disappearance of the never-explicitly modeled NTBs.

What can be expected from such an experiment? Firms are thought to charge higher prices on their domestic market in which they usually hold the largest share. A move to a single-price strategy within the Community would therefore induce a reduction of prices charged on own markets, together with increases in export prices. The conjecture is that consumer prices will decline relatively to factor prices, and that European consumers will be better off. In addition, in the long run, a rationalization effect *à la* Harris (1984) could result from adjustments in industry structure. Indeed, the new pricing rule could reduce industry profits[12], induce exits *à la* Chamberlin, so that a smaller number of surviving firms would operate on a larger scale with lower average costs.[13] The positive outcome for the consumer of this structural adjustment could, however, be offset by two companion effects. Exit of firms from an industry means reduced product diversity. This has a direct welfare cost, as consumers are endowed with love-of-variety-type preferences [see Dixit-Stiglitz (1977)]. Furthermore, diversity in available intermediate goods affects production-efficiency in *all* sectors: exit of firms in an industry increases variable unit costs in other sectors, competitive and noncompetitive [see Ethier (1982)]. Our aim is to measure these effects and analyze how

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10 See, *e.g.*, Winters (1991) for a synthetic discussion of the '1992' program and of its possible implications.

11 It is, of course, well known that there is no such thing as a tariff-equivalence to NTBs in a noncompetitive environment.

12 Although from an individual firm's point of view, holding everything else fixed, the switch to single pricing should reduce its profits, it is far from obvious that this will be the case when all firms in the industry change their pricing strategy in a similar way.

13 Obviously, if only because of substitution effects, new firms could simultaneously enter the industry in some other countries.

they combine to affect the level and pattern -intertemporal and international - of welfare. production, and employment.

4. Data, Calibration and Computational Strategy

4.1 The data set

The chosen base year is 1982 because of availability constraints on data. The *EEC* set should therefore be understood as the EEC-10. The adopted sectoral breakdown of activities is detailed in Table 1. As is well known, the choice of an 'appropriate' sectoral disaggregation is not an easy one. Higher disaggregation results in a more-than-proportional increase in the number of parameters for which econometric estimates are unlikely to exist. Also, the dimension of the fixed point to be computed increases rapidly with the number of sectors, which may force the modeler to compromise on some other possibly more important devices. In this model, the rigorous computation of the perceived elasticities by oligopolistic firms is extremely complex, as is clear from Appendix B. Yet, it constitutes the nexus of our analysis, and one therefore does not wish to compromise on this. In absence of dimensionality or data-availability constraints, one would have been willing to single out as noncompetitive two subsectors, namely: food processing and the steel industry. However, given that the first is characterized by a very low concentration index, and the second by low product differentiation, embedding these subindustries within broader competitive aggregate sectors is presumably unconsequential.[14] However, one should keep in mind that this could slightly bias our welfare estimates.

The data base includes bilateral trade flows, separate input-output tables for domestic and imported inputs, final demands by type, and sectoral origin, production, and labor earnings figures, all collected from various standard international publications When necessary, consistency between different sources is ensured by using a RAS procedure. There are numerous sources of Armington elasticities in the literature from which reasonable estimates may be inferred. The calibration of the competitive side of the model is by now quite standard, so we shall not dwell on this; see, *e.g.*, Srinivasan and Whalley (1986).

14 Some authors may think differently, though. Gasiorek *et al.* (1992), for instance, disaggregate slightly more than we do, but neglect to take account of intermediate demands in the computation of perceived price elasticities. We shall show that this last compromise, obviously made to simplify the computations, is far from being innocuous.

Table 1: *Sectoral Disaggregation and Industry Characteristics*

		(*)	Armington Elasticities	Product Differentiation σ_s^f: Final Demands	σ_s^x: Interm. Demands	Industry Concentration
- Agriculture and primary products	(SITC: 2,3,4)	$\in C$	2	–	–	–
- Food, beverage, and tobacco	(SITC: 1,0)	$\in C$	2	–	–	–
- Pharmaceutical products	(SITC: 54; Nace-clio: 257)	$\in \overline{C}$	–	5	2.5	Low
- Chemistry other than pharma. products	(SITC: 5 - 54)	$\in \overline{C}$	–	5	2.5	Low
- Motor vehicles	(SITC: 78; Nace-clio: 350)	$\in \overline{C}$	–	10	5	High
- Office machinery	(SITC: 75; Nace-clio: 330)	$\in \overline{C}$	–	10	5	High
- Other machinery and transport materials	(SITC: 7 - 78 -75)	$\in \overline{C}$	–	7	3.5	Low
- Other manufacturing industries (textile, wood, paper, metallurgy, minerals)	(SITC: 6,8,9)	$\in C$	4	–	–	–
- Transport and services	Nontraded	$\in C$	2	–	–	–

Note: (*) C = competitive, $\overline{C}$ = noncompetitive.

The number of symmetric firms in noncompetitive sectors (n_{is}) is inferred from Herfindahl indices and information concerning industry concentration in the literature. In the absence of reliable estimates on product differentiation as well as on returns-to-scale (and indeed, on price-cost margins) in oligopolistic industries, we exogenously supply reasonable values for the differentiation elasticities σ_s^f, σ_s^x. (See Table 1 for the values adopted for the base case.) We then jointly determine, as detailed below, the base-year price system and scale elasticities consistent with the data base and the optimal price-discriminating Cournot-Nash behavior of noncompetitive firms. We then perform a systematic sensitivity analysis with respect to both σs and ns to check for robustness.

4.2 The joint calibration of initial markups and scale elasticities

Our calibration procedure differs from the one adopted by Gasiorek *et al.* (1992) and, as will be argued, avoids unrealistic assumptions on producers' technologies.

It is easy to see from the expressions in Appendix B that the perceived price elasticities on market j of noncompetitive firms operating in country i, depend on substitution elasticities σ_s^f, σ_s^x, on the number of national competitors n_{is}, and on the market share (say, φ_{isj}) the exporting country has in the client market j.

Let us denote by $\tilde{e}_{isj}$ the current-price trade flows as supplied by the data base. It may be checked that the market share φ_{isj} is the ratio of $\tilde{e}_{isj}$ and an "income" term that is exogenous to the firm by our behavioral assumptions (related to the Ford effect), and known from the data set. For calibration purposes, one may therefore express the perceived elasticities in a convenient compact form as:

$$(4.1) \qquad E_{isj} = \mathbf{E}_{\mathbf{isj}}(\tilde{e}_{isj}, \sigma_s^f, \sigma_s^x, n_{is}) \qquad s \in \overline{C},$$

where $\mathbf{E}_{\mathbf{isj}}(.)$ denotes a known function. Substituting (4.1) in the Lerner formula and rearranging, we obtain:

$$(4.2) \qquad \frac{p_{isj}}{v_{is}} = \frac{\mathbf{E}_{\mathbf{isj}}(\tilde{e}_{isj}, \sigma_s^f, \sigma_s^x, n_{is})}{\mathbf{E}_{\mathbf{isj}}(\tilde{e}_{isj}, \sigma_s^f, \sigma_s^x, n_{is}) + 1} \qquad s \in \overline{C},$$

so that for a given (as yet unknown) level of the variable unit cost v_{is}, the prices charged by firms on each national market may be computed from the data, exogenously supplied values of the σs and ns.

Define $\overline{p}_{is}$ as the average selling price of the firm operating in country i; by definition, $\overline{p}_{is}$ satisfies:

$$\overline{p}_{is} \sum_{j}^{W} e_{isj} = \sum_{j}^{W} \tilde{e}_{isj}$$

where $e_{isj} = \tilde{e}_{isj}/p_{isj}$. This definition equality may be rearranged as follows:

$$\text{(4.3)} \qquad \frac{\overline{p}_{is}}{v_{is}} \sum_{j}^{W} \frac{\tilde{e}_{isj}}{\left[\frac{p_{isj}}{v_{is}}\right]} = \sum_{j}^{W} \tilde{e}_{isj} \qquad s \in \overline{C}\,.$$

With $\overline{p}_{is}$ fixed at unity by normalization, equations (4.2) and (4.3) jointly determine the variable unit costs v_{is} and the segmented-market price system, consistent with the data set, with preferences and with the competitive game assumed to prevail at the base year. The assumption of zero pure profits then determines average costs: $V_{is} = \overline{p}_{is}$. We next compute the fixed costs from the following expression:

$$(w_i L_{is}^F + r K_{is}^F) = v_{is}\, Q_{is} \left[\frac{V_{is}}{v_{is}} - 1\right], \qquad s \in \overline{C}\,.$$

Due to the lack of reliable data on the composition of fixed costs, we assume that fixed and total costs have the same share of capital and labor inputs.

