ASSESSING THE ECONOMIC IMPACT OF THE NEW EU CHEMICALS STRATEGY (REACH)

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Abstract

The primary task of most policy evaluations is to estimate the potential costs and/or benefits of a policy, based on the best knowledge of stakeholders and the available information. In the case of the European Commission's new chemicals legislation, referred to as REACH (the **R**egistration, **E**valuation, and **A**uthorisation of **Ch**emicals), a number of well documented studies were commissioned at national government and EU level to assess the potential costs and benefits of this proposed legislation.

The difficulty with these studies is that they often omit, or are unable to accurately represent, many costs and benefits that partly depend on factors such as market power, sector specific characteristics, substitutability of inputs, suppliers and production processes. This provided the authors with a unique opportunity to develop a microeconomic model to quantify the impact of market-related variables on compliance costs for companies in three different supply chains, with the aim of providing indirect cost estimates of REACH and a methodology applicable to other policy areas.

1. Background & Objectives

The European Commission has proposed a revised system for the regulation of new and existing substances within the EU, referred to as REACH (the **R**egistration, **E**valuation, and **A**uthorisation of **Ch**emicals). Following publication of a White Paper in 2001[3] and an Internet consultation exercise in May - July 2003, a proposal for the REACH regulation was adopted by the European Commission in October 2003.

For those unfamiliar with REACH, at present there are around 30,000 different substances placed on the market in the EU, and which are produced or imported in various tonnage bands in to the EU. From this base of 30,000, each substance can be mixed with any number of other substances or other mixtures to formulate what are technically referred to as preparations in this paper (approximately 2,000,000 in the EU). These chemical products can then be divided between existing and new products (new refers to post 1980) and information on the properties of existing chemicals can be largely unknown. In order to protect human health and the environment from any adverse impacts that these currently unknown properties may give rise to, REACH will require testing of all substances to a specified standard with information to be presented

[3] Available at http://europa.eu.int/comm/enterprise/chemicals/chempol/whitepaper/reach.htm

in a standardised dossier on each substance by each manufacturer or importer of that substance within the EU. This information must then be passed down supply chains, requiring downstream users to reclassify products, update Safety Datasheets and labelling. It is important to note that neither of these activities are required by REACH, but rather are a response to it. In cases where a substance is found to have properties of very high concern, it then progresses to the Authorisation stage of REACH where use of a substance can be limited. Restrictions can also be placed on the use of substances if significant risks can be found relating to that use. Product withdrawal is therefore possible if restrictions apply or where it no longer becomes economically viable to produce a particular substance or preparation.
Within the UK, a partial regulatory impact assessment (RIA) was prepared which assessed the costs and benefits of the proposed REACH regulation[4]. The partial RIA includes some case study summaries on the impact of REACH for selected downstream users of substances. However, given the uncertainties about the indirect costs of REACH, the UK Department for Environment, Food and Rural Affairs (Defra) and the Department of Trade and Industry (DTI) commissioned a further, complementary and more detailed study to identify the costs and benefits of REACH along supply chains for particular products.

The aims of the study were:

- identify the costs and benefits of REACH along supply chains for particular products;
- devise an economic model to show the impact of REACH on downstream users; and
- estimate the range of the indirect costs of REACH.

2. Approach

The first step in the study was to identify possible case studies and to develop a detailed understanding of the structure of the supply chains for these. A long list of case studies was developed to reflect different types of supply chain and highlight particular issues, such as potential for parts of the chain to move outside the EU, and downstream industry buyer power. Three case studies were agreed with the Steering Group to provide the focus for the study. These included case studies on the manufacture of silicon wafers for use in semiconductors, the manufacture of coated cans for food packaging purposes and fragrances used in cosmetics and household products.

Data on the impacts of REACH on companies in the case study supply chains were collected through consultation. This included the development of a set of questions for participating companies to answer. These were used as the starting point to more detailed discussions. Through this work and further literature review, the information required to estimate the compliance costs arising from REACH, together with the possible impact of changes in costs on companies' activities and product prices, was gathered.

Two types of economic model were created to provide the basis for the case study analysis. The first was a spreadsheet-based model, which combined sets of data together

4 Available at http://www.defra.gov.uk/corporate/consult/reach/index.htm

to estimate the compliance costs associated with the testing and registration of substances used by the downstream user companies in each of the supply chains. In addition, a microeconomic model was developed to reflect the linkages between different actors based on sector characteristics. The intention was for this model to be used to predict the economic impacts that REACH might have on suppliers and to translate these to impacts on downstream users, in terms of changes in input and final product prices. This model differs from those developed in other studies looking at the wider economic effects of REACH in that it takes account of the price sensitivity of final demand, market characteristics and potential substitution at each stage within the supply chain.