Observe that this calibration procedure does not exogenously impose that scale economies be identical across countries, as is the case in Smith and Venables (1988) and in Gasiorek *et al.* (1992). Rather, they are jointly determined with the monopoly power of the price-discriminating producers. There is indeed little reason to believe that British and Japanese firms face the same potential economies-of-scale in the base year.

Table 2.1 reports on the calibrated ratios of marginal to average unit costs (*i.e.*, the inverse of the scale elasticities). In Table 2.2, the calibrated price spread is summarized: here, we contrast the prices charged by European firms on their domestic market to their

Table 2.1: *Calibrated Ratios of Marginal to Average Costs*

	Pharmacy	*Chemistry*	*Road Vehicles*	*Office Machinery*	*Other Mach. & Transp. Material*
GB	0.617	0.612	0.629	0.824	0.790
D	0.629	0.624	0.729	0.816	0.785
Fr	0.635	0.621	0.604	0.795	0.793
It	0.645	0.616	0.550	0.761	0.805
RE	0.636	0.632	0.756	0.851	0.756
ROW	0.629	0.611	0.675	0.858	0.786

Table 2.2: *Calibrated Price Spread Within the EEC*

		Pharmacy	*Chemistry*	*Road Vehicles*	*Office Machinery*	*Other Mach. & Transp. Material*
GB	*Price charged on domestic market*	1.019	1.010	1.042	1.005	0.997
	Average export price to EEC	0.904	0.893	0.732	0.956	0.979
D	*Price charged on domestic market*	1.013	1.011	1.066	1.011	0.998
	Average export price to EEC	0.935	0.918	0.871	0.945	0.963
Fr	*Price charged on domestic market*	1.012	1.011	1.185	1.052	0.998
	Average export price to EEC	0.938	0.921	0.723	0.922	0.987
It	*Price charged on domestic market*	1.003	1.006	1.117	1.027	0.996
	Average export price to EEC	0.940	0.896	0.646	0.885	0.997
RE	*Price charged on domestic market*	1.017	1.025	1.127	1.001	1.017
	Average export price to EEC	0.937	0.925	0.898	0.987	0.943

Table 3: *Some Parameters Characterizing the Dynamic Behavior*

Number of years between the two periods : 20.

Discount rate ρ (%) : 7.5

Intertemporal substitution elasticity $1/\gamma$: 1.0

Capital-output ratio (calibrated) :

GB: 3.94, *D*: 3.20, *Fr*: 3.10, *It*: 3.44, *RE*: 4.76, *ROW*: 3.44

Depreciation rate of capital δ (%, calibrated) :

GB: 4.2, *D*: 6.3, *Fr*: 6.3, *It*: 6.2, *RE*: 3.6, *ROW*: 5.5

export-price averages within the Community. Observe that despite the complexity of the calibration procedure, the computed scale elasticities are in the expected range of magnitude. Although independent evaluations [such as those of Pratten (1988)] suggest that these estimates could slightly overestimate the true potential for economies-of-scale in the *Road vehicles* sector, it should be noted that the price spread underlying the calibrated Cournot-Nash equilibrium is far from being excessive, when compared to the econometric estimates of Mertens and Ginsburgh (1985). On the basis of that empirical evidence, one would conclude that our estimates are reasonably close to the true scale parameters.

4.3 The calibration of the intertemporal equilibrium

The world economy is assumed to be in steady-state before the '1992 program' is implemented.

Underlying the dynamically aggregated problem (2.1) is a "true" model, which may be conveniently thought as infinite horizon continuous time.[15] We write this intertemporal decision problem in the following abstract and compact form:

$$(4.4) \qquad \text{Max} \int_0^{\infty} e^{-\rho t} g(x(t),u(t))\, dt \qquad \text{s.t. } \dot{x}(t) = f(x(t),u(t)) \; , \; x(0) = x_0 \text{ given,}$$

where $x(t)$, $u(t)$ are respectively state and decision vectors, and standard assumptions are made on the functions $g(.)$ and $f(.)$ for a stationary solution $(\widehat{x},\widehat{u})$ to exist. Consider the following finite horizon discrete-time approximate to problem (4.4):

$$(4.5) \qquad \begin{aligned} &\text{Max} \sum_{n=0}^{N-1} \alpha_n \Delta_n \, g(x(t_n),u(t_n)) + \beta_N \frac{1}{\rho} g(x,u(x))) \\ &\text{s.t. } x(t_{n+1}) - x(t_n) = \Delta_n f(x(t_n),u(t_n)), \quad 0 \le n \le N-1, \quad x(t_0) = x_0 \text{ given,} \end{aligned}$$

where t_n $(n=0,\ldots,N)$ are dates (possibly unequally spaced), $\Delta_n = t_{n+1} - t_n$, α_n and β_N are (unknown) discount factors, and $u(x)$ is such that $f(x,u(x)) = 0$. It is easy to verify that problem (2.1)-(2.4) is a special case of (4.5). Proposition 2 of Mercenier-Michel

15 Reference to a continuous-time formulation is only made for exposition and conceptual convenience. The approach remains essentially identical if one assumes that the "true" model is discrete-time, defined on a dense grid.

(forthcoming) ensures that (4.4) and (4.5) share the same stationary equilibrium, *i.e.*, that dynamic aggregation satisfies the property of steady-state invariance, if and only if the discount factors α_n and β_N satisfy:

$$\alpha_{n+1} = \frac{\alpha_n}{(1 + \rho\, \Delta_{n+1})} \qquad o \leq n \leq N-2 \ ,$$

$$\beta_N = \alpha_{N-1} \, .$$

Using these results, the calibration of the intertemporal equilibrium is straightforward. Table 3 reports on some parameters (imposed or calibrated) characterizing the dynamic behavior of the economy.

4.4 Computational strategy

(a) Given that the model is highly nonlinear, the implementation of the '1992 program' requires some care: a continuation-type computational strategy is necessary. The Lerner formula is written in terms of a convex combination between the segmented and the integrated market perceived elasticities: $\lambda\, E_{isj}(t) + (1-\lambda)\, E_{isEEC}(t)$. The parameter λ is then changed from its initial value of one to zero in a fixed number of steps.

(b) The dimensionality of this two-period problem is also a challenge. To overcome this problem, we built on Negishi's (1961) existence proof of an imperfectly competitive GE. Using a Newton-type algorithm,[16] with exogenously fixed oligopolistic markups, we solve for the intertemporal equilibrium allocations, prices, and industry structures. We then upgrade the values of the perceived price elasticities, and iterate until convergence in a Gauss-Seidel fashion.

No serious computational difficulties occur when strategies (a) and (b) are wisely combined. Unfortunately, the control one has on the search path is limited with such a procedure, and no serious exploration of the possible existence of more than one equilibrium is possible. This is particularly unpleasant in view of the recent results of Mercenier

16 All computations have been performed using the GAMS/MINOS software [Brooke *et al.* (1988)], which uses a projected Lagrangian algorithm; see Murtagh and Saunders (1982).

(forthcoming *b*), which suggest that in this generation of applied GE models, nonuniqueness of solutions is not a theoretical *curiosum* but a potentially serious problem.[17]

5. The Results

5.1 The flexible wage case

The results of our base scenario with flexible wages are presented in Tables 4a and 4b, respectively for the short and the long run. All results are percent deviations from initial segmented stationary equilibrium. In addition to standard aggregate indicators, we also present some sectoral variables of particular interest.

We first note that no systematic sectoral pattern emerges, reflecting the complexity and importance of general-equilibrium effects. However, the partial equilibrium mechanism described in section 3 can be seen to operate in the most concentrated sectors. Indeed, we observe from Table 4a that the move from a segmented to an integrated market unambiguously reduces the average selling price to EEC customers in *Road vehicles* and *Office machinery*. The price reduction has obviously no reason to be uniform among competitors within the same sector, and demand substitutions may result in some European producers gaining and others losing market shares. On aggregate, EEC production expands in these sectors, however, pulling resources out of other (in particular constant returns-to-scale) industries. This drives primary factor prices up: both wages and capital rentals increase more than the cost-of-living index. (The only exception to this observation is provided by *RE*, where the relative decline of the rental rate of capital reflects a shift towards more labor-intensive activities.) Hence, the first-period real income increases in all countries (despite negative pure profits experienced in some oligopolistic sectors). This wealth effect adds to the previously mentioned price-induced expansion of demand and output increases in all sectors, competitive and noncompetitive, at the aggregate EEC level. European oligopolistic producers, on average, gain in efficiency as they move down along their average-cost curve. (In this and the following tables, the 'Efficiency gain' entry reports on the real cost savings achieved due to increased scale on initial output.) However, this

17 The static model used by Mercenier (forthcoming *b*), though very similar to the instantaneous equilibrium described in Appendix A, is not identical. In particular, assumptions on primary factors differ. It is possible (if not likely) that these differences are not innocuous with respect to the nonuniqueness issue.

Table 4a: *Short-Term Effects of the '1992' Program, Flexible Wages (% Changes, Cournot-Nash Competition)*

Aggregate indicators	GB	D	Fr	It	RE	ROW
Felicity (% equiv. var.)	0.60	0.38	0.37	0.62	0.23	−0.03
Wage rate	1.50	0.02	0.51	0.82	0.59	0.00
Rental rate of capital	1.40	0.06	0.58	0.79	0.26	0.01
Cost-of-living index	0.89	−0.56	0.23	0.38	0.31	6.E−3
Terms of trade	0.22	−9.E−3	1.32	0.38	−0.75	−0.16
Efficiency gains (%)	1.98	0.36	0.15	0.93	−0.35	−0.06
Employment	...	...	...	...	...	...
Investment	1.02	1.14	0.97	0.65	−1.56	−0.04

	Agricult.	Food, Beverage	Pharma.	Chemist.	Road Vehicles	Office Machin.	Other Mach. & Transp. Material	Other Manuf.	Services
Average selling price to EEC (% change)									
GB	1.14	1.15	0.27	0.64	−5.12	−0.66	0.63	1.09	1.22
D	0.27	7.E−3	−1.44	−1.39	−3.64	−2.42	−0.99	−0.25	−0.22
Fr	0.62	0.51	−0.46	−0.28	−1.47	−0.05	−0.40	0.34	0.35
It	0.74	0.67	1.13	1.05	−2.04	−5.26	0.20	0.70	0.71
RE	0.30	0.30	1.24	1.06	−0.16	−0.69	6.E−3	0.17	0.32
ROW	0.02	0.02	−0.12	−0.43	−0.10	−0.22	−0.07	9.E−3	7.E−3
Profits (% of value added)									
GB	...	...	−2.27	−0.89	3.83	−2.26	0.42	...	...
D	...	...	0.72	0.60	−7.04	−2.86	−0.27	...	...
Fr	...	...	0.46	0.55	2.09	−7.84	−0.29	...	...
It	...	...	−0.43	9.E−3	7.82	−9.65	−0.10	...	...
RE	...	...	−1.01	−0.82	6.66	0.14	−0.19	...	...
ROW	...	...	0.07	0.06	−0.33	−0.03	−0.02	...	...
Output (% change)									
GB	−0.19	−0.11	−1.45	−0.69	19.86	3.21	1.78	0.06	0.48
D	−0.12	0.08	2.84	2.36	−3.18	2.94	0.61	0.55	0.21
Fr	−0.12	0.02	2.23	2.09	−3.73	−11.92	0.93	0.12	0.25
It	0.07	0.07	−0.76	−0.27	5.89	7.40	0.81	−0.05	0.25
RE	0.26	0.30	−2.79	−3.13	14.58	7.45	−0.22	0.41	−0.25
EEC	−0.03	0.07	0.29	0.44	3.43	2.68	0.93	0.25	0.22
ROW	0.07	0.02	0.11	0.11	−0.72	0.10	−0.00	0.01	−0.03
Efficiency gains (%)									
GB	...	...	−1.33	−0.56	13.99	1.32	0.83	...	...
D	...	...	2.40	1.94	−2.15	1.28	0.30	...	...
Fr	...	...	1.46	1.25	−3.06	−8.35	0.37	...	...
It	...	...	−0.44	−0.16	5.47	4.10	0.35	...	...
RE	...	...	−1.49	−1.53	4.55	1.67	−0.09	...	...
EEC	...	...	0.17	0.27	2.25	1.03	0.41	...	...
ROW	...	...	0.07	0.07	−0.53	0.03	−3.E−4	...	...

Table 4b: *Long-Term Effects of the '1992' Program, Flexible Wages (% Changes, Cournot-Nash Competition)*

Aggregate indicators	***GB***	***D***	***Fr***	***It***	***RE***	***ROW***
Felicity (% equiv. var.)	0.89	1.04	0.85	1.00	–0.13	0.00
Wage rate	1.70	0.05	0.63	1.07	0.81	–0.07
Rental rate of capital	0.42	–1.16	–0.50	5.E–3	0.67	–6.E–3
Cost-of-living index	0.60	–1.20	–0.24	–3.E–3	0.67	–0.02
Terms of trade	0.08	–0.76	0.97	0.26	–0.11	0.32
Efficiency gains (%)	1.79	1.92	0.17	0.77	–0.36	–0.12
Employment	...	...	...	...	...	...
Investment	0.85	1.44	1.21	0.81	–1.14	–0.05

	Agricult.	*Food, Beverage*	*Pharma.*	*Chemist.*	*Road Vehicles*	*Office Machin.*	*Other Mach. & Transp. Material*	*Other Manuf.*	*Services*
Average selling price to EEC (% change)									
GB	0.70	0.88	0.80	1.00	–5.91	–0.75	0.39	0.96	0.79
D	–0.43	–0.69	–4.96	–4.96	–2.04	–2.75	–1.57	–0.97	–1.22
Fr	–0.17	–0.11	–1.54	–1.30	–1.90	0.45	–0.60	–0.10	–0.21
It	0.28	0.33	0.48	0.47	–3.78	–4.20	–0.11	0.40	0.43
RE	0.63	0.57	1.39	1.59	–2.00	–0.54	0.27	0.79	0.70
ROW	–0.05	–0.03	0.09	–0.18	0.02	–0.09	–0.02	–0.02	–0.03
Number of firms (% change)									
GB	...	...	–4.19	–1.33	4.25	–5.12	1.34	...	...
D	...	...	7.34	4.89	–10.12	–5.92	–0.14	...	...
Fr	...	...	1.87	2.08	3.12	–18.88	–1.07	...	...
It	...	...	–0.77	0.32	8.06	–15.43	–0.01	...	...
RE	...	...	–5.63	–5.43	34.04	7.53	–0.87	...	...
ROW	...	...	–0.20	–0.14	–0.32	0.84	–0.15	...	...
Output (% change)									
GB	0.33	0.20	–4.21	–1.76	21.93	2.70	2.43	0.27	0.82
D	1.05	1.04	13.82	10.59	–9.00	2.86	1.54	1.89	1.26
Fr	0.91	0.79	4.29	3.83	–2.34	–20.61	0.74	0.75	0.78
It	0.58	0.42	–0.62	0.12	9.99	1.41	1.30	0.33	0.49
RE	–0.24	–0.34	–6.61	–7.39	40.10	14.59	–0.99	–0.96	–0.49
EEC	0.47	0.45	2.46	2.47	3.89	1.33	1.40	0.58	0.73
ROW	0.11	0.04	–0.31	–0.22	–1.08	0.86	–0.15	–5.E–3	–0.03
Efficiency gains (%)									
GB	...	...	–0.02	–0.36	12.25	3.24	0.51	...	...
D	...	...	4.67	4.18	0.83	3.85	0.80	...	...
Fr	...	...	1.55	1.02	–4.39	–1.47	0.73	...	...
It	...	...	0.09	–0.11	1.73	10.12	0.56	...	...
RE	...	...	–0.57	–1.04	1.30	1.39	–0.05	...	...
EEC	...	...	1.32	0.96	2.02	3.86	0.61	...	...
ROW	...	...	–0.06	–0.05	–0.56	6.E–3	2.E–3	...	...

aggregate positive effect masks important disparities between national producers in each industry, which not only reflects uneven changes in production scale, but also in the variable-to-fixed-cost ratios. All countries globally experience efficiency gains, except the Rest of Europe (*RE*). This region also faces a nonnegligible deterioration of its terms of trade. Also, and most importantly, the '1992' package induces a contraction of short-term investment (–1.6 percent) and of long-term production capacities by more than 1 percent in *RE*. [Remember: long-term investment is proportional to the optimal steady-state level of capital; see eq. (2.3).] This obviously reflects, among other things, the shift towards more labor-intensive activities and the relative decline of returns on physical capital. In contrast, all other countries in the Community experience an increase close to one percent in their long-term capital stock as a result of European integration. As one expects, this pattern is reflected in the time path of felicity. The gains from '1992' are unambiguously positive in the short run for all members of the Community. However, for the smaller countries, the modest short-term gains turn into long-term immizerization. (Observe that for the Rest-of-Europe, the move to a Single European market results in production efficiency losses on the whole time horizon.) In contrast, in larger European countries, the felicity gains are roughly doubled between periods one and two. These remain quite modest though: they never exceed 1 percent. We are indeed very far from the 2.5 percent to 6 percent estimates provided by the Cechini report!