The outputs from the case study analyses enabled predictions of the likely effects of REACH at the sectoral level, identifying the relative magnitude of compliance costs in relation to the different size companies. From the work carried out, conclusions were drawn for the markets examined in the study with regard to the likely overall impact of REACH. It is more difficult to extend these to other sectors, although some remarks can be made based on generalised characteristics.

3. Direct Costs of REACH

3.1 Approach

Estimation of the direct costs to industry of REACH was a more straightforward exercise than estimation of the indirect costs. Several of the studies that have attempted to estimate the indirect costs have been heavily criticised for a number of different reasons. These criticisms included (in a few cases) the assumptions concerning the direct costs of REACH to industry underlying the predictions of indirect costs, as these are the starting point for deriving figures on the indirect costs.

As a result, it was necessary for the purposes of this study to clearly define the assumptions that were going to form the basis for calculating any direct compliance costs that will be incurred by companies within the case study supply chains. These had to reflect what would be required of manufacturers, importers and downstream users under the current REACH proposals.

The key assumptions underlying estimates of direct compliance costs that were important to the analysis are as follows:

- costs to manufacturers/importers of meeting the testing requirements of REACH (with this including assumptions on levels of data available, availability of QSARs (Quantitative Structure Activity Relationships), and further testing requirements);

- costs to manufacturers/importers of preparing a registration dossier including a Chemical Safety Assessment and Chemical Safety Report for different types of substances. This includes taking into account the potential for consortium registrations; and

- costs to manufacturers/importers of liaison with downstream users.

Assumptions that were adopted for this study were taken from Extended Impact Assessment (EIA) prepared by the European Commission to maintain consistency with previous work.

In addition, assumptions were made on the costs arising from a range of other REACH requirements in order to predict the compliance costs associated with a particular portfolio of chemicals and for the impact of manufacturer and importers responses to REACH on downstream companies. These included levels of product withdrawal and the subsequent implications of this for downstream users; numbers of substances that would be likely to go through authorisation and costs of authorisation; and costs to downstream users of their data management and other requirements under REACH.

Three case studies were examined, with these representing supply chains within the fragrance, semiconductors and coatings sectors. These supply chains have the following attributes.

- **Silicon wafers**: the manufacture of silicon wafers for the semiconductor industry and the supply chain above this activity provides the focus of the first case study. The supply chain here involves supply of bulk chemicals, import of specialist substances, and use of various gases. This case study provides an opportunity to look at the implications of changes in the price of a global commodity.

- **Food can coatings**: the case study for this sector involves examining the supply chain for the manufacture of coated cans used in food packaging, which must meet the requirements of the food processor and of food safety legislation.

- **Fragrances**: the supply chain covers the use of fragrances in both cosmetics and household products, with this case study covering the manufacture and import of synthetic and natural substances through to retailers as the last link in the supply chain. The case study looks at the linkage between REACH and existing regulations and voluntary action on chemicals. Although cosmetic ingredients are exempt from the requirements for health risk assessment under REACH, as these are negotiated under the Cosmetics Directive, they are subject to the other provisions.

In addition to consulting in detail with potential case study companies and their trade associations, data were collected with the aim of developing an understanding of the structure of the supply chains for the three application areas. This involved collection of information on:

- the manufacture and trade (within the UK) of specified products in the above applications;
- the main manufacturers, suppliers, distributors and users of these products;
- data on markets, the nature of product demand and trends in this demand for specified products in these application areas; and
- the structure of the industry, including the relative share of SMEs versus large companies, the profitability of companies, typical levels of investment by size of

company, employment, turnover and the ability to pass increased costs onto the next link in the supply chain.

Initial contacts were then made with the individual companies and questionnaires were sent to them, indicating the types of information required for the purposes of the study. Discussions were then held with individual companies (or in some cases, a mix of companies from across the supply chain) to discuss the focus of the case studies and to collect responses to the questionnaire.

3.2 Methodology

In all three case studies, the same basic approach to the estimation of direct costs and impacts was applied. In essence, the approach consists of the following steps:

1) The list of substances comprising the portfolio of those used in the manufacture of the relevant end-products was identified, including those used in preparations. This data was then used to determine the number of substances that would need to go through testing and registration (taking into account any overlap between substances present both in their own right and within preparations).

2) The total tonnes produced/imported into the EU as a whole and the quantities used in the production of the case study products (on a sectoral or company basis) were established.

3) The quantities produced/imported by individual manufacturers/importers were estimated and the appropriate testing and registration requirements under REACH were identified.

4) For each substance, the direct costs associated with testing and registration in line with the current REACH proposals were estimated, taking into account the degree to which substances were likely to be (or are known to be) dangerous or non-dangerous[5]. These include assumptions about the level of consortium formation likely to apply to each substance.

5) The potential maximum price increase per tonne of each substance was then estimated by dividing the total testing and registration costs for each substance by the quantities manufactured/imported into the EU.