It should be clear from the above discussion that intertemporal reallocations are important. Neglecting these in applied general-equilibrium evaluations of trade liberalization may seriously bias the analysis, both quantitatively and qualitatively. To emphasize this, we perform the same trade experiment with the model adequately restricted to its closest static formulation [see Mercenier (forthcoming *a*)]. In this scenario, nothing links the two instantaneous equilibria indexed $t=1$ and $t=2$. They only differ by the assumptions governing industry structure: fixed when $t=1$, endogenous with Chamberlinian entry/exit when $t=2$. The welfare results are reported in Table 5 as scenario 2. (The first scenario is the base case detailed in the previous table.) Observe that in this case, all members of the Community uniformly gain from the experiment, a qualitative conclusion that contrasts with the one obtained from the intertemporal model. Abstracting from distributional considerations by focusing on the four larger European countries, we see that the aggregate long-term felicity gains for the Community are biased downwards by some 50 percent when

Table 5:

Welfare Effects of the '1992' Measured from Different Model Formulations

(Felicity as % Equivalent Variations, Cournot-Nash Competition, Flexible Wages)

		GB	*D*	*Fr*	*It*	*RE*	*ROW*
Scenario 1 (base case)	$t = 1$	.60	.38	.37	.62	.23	−.03
	$t = 2$	.89	1.04	.85	1.00	−.13	.00
Scenario 2 (static)	$t = 1$	.63	.33	.42	.60	.11	−.01
	$t = 2$	.50	.54	.40	.54	.13	−.01
Scenario 3 (static with perceived monopoly power based on final demands only)	$t = 1$	.43	.14	.35	.59	.07	−.01
	$t = 2$	.34	.18	.31	.48	.05	−.01

dynamic effects are not taken into account in the analysis. This is clearly a serious underestimation.

As is clear from Appendix B, the expressions for the perceived price elasticities are extremely complex because of the distinction made in the model between consumption, investment, and intermediate demands. One therefore may wish to simplify these calculations as some authors do [*e.g.*, Gasiorek *et al.* (1992)], and determine the markups on the basis of the firm's monopoly power on final demands only. One should be careful though: the perceived elasticities are at the nexus of the policy analysis and the simplification might be noninnocuous. Scenario 3 of Table 5 reports the welfare estimates that are obtained from the static model with this approximation. Comparing these estimates with those of the previous scenario, we see that in most countries, the simplifying assumption results in serious downward bias, which suggests that such simplifications are not to be recommended.

A last important question is: how robust, qualitatively and quantitatively, are our results to changes in parameter values? A systematic sensitivity analysis has been performed with respect to all important parameters: product differentiation (σ_s^f, σ_s^x, $s \in \bar{C}$), industry concentration (n_{is}), intertemporal substitution (γ), time discounting (ρ), and horizon length (T). Table 6 summarizes the findings.[18] As can be seen from Table 6, our estimates of welfare gains from the '1992' package prove quite robust to changes in all parameters, except for those characterizing product differentiation. This can hardly be a surprise. With low values of σ_s^f, σ_s^x, households (as consumers and investors) and firms (as demanders of intermediate goods) are less likely to be able to take advantage of relative price changes, whereas noncompetitive producers enjoy increased monopoly power. [See Haaland and Wooton (1992) on this.] Furthermore, it is a characteristic feature of the Dixit-Stiglitz-Ethier specification that the returns to available number of varieties vary with σs. [It is easy to check from (A.1),(A.4) and (A.6) that preferences and technologies are homogeneous of degree $\sigma/(\sigma-1)$ with respect to n.] Increasing product differentiation (lower σs) increases the returns to varieties, and the welfare and efficiency costs associated with industry adjustment (exit of firms) in period two. Another possible explanation is related to the

18 For each selected value of the static parameters ([.5, 1.0, 1.5] $*$ σ_s^f, σ_s^x, [.75, 1.0, 1.25] $*$ n_{is}), robustness has been tested with respect to each intertemporal parameter [T = 15, 20, 25; ρ = .05, .075, .10; γ = .5, 1.0, 1.5]. For space conservation, we only report a representative sample of these experiments.

Table 6a:

Short-Term Welfare Effects of '1992': Sensitivity Analysis, Flexible Wages (Felicity Measured as % Equivalent Variations, Cournot-Nash Competition)

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Base case	0.60	0.38	0.37	0.62	0.23	−0.03
T=25	0.62	0.39	0.40	0.64	0.21	−0.02
T=15	0.57	0.36	0.33	0.58	0.26	−0.03
ρ =.10	0.63	0.40	0.41	0.65	0.21	−0.02
ρ =.05	0.55	0.35	0.31	0.56	0.27	−0.03
$1/\gamma$= .5	0.64	0.48	0.44	0.66	0.15	−0.03
$1/\gamma$=1.5	0.57	0.31	0.33	0.59	0.30	−0.02
$.50\sigma_s$, $s\in\overline{C}$	−1.17	−2.14	2.50	−0.58	0.04	0.18
$1.50\sigma_s$, $s\in\overline{C}$	0.55	0.18	0.38	0.67	0.29	−0.02
$.75n_{is}$, $s\in\overline{C}$	0.80	0.47	0.49	0.74	0.31	−0.03
$1.25n_{is}$, $s\in\overline{C}$	0.47	0.33	0.30	0.50	0.17	−0.02

Table 6b:

Long Term Welfare Effects of '1992': Sensitivity Analysis, Flexible Wages (Felicity Measured as % Equivalent Variations, Cournot-Nash Competition)

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Base case	0.89	1.04	0.85	1.00	−0.13	0.00
T=25	0.90	1.03	0.86	1.01	−0.14	2.E−3
T=15	0.87	1.04	0.83	0.98	−0.12	−3.E−3
ρ =.10	0.90	1.03	0.86	1.01	−0.15	3.E−3
ρ =.05	0.87	1.05	0.83	0.98	−0.12	−4.E−3
$1/\gamma$= .5	0.82	0.87	0.74	0.91	−0.03	−2.E−3
$1/\gamma$=1.5	0.94	1.16	0.92	1.05	−0.23	−2.E−3
$.50\sigma_s$, $s\in\overline{C}$	−1.00	−3.77	−3.48	0.04	−3.09	−1.56
$1.50\sigma_s$, $s\in\overline{C}$	0.80	0.50	0.69	0.92	0.07	1.E−3
$.75n_{is}$, $s\in\overline{C}$	1.12	1.04	0.89	1.10	−0.06	−1.E−3
$1.25n_{is}$, $s\in\overline{C}$	0.72	0.98	0.80	0.89	−0.20	−0.00

existence of more than one equilibrium. Indeed, using a very similar structure, Mercenier (forthcoming) has shown that the computed allocation may be path-dependent, so that there is nothing that tells us which equilibrium is being chosen by the algorithm.[19] This is obviously a very serious problem, as it shakes the foundations of a comparative static-type analysis. Also, in such circumstances, one may question the rationale behind the calibration methodology (which equilibrium are we calibrating the model on, and how dependent are our policy analyses to that arbitrary selection?). Unfortunately, as mentioned in section 4.4, we are strongly constrained in our computational strategy by the dimensionality of the model. For this reason, we have little control on the search path, and have not been able to seriously test the conjecture that the reported sensitivity of welfare to changes in differentiation elasticities is due to a nonuniqueness problem. We conclude from this discussion that policy recommendation using this generation of AGE model should be made with care, as many of their properties remain ill-understood. Also, we urge for serious statistical estimation of the differentiation elasticities.

5.2 The rigid short-term real wage case

The previous experiment assumed competitive labor markets with vertical labor-supply curve. This is an extreme and unrealistic representation of European economies. Obviously not the kind of world policymakers in Brussels considered when they launched the '1992' program. With little effort, one can imagine what they most likely had in mind: the move to a single integrated market *should* result in a reduction of consumer prices with increased production efficiency and more intensive competition for primary factors; in the short run, equilibrium on the labor market will be ensured by a combination of real wage increases and job creations; investment will also become more profitable so that long-run production capacities will expand, presumably enough for the 'newly' hired labor force to remain employed in the post'1992' steady state. The analysis of section 5.1 assumed no job creation

19 Kiyotaki (1988) develops a simple theoretical one-sector model with similar structure as ours (*i.e.*, a two-period intertemporal framework with increasing returns, imperfect competition, product differentiation *à la* Dixit-Stiglitz, and capital accumulation). He shows that two stable (rational expectations) equilibria may exist: a high and a low investment one, respectively associated with optimistic and pessimistic expectations. (It should be mentioned that endogenous labor supply -- households make optimal leisure decisions-- is important for this nonuniqueness to occur in his model. Though we do not account for leisure decisions, labor supply *to the increasing returns-to-scale sectors* is endogenous, as resources may be shifted out of the competitive industries.) See also Manning (1990, 1992) and the survey essay by Silvestre (1992).

so that labor productivity gains were absorbed exclusively by real wage increases. We now explore the implications of the alternative extreme assumption: European wages are fixed to the consumer price index in the short run (with employment determined by firms, labor supply being horizontal), and assumed to adjust in the long run so as to maintain the employed labor force at its first-period level. The two scenarios together provide a bracket of welfare gains from '1992' which presumably includes estimates that would be generated with more sophisticated wage fixing mechanism [such as Oswald-type (1982) explicit bargaining between unions and employers].

To conserve on space, we only report in Table 7 standard aggregate indicators; some sectoral details may be found in Appendix C. We see that the welfare gains have approximately doubled in both periods when compared with the flexible-wage/fixed-labor supply case. All countries within the EEC benefit from the trade integration on the whole time horizon, including *RE*, despite a contraction of its long-term production capacities. The reason is, of course, that for this region, lower capital stock is compensated by an increase in employment, as is consistent with the shift towards labor-intensive activities observed in the previous experiment. Employment rises between one half percent and one percent, depending on the country considered. This could represent more than 75,000 jobs created in Europe. The reason behind this is clear enough: by forcing down the average price charged by firms within the EEC, the '1992' program reduces cost-of-living indices of European consumers *vis à vis* the *numéraire*. Wage indexation therefore implies that European wages are reduced relative to Rest-of-the-World labor costs without any loss in purchasing power for workers. The increase in the external competitiveness of the EEC helps European producers gain market shares within as well as outside Europe, boost their output, and move further down their average-cost curves. As the sensitivity analysis reported in Table 8 indicates, these conclusions are quite robust except, as in the flexible-wage case, with respect to product differentiation: in a world where products are highly differentiated, forcing firms to switch to a single pricing rule within the EEC could actually prove quite dramatic.

6. Conclusion

Previous attempts to evaluate the welfare costs of price discrimination within the European Community conclude that though unambiguously positive for all countries these should prove quite mild. In any case, much milder than extrapolated by the Cechini group

Table 7a: *Short-Term Effects of the '1992' Program: Fully Indexed Wages at t=1 (% Changes,Aggregate Indicators, Cournot-Nash Competition)*

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Felicity (% equiv. var.)	1.34	1.24	0.72	1.12	0.45	–0.06
Wage rate	1.02	–0.36	0.32	0.49	0.42	0.00
Rental rate of capital	2.27	1.01	1.02	1.38	0.63	0.02
Cost-of-living index	1.02	–0.36	0.32	0.49	0.42	0.01
Terms of trade	0.32	0.03	1.30	0.39	–0.70	–0.28
Efficiency gains (%)	2.40	0.74	0.37	1.18	–0.26	–0.05
Employment	1.13	1.03	0.56	0.81	0.51	0.00
Investment	2.19	2.05	1.29	1.24	–1.20	–0.10

Table 7b: *Long-Term Effects of the '1992' Program: Fully Indexed Wages at t=1 (% Changes, Aggregate Indicators, Cournot-Nash Competition)*

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Felicity (% equiv. var.)	2.08	2.34	1.45	1.88	0.35	0.02
Wage rate	1.63	0.32	0.45	0.92	0.56	–0.16
Rental rate of capital	0.42	–1.11	–0.53	–0.08	0.67	–0.02
Cost-of-living index	0.30	–1.43	–0.41	–0.26	0.52	–0.07
Terms of trade	–0.13	–1.07	0.99	0.20	–0.01	0.64
Efficiency gains (%)	2.13	2.57	0.22	0.96	–0.35	–0.15
Employment	1.13	1.03	0.56	0.81	0.51	0.00
Investment	1.84	2.61	1.62	1.54	–0.87	–0.11

Table 8a:

Short Term Welfare Effects of '1992': Sensitivity Analysis, Indexed Wages at t=1
(Felicity Measured as % Equivalent Variations, Cournot-Nash Competition)

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Base Case	1.34	1.24	0.72	1.12	0.45	–0.06
$T=25$	1.38	1.27	0.76	1.16	0.46	–0.05
$T=15$	1.28	1.18	0.65	1.07	0.45	–0.06
$\rho=.10$	1.39	1.28	0.77	1.17	0.46	–0.05
$\rho=.05$	1.24	1.15	0.62	1.04	0.45	–0.07
$1/\gamma=.5$	1.45	1.42	0.82	1.22	0.39	–0.06
$1/\gamma=1.5$	1.27	1.11	0.65	1.06	0.51	–0.05
$.50\sigma_s,\ s\in\overline{C}$	–2.69	–3.41	5.77	–0.77	–0.85	0.20
$1.50\sigma_s,\ s\in\overline{C}$	1.25	0.81	0.66	1.17	0.57	–0.04
$.75n_{is},\ s\in\overline{C}$	1.48	1.47	0.79	1.13	0.45	–0.06
$1.25n_{is},\ s\in\overline{C}$	1.22	1.07	0.69	1.08	0.41	–0.05

Table 8b:

Long Term Welfare Effects of '1992': Sensitivity Analysis, Indexed Wages at t=1
(Felicity Measured as % Equivalent Variations, Cournot-Nash Competition)

	GB	*D*	*Fr*	*It*	*RE*	*ROW*
Base Case	2.08	2.34	1.45	1.88	0.35	0.02
$T=25$	2.09	2.34	1.47	1.89	0.36	0.03
$T=15$	2.05	2.33	1.43	1.88	0.34	0.02
$\rho=.10$	2.10	2.34	1.47	1.89	0.36	0.03
$\rho=.05$	2.04	2.32	1.42	1.88	0.33	0.01
$1/\gamma=.5$	1.92	2.09	1.31	1.71	0.39	0.01
$1/\gamma=1.5$	2.18	2.51	1.54	1.99	0.30	0.02
$.50\sigma_s,\ s\in\overline{C}$	–2.87	–5.64	–2.02	1.55	–5.00	–1.75
$1.50\sigma_s,\ s\in\overline{C}$	1.81	1.37	1.15	1.71	0.56	0.03
$.75n_{is},\ s\in\overline{C}$	2.22	2.54	1.44	1.83	0.32	0.02
$1.25n_{is},\ s\in\overline{C}$	1.91	2.11	1.46	1.86	0.30	0.02

from partial equilibrium studies. It is generally suggested that the modesty of these results could be due to the neglect of dynamic gains from capital accumulation. This paper has offered an evaluation of the intertemporal general-equilibrium reallocation effects of the '1992' package. In order to investigate the possible consequence of European labor-market imperfections, we have explored two alternative extreme assumptions on wage fixing. One specification assumed flexible wages with fixed employment/unemployment. The second assumed that short-term labor productivity gains are absorbed by job creation rather than wage increases under the condition that no worker previously employed loses, *i.e.*, the wage-to-cost-of-living ratios are held fixed in the short run. To capture hysteresis-type effects often associated with European labor markets, long-term flexible wages are determined consistent with employment levels inherited from the short run. It is suggested that welfare estimates obtained from a more sophisticated wage fixing mechanism would fall in the interval provided by these two extreme scenarios.

Four important conclusions may be drawn from our results. One is that the fear of the gains from '1992' being dissipated by wage rigidities is ill-founded. If '1992' is to be welfare-improving with flexible wages, it will also be beneficial (possibly more so) with real wage rigidities, precisely because the policy aims at reducing the cost-of-living index in the Community. The results suggest that the number of jobs created could be important.

A second conclusion is that when intertemporal reallocation effects are taken into account, all member countries are not sure to gain from European integration in the long run: the steady-state level of capital may actually decline as a country shifts to more labor-intensive industries.

Thirdly, even when dynamic effects are taken into account in the most favorable Cournot case, the welfare gains from '1992' remain far below those suggested by the Cechini report.

A fourth conclusion is that the results prove reasonably robust to changes in parameter values, except with respect to product differentiation elasticities. With more differentiated products than assumed in our base case, the general-equilibrium consequences of forcing firms to trade their initial price-discrimination strategy for a uniform-pricing rule in the Community could be quite dramatic. How extreme this scenario is may be debated.

Nevertheless, it clearly indicates that accurate statistical estimates of the differentiation parameters, which are presently lacking, are urgently needed before one can seriously conclude on the costs and benefits of the European Commission's strategy to enforce single pricing in Europe.

A final comment is related to the possibility of nonuniqueness of solutions in our model. Indeed, recent theoretical [*e.g.*, Kiyotaki (1988)] and applied [Mercenier (forthcoming *b*)] research has demonstrated that multiplicity of equilibria is fairly characteristic of the general-equilibrium models of the type used in this paper. Though in an intertemporal framework this can be given interesting interpretations in terms of coordination failures in expectations (a formal representation of Europessimism?), many conceptual and methodological issues remain unaddressed. Until these are better understood, care should be taken in deriving strong policy conclusions from such models.

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Appendix A: A Formal Description of the Instantaneous General Equilibrium

For notational ease, we neglect the time index except where necessary. We identify sectors of activity by indices s and t, with S representing the set of all industries, so that $s,t = 1,\ldots,S$. S is partitioned into the subset of competitive, constant return-to-scale sectors, denoted C, and the subset of noncompetitive, increasing return-to-scale industries, which we note $\overline{C}$. Countries are identified by indices i and j, with $i,j = 1,\ldots,W$ and $W = EEC \cup ROW$, where the first subset represents the European Community, and the last subset represents the OECD countries that do not belong to *EEC*. We keep track of the trade flows by following the usual practice that identifies the first two indices with, respectively, the country and industry supplying the good and, when appropriate, the next two with the purchasing country and industry. Thus, a subscript $isjt$ indicates a flow originating in sector s of country i with industry t of country j as recipient. It will be necessary more than once to aggregate variables with respect to a particular subscript. In order to avoid unnecessary proliferation of symbols, it is convenient to keep the original notation, but substitute a dot for the subscript on which aggregation has been performed; for instance, $c_{.si}$ is an aggregate of c_{jsi} with respect to the first subscript.

1. The Households' Static Decision Problem

Domestic final demand decisions in country i are made by a single representative household. For exposition ease, we break this decision problem into a 'consumer' and an 'investor' problem. (This is innocuous, given our separability assumptions on preferences and technologies.) The domestic consumer values products of competitive industries from different countries as imperfect substitutes (the Armington assumption), while it treats as specific each good produced by individual firms operating in the noncompetitive industries. This is represented by a two-level utility function. The first level combines consumption goods ($c_{.si}$), assuming constant expenditure shares (ρ_{si}). The second level determines the optimal composition of the consumption aggregates in terms of geographical origin for competitive industries, or in terms of the individual firm's product for the noncompetitive sectors. Formally, the consumer's preferences are:

$$\log(C_i) = \sum_{s \in S} \rho_{si} \log(c_{.si}) , \qquad \sum_{s \in S} \rho_{si} = 1,$$

(A.1)
$$c_{.si} = \left\{ \sum_{j \in W} \delta^{c}_{jsi} \, c_{jsi}^{\frac{\sigma_s - 1}{\sigma_s}} \right\}^{\frac{\sigma_s}{\sigma_s - 1}} , \qquad s \in C,$$

$$c_{.si} = \left\{ \sum_{j \in W} n_{js} \, \delta^{c}_{jsi} \, c_{jsi}^{\frac{\sigma^f_s - 1}{\sigma^f_s}} \right\}^{\frac{\sigma^f_s}{\sigma^f_s - 1}} , \qquad s \in \overline{C},$$

where δ^{c}_{jsi} are share parameters, σ_s, σ^f_s are substitution elasticities [superscript f identifies final-demand-specific product differentiation for imperfectly competitively produced goods; see Dixit-Stiglitz (1977)], and n_{js} denotes the number of symmetric oligopolists operating in country j, sector s. Observe that when $s \in C$, c_{jsi} denotes the sales to the consumer of the whole industry s of country j, whereas when $s \in C$, it represents the sales of a *single* representative firm. Note also that this formulation is sufficiently general to allow for the treatment of nontraded goods; for such goods, $\delta^{c}_{jsi}=0$, $\forall j \neq i$. The consumer maximizes (A.1) subject to:

(A.2)
$$p_{ci} C_i = \sum_{j \in W} \sum_{s \in C} p_{js.} \, c_{jsi} + \sum_{j \in W} \sum_{s \in \overline{C}} p_{jsi} \, n_{js} \, c_{jsi}$$

where p denotes prices on which consumers have no influence, and the term on the left-hand side results from the intertemporal decision of the household. Observe that this formulation recognizes the possibility for noncompetitive firms to price-discriminate between client countries (p_{jsi}) but not for competitive industries ($p_{js.}$).

The investor's problem is to determine the optimal composition of the domestic investment good; formally:

$$\text{(A.3)} \qquad \text{Minimize } p_{Ii}I_i = \sum_{j\in W}\sum_{s\in C} p_{js.}\, I_{jsi} + \sum_{j\in W}\sum_{s\in \overline{C}} p_{jsi}\, n_{js}\, I_{jsi}$$

such that

$$\log(I_i) = \sum_{s\in S} \omega_{si} \log(I_{.si}), \qquad \sum_{s\in S}\omega_{si} = 1,$$

$$\text{(A.4)} \qquad I_{.si} = \left\{ \sum_{j\in W} \delta^{I}_{jsi}\, I_{jsi}^{\frac{\sigma_s - 1}{\sigma_s}} \right\}^{\frac{\sigma_s}{\sigma_s - 1}}, \qquad s\in C,$$

$$I_{.si} = \left\{ \sum_{j\in W} n_{js}\, \delta^{I}_{jsi}\, I_{jsi}^{\frac{\sigma^f_s - 1}{\sigma^f_s}} \right\}^{\frac{\sigma^f_s}{\sigma^f_s - 1}}, \qquad s\in \overline{C}.$$

Note that the share parameters δ^{c}_{jsi} and δ^{I}_{jsi} in (A.1) and (A.4) are specific to each decision problem so that price responsiveness of the two final demand components will accordingly differ, even though we assume that the substitution elasticities are identical by lack of econometric information.

2. The Behavior of Firms

a) Competitive industries

In competitive industries, the representative firm of country i-sector s operates with constant return-to-scale technologies, combining variable capital (K^{v}_{is}) and labor (L^{v}_{is}) as well as intermediate inputs (x_{jtis}). Material inputs are introduced in the production function in a similar way as consumption goods are treated in the preferences of households: with an Armington specification for goods produced by competitive industries, and with product differentiation at the firm level in the imperfectly competitive sectors. Input demands by producer $s\in C$ result from minimization of variable unit cost v_{is}:

$$\text{(A.5)} \qquad v_{is}\, Q_{is} = \sum_{j\in W}\sum_{t\in C} p_{jt.}\, x_{jtis} + \sum_{j\in W}\sum_{t\in \overline{C}} p_{jti}\, x_{jtis} + w_i L^{v}_{is} + r K^{v}_{is}$$

such that:

$$\log(Q_{is}) = \alpha_{Lis} \log(L_{is}^{v}) + \alpha_{Kis} \log(K_{is}^{v}) + \sum_{t\in S} \alpha_{tis} \log(x_{.tis}) ,$$

(A.6)
$$x_{.tis} = \left\{ \sum_{j\in W} \beta_{jtis} \; x_{jtis}^{\frac{\sigma_t - 1}{\sigma_t}} \right\}^{\frac{\sigma_t}{\sigma_t - 1}} , \qquad t\in C,$$

$$x_{.tis} = \left\{ \sum_{j\in W} n_{jt} \; \beta_{jtis} \; x_{jtis}^{\frac{\sigma_t^x - 1}{\sigma_t^x}} \right\}^{\frac{\sigma_t^x}{\sigma_t^x - 1}} , \qquad t\in \overline{C},$$

where the σs are substitution elasticities [superscript x identifies intermediate-demand-specific product differentiation for imperfectly competitively produced goods; see Ethier (1982)], and the αs and βs are share parameters with:

$$\alpha_{Lis} + \alpha_{Kis} + \sum_{t\in S} \alpha_{tis} = 1$$

and $\beta_{jtis}=0$, $\forall j\neq i$, if t is nontraded.

Cost minimization implies marginal cost pricing ($p_{is.}=v_{is}$) and zero profits ($\pi_{is}=0$) in the competitive sectors ($s\in C$).

b) Noncompetitive industries

Noncompetitive industries have increasing returns-to-scale in production. We model this by assuming that in addition to variable costs associated with technological constraints similar to (A.4), individual firms face fixed primary factor costs. This introduces a wedge between total unit costs V_{is} and marginal costs v_{is}:

(A.7)
$$V_{is} = v_{is} + \frac{\left[w_i L_{is}^F + r K_{is}^F\right]}{Q_{is}} , \qquad s\in \overline{C} ,$$

where Q_{is}, L_{is}^F, K_{is}^F denote respectively the *individual* firm's output, fixed labor and fixed capital. The definition of oligopolistic industry profits then immediately follows:

(A.8)
$$\pi_{is} = n_{is} V_{is} Q_{is} - n_{is} \sum_{j\in W} p_{isj} \left[c_{isj} + I_{isj} + \sum_{t\in S} x_{isjt} \right] , \qquad s\in \overline{C} .$$

With initial market segmentation, the noncompetitive firm exploits the monopoly power it has on each individual country market. To establish this, each producer is endowed with the full knowledge of the behavior, preferences (A.1) and technologies (A.4), (A.6) of its clients. Using this information, he performs a *partial equilibrium* calculation assuming that in each country, *each* individual client's current-price expenditure on the *whole* industry is unaffected by the firm's own action, *i.e.*, assuming that:

$$\frac{\partial \rho_{sj} p_{cj} C_j}{\partial a_{isj}} = 0, \quad j = 1,\ldots,W,$$

$$\frac{\partial \omega_{sj} p_{Ij} I_j}{\partial a_{isj}} = 0, \quad j = 1,\ldots,W,$$

$$\frac{\partial \alpha_{sjt} v_{jt} Q_{jt}}{\partial a_{isj}} = 0, \quad j = 1,\ldots,W\,, \quad t = 1,\ldots,S\,,$$

where a_{isj} denotes the strategic variable of the firm producing in country i, sector $s \in \overline{C}$. On the basis of the resulting perceived demand curves, the firm chooses country-specific profit-maximizing prices using the Lerner formula:

$$\text{(A.9)} \qquad \frac{p_{isj} - v_{is}}{p_{isj}} = \frac{-1}{E_{isj}}\,, \qquad s \in \overline{C}\,,$$

where $E_{isj}<0$ is the firm's perceived elasticity of demand for market j. Assuming that oligopolistic firms behave *à la Cournot*, we have:

$$\text{(A.10)} \qquad \frac{1}{E_{isj}} = \frac{\partial \log p_{isj}}{\partial \log\left[c_{isj} + l_{isj} + \sum_t x_{isjt}\right]}\,.$$

The computation of these elasticities is extremely complex because of the distinction made in the model between consumption, investment, and intermediate demands: one has to inverse the log-linearized aggregate demand system for each country and for each noncompetitive sector; see Appendix B for more details.

3. The Instantaneous General Equilibrium

The instantaneous general equilibrium is defined as a static allocation, supported by a vector of prices $(p_{is.}, p_{itj}, w_i, r_i)$, $s \in C$, $t \in \overline{C}$, $i,j \in W$, consistent with the intertemporal constraints and choices (2.1) to (2.4), and such that:

– Consumers maximize (A.1) subject to (A.2);

– Investors minimize (A.3) subject to (A.4);

– Firms minimize (A.5) subject to (A.6);

– Oligopolistic firms set prices according to (A.8) and (A.9) and satisfy the resulting demand;

– Industry concentration n_{is} is fixed in the short run so that oligopolistic profits as defined by (A.7), (A.8) may differ from zero; in period two, the number of competitors is such that these profits vanish: $\pi_{is} = 0$;

– Supply equals demand on each market:

(A.11) $$Q_{is} = \sum_{j \in W} \left[c_{isj} + I_{isj} + \sum_{t \in S} x_{isjt} \right], \qquad s \in S,\ i \in W\ ;$$

(A.12) $$K_i = \sum_{s \in C} K_{is}^{v} + \sum_{s \in \overline{C}} n_{is} \left[K_{is}^{v} + K_{is}^{F} \right], \qquad i,j \in W\ ;$$

(A.13) $$L_i^{sup} = L_i = \sum_{s \in C} L_{is}^{v} + \sum_{s \in \overline{C}} n_{is} \left[L_{is}^{v} + L_{is}^{F} \right], \qquad i \in W\ ,$$

where L_i^{sup} denotes fixed labor supply.

In the alternative case where initial unemployment and short-term wage indexation prevails in Europe, (A.13) holds only for the *ROW*. For the European countries, we assume:

(A.14a) $w_i = constant$, $i \in EEC$, period 1,

(A.14b) $L_i^{sup} >> L_i = \sum_{s \in C} L_{is}^{v} + \sum_{s \in \overline{C}} n_{is}\left[L_{is}^{v} + L_{is}^{F}\right]$, $i \in EEC$, period 1,

(A.14c) $L_i(\text{period } 2) = L_i(\text{period } 1)$, $i \in EEC$.

The first period Rest-of-the-World wage rate is chosen as the *numéraire* and fixed to unity.

Appendix B: The Computation of the Perceived Elasticities

a) The segmented market case

To determine the segmented-market perceived elasticity E_{isj}, it may be shown using staightforward but tedious calculus that for each $s \in \overline{C}$, $i \in W$, $j \in W$, the following system has to be solved:

(B.1)

$$0 = \sum_{\substack{k \neq i \\ k \in W}} n_{ks}\, \varepsilon_{hsj}^{k}\, \tilde{\varepsilon}_{ksj}^{i} + (n_{is}-1)\, \varepsilon_{hsj}^{i}\, \tilde{\varepsilon}_{isj}^{i} - \overline{\sigma}_{hsj}\, \tilde{\varepsilon}_{hsj}^{i} + \frac{\varepsilon_{hsj}^{i}}{E_{isj}}, \qquad h = 1,\ldots,W$$

$$1 = \sum_{\substack{k \neq i \\ k \in W}} n_{ks}\, \varepsilon_{isj}^{k}\, \tilde{\varepsilon}_{ksj}^{i} + (n_{is}-1)\, \varepsilon_{isj}^{i}\, \tilde{\varepsilon}_{isj}^{i} + \frac{(\varepsilon_{isj}^{i} - \overline{\sigma}_{isj})}{E_{isj}}$$

• where the variables $\tilde{\varepsilon}_{isj}^{k}$ are cross-elasticities determined jointly with E_{isj}: .

$$\tilde{\varepsilon}_{isj}^{k} = \frac{\partial \log p_{isj}}{\partial \log\left[c_{ksj} + I_{ksj} + \sum_{t} x_{ksjt}\right]}, \qquad k = 1,\ldots,W;$$

• where the ε_{isj}^{k}, $k=1,\ldots,W$, are cross-price elasticities treated as coefficients in this system though endogenously determined in the model:

$$\varepsilon^k_{isj} = \frac{\partial \log\left[c_{isj} + I_{isj} + \sum_t x_{isjt}\right]}{\partial \log p_{ksj}}$$

(B.2)

$$= \left[\sigma^f_s - 1\right] \left\{\theta^c_{isj} \frac{p_{ksj}\, c_{ksj}}{\rho_{sj}\, p_{cj}\, C_j} + \theta^I_{isj} \frac{p_{ksj}\, I_{ksj}}{\omega_{sj}\, p_{Ij}\, I_j}\right\} + \left[\sigma^x_s - 1\right] \sum_t \left[\theta^x_{isjt} \frac{p_{ksj}\, x_{ksjt}}{\alpha_{sjt}\, v_{jt}\, Q_{jt}}\right]$$

with

$$\theta^c_{isj} = \frac{c_{isj}}{c_{isj} + I_{isj} + \sum_t x_{isjt}}, \quad \theta^I_{isj} = \frac{I_{isj}}{c_{isj} + I_{isj} + \sum_t x_{isjt}}, \quad \theta^x_{isjt} = \frac{x_{isjt}}{c_{isj} + I_{isj} + \sum_t x_{isjt}};$$

• where the $\overline{\sigma}_{hsj}$ are weighted averages of substitution elasticities treated as parameters in the system even though endogenous to the model:

$$\text{(B.3)} \quad \overline{\sigma}_{hsj} = \frac{\sigma^f_s\left[c_{hsj} + I_{hsj}\right] + \sigma^x_s \sum_t x_{hsjt}}{c_{hsj} + I_{hsj} + \sum_t x_{hsjt}}.$$

b) The integrated market case

The integrated EEC-market elasticities E_{isEEC} are computed for each $s \in \overline{C}$, $i \in W$, jointly with the *EEC*-aggregated cross-elasticities $\tilde{\varepsilon}^k_{isEEC}$, by solving systems identical in structure to (B.1), but with the cross-price elasticities ε^k_{isj} and substitution-elasticity averages $\overline{\sigma}_{hsj}$ replaced by their *EEC*-aggregated values:

$$\text{(B.2')} \quad \varepsilon^k_{isEEC} = \frac{\sum_{j \in EEC} \varepsilon^k_{isj} \left[c_{isj} + I_{isj} + \sum_t x_{isjt}\right]}{\sum_{j \in EEC} \left[c_{isj} + I_{isj} + \sum_t x_{isjt}\right]},$$

$$\text{(B.3')} \quad \overline{\sigma}_{hsEEC} = \frac{\sigma^f_s \sum_{j \in EEC} \left[c_{hsj} + I_{hsj}\right] + \sigma^x_s \sum_{j \in EEC} \sum_t x_{hsjt}}{\sum_{j \in EEC} \left[c_{hsj} + I_{hsj} + \sum_t x_{hsjt}\right]}.$$

Appendix C:
Effects of '1992' with Fully Indexed Wages at $t=1$: Sectoral Details

Short-Term (% changes, Cournot-Nash Competition)

	Agricult.	*Food, Beverage*	*Pharma.*	*Chemist.*	*Road Vehicles*	*Office Machin.*	*Other Mach. & Transp. Material*	*Other Manuf.*	*Services*
Average selling price to EEC (% change)									
GB	1.52	1.33	0.43	0.82	–5.06	–0.67	0.62	1.12	1.51
D	0.54	0.24	–1.23	–1.18	–3.55	–2.37	–0.94	–0.14	0.22
Fr	0.84	0.66	–0.35	–0.14	–1.45	–0.05	–0.42	0.39	0.48
It	1.00	0.83	1.34	1.27	–1.97	–5.25	0.22	0.80	0.81
RE	0.55	0.46	1.46	1.32	–0.16	–0.68	0.01	0.26	0.43
ROW	0.03	0.03	–0.14	–0.46	–0.09	–0.22	–0.07	0.01	0.01
Profits (% of value added)									
GB	...	...	–1.72	–0.44	4.80	–1.78	0.93	...	...
D	...	...	1.10	1.07	–6.44	–2.47	0.15	...	...
Fr	...	...	0.71	0.72	2.54	–7.47	–0.03	...	...
It	...	...	–0.32	0.16	8.52	–9.24	0.21	...	...
RE	...	...	–1.02	–0.81	6.85	0.27	1.E–3	...	...
ROW	...	...	0.10	0.08	–0.32	–2.E–3	–0.01	...	...
Output (% change)									
GB	0.13	0.49	–0.98	–0.12	20.85	4.17	2.69	0.88	1.15
D	0.46	0.77	3.22	2.88	–2.58	3.68	1.35	1.30	0.80
Fr	0.10	0.31	2.57	2.40	–3.35	–11.47	1.47	0.51	0.54
It	0.38	0.51	–0.50	0.06	6.40	8.01	1.41	0.41	0.77
RE	0.44	0.61	–2.76	–3.07	15.17	8.03	0.24	0.67	0.03
EEC	0.29	0.54	0.61	0.83	4.05	3.43	1.64	0.80	0.70
ROW	0.11	0.02	0.16	0.14	–0.72	0.20	0.02	1.E–2	–0.04
Efficiency gains (%)									
GB	...	...	–0.89	–0.10	14.44	1.68	1.24	...	...
D	...	...	2.70	2.33	–1.72	1.58	0.64	...	...
Fr	...	...	1.67	1.42	–2.72	–7.95	0.58	...	...
It	...	...	–0.29	0.03	5.89	4.38	0.60	...	...
RE	...	...	–1.48	–1.49	4.69	1.78	0.09	...	...
EEC	...	...	0.39	0.52	2.64	1.33	0.71	...	...
ROW	...	...	0.10	0.10	–0.53	0.06	7.E–3	...	...

Appendix C (continued):
Effects of '1992' with Fully Indexed Wages at t =1: Sectoral Details

Long-Term (% changes, Cournot-Nash Competition)

	Agricult.	*Food, Beverage*	*Pharma.*	*Chemist.*	*Road Vehicles*	*Office Machin.*	*Other Mach. & Transp. Material*	*Other Manuf.*	*Services*
Average selling price to EEC (% change)									
GB	0.47	0.65	–0.05	0.22	–6.50	–1.23	–0.08	0.70	0.63
D	–0.61	–0.79	–6.40	–6.41	–2.60	–3.16	–1.98	–1.09	–1.31
Fr	–0.32	–0.25	–1.69	–1.43	–2.27	0.13	–0.85	–0.26	–0.34
It	0.10	0.16	0.03	0.07	–4.39	–4.64	–0.46	0.18	0.25
RE	0.54	0.45	1.00	1.39	–2.18	–0.74	0.10	0.64	0.57
ROW	–0.12	–0.09	0.22	–0.01	–0.02	–0.15	–0.01	–0.07	–0.07
Number of firms (% change)									
GB	...	...	–2.76	–0.02	5.59	–3.44	2.77	...	...
D	...	...	10.37	7.19	–9.10	–4.37	1.26	...	...
Fr	...	...	2.04	2.28	3.66	–18.10	–0.52	...	...
It	...	...	–0.06	1.04	8.86	–14.67	0.96	...	...
RE	...	...	–5.59	–5.51	33.97	7.48	–0.74	...	...
ROW	...	...	–0.48	–0.32	–0.46	0.45	–0.34	...	...
Output (% change)									
GB	1.40	1.28	–1.89	0.31	24.44	5.14	4.28	1.55	1.90
D	2.26	2.16	19.35	15.16	–6.93	5.35	3.57	3.09	2.47
Fr	1.51	1.38	4.47	4.02	–1.45	–19.63	1.37	1.34	1.26
It	1.37	1.22	0.45	1.12	11.64	2.96	2.46	1.23	1.26
RE	0.31	0.28	–6.27	–7.43	39.98	14.58	–0.97	–0.44	–0.11
EEC	1.34	1.30	4.77	4.47	5.63	3.31	2.86	1.49	1.58
ROW	0.19	0.08	–0.68	–0.50	–1.26	0.48	–0.33	–0.02	–0.04
Efficiency gains (%)									
GB	...	...	0.80	0.26	12.64	3.42	0.68	...	...
D	...	...	5.99	5.47	1.55	4.08	1.07	...	...
Fr	...	...	1.55	1.01	–4.05	–1.27	0.75	...	...
It	...	...	0.29	0.05	2.44	10.34	0.63	...	...
RE	...	...	–0.40	–1.02	1.30	1.40	–0.09	...	...
EEC	...	...	–0.13	–0.12	–0.59	0.01	3.E–3	...	...
ROW	...	...	1.88	1.44	2.54	4.04	0.75	...	...

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