6) The additional costs that would then be passed on to the downstream user sectors/companies were then calculated based on the tonnes of each substance consumed per annum, the maximum price increase, and any impacts of authorisation and product withdrawal. The estimated costs per substance are also analysed to determine the likelihood that an individual substance will be withdrawn from the market (based on cost considerations alone).

[5] Substances classified by at least one end point in terms of toxicity, carcinogenicity, etc. are referred to as dangerous. Non-dangerous refers to those substances and preparations without a hazard classification.

Steps 1 to 3: Estimation of Numbers and Tonnes of Substances
The numbers of substances undergoing registration were provided by industry or sourced from elsewhere. Where the identity of the substance was known, the total tonnages produced in the EU were identified from IUCLID, where this also permitted the identification of the number of producers and existing status as regards dangerous properties. The tonnages used in the production of the case study products were also provided by industry or, where necessary, estimated from other sources. Where these details were not known, assumptions were made to fill data gaps.

Step 4: Estimation of Testing and Registration Costs

Test Costs
For all case studies, at least two scenarios for testing costs were applied, one with and one without the use of QSARs. In addition, account was taken of the availability of data through the US High Production Volume (HPV) Challenge and ICCA HPV programmes, which seek to gather basic toxicological information on a large number of Medium and High Production Volume substances.

The per substance test costs applied to each of the substances were drawn from the European Chemical Bureau's (ECB, 2003) original assessment of testing costs under REACH and the associated spreadsheets. The ECB analysis was based on a series of assumptions concerning the need for testing, availability of existing data (both generally and from the US HPV, the ICCA HPV and the German VCI programmes), use of QSARs and also waiving of certain tests.

Fees and Pre-Registration Costs
For each substance, fees and pre-registration costs were calculated on the basis of each manufacturer/importer pre-registering at €500 per substance, and an additional €8,000 per substance for a full registration (based on Commission's Extended Impact Assessment). Fees for registration and pre-registration are set out below in Table 3.1.

Table 3.1: Fees and Pre-registration Costs per Substance Based on Tonnage

	1-100t	100 to >1000t
Fees - Full Registration	€ 400	€ 8,000
Pre-registration	€ 500	€ 500

Registration Costs
All full registrations were assumed to be consortium registrations based on the data gathered from IUCLID. The consortium registration cost function developed for Defra's work on One Substance, One Registration (RPA, 2005) was used to calculate the registration costs for each substance in each tonnage band. In the further work for Defra, it was found that the actual size of consortia might be much greater (or sometimes smaller). As such, the costs of providing dossiers have been revised to provide greater sensitivity to the number of companies in a consortium. In this new analysis, the costs of registration are divided as follows:

- dangerous versus non-dangerous substances;
- the tonnage band;
- costs of an individual (full) registration (i.e. by one company);
- costs of a registration by a consortium of two; and
- costs of a registration by a consortium of greater than two (where this varies depending on the size of the consortium).

Table 3.2 sets out these costs. As can be seen from this, the costs of a consortium registration of two are less than twice the costs of two separate individual registrations. This was actually derived by considering the costs set out in the revised BIA (reported above) and the spread of the additional administrative costs that would arise across members in a consortium.

Table 3.2: Estimated Total Costs per Dossier

	<10 t/y	**<100 t/y**	**<1000 t/y**	**>1000 t/y**
Phase-in Full Reg dangerous	€ 9,118	€ 12,618	€ 38,806	€ 52,631
Phase-in Full Reg not dangerous	€ 5,661	€ 6,536	€ 18,069	€ 18,069
Full Reg Phase-in Consortia 2-danger	€ 13,274	€ 18,159	€ 47,265	€ 67,215
Full Reg Phase-in Consortia 2-non danger	€ 8,432	€ 10,693	€ 24,413	€ 29,006
Full Reg Phase-in Consortia>2-danger	**Variable and Proportionate to the Average Number of Companies in Consortia**			
Full Reg Phase-in Consortia>2-non danger				
Phase-in Partial dangerous	€ 3,063	€ 4,594	€ 11,375	€ 12,688
Phase-in partial non dangerous	€ 2,188	€ 3,063	€ 6,125	€ 6,125

In terms of the costs of a consortium registration for a consortium of more than two, these are dependant on the number of companies in the consortium. To calculate these, we developed a series of functions to reflect the increase in total costs with the increase in the size of a consortium.

Substances (dangerous and non-dangerous) covered by the US and the ICCA HPV programmes will already have some data related to a hazard assessment available. A cross check was therefore made with the US/ICCA HPV listings to identify whether the case study substances were present. Costs were then adjusted according to these findings and the information available, further details can be found in the full report available online.

Steps 5 and 6: Price Increases, Authorisation and Withdrawal

Steps 5 and 6 provide the basis for examining the magnitude of costs to downstream users on the basis of all compliance costs being passed onto downstream users.

It is important to note that most of the work undertaken to date on indirect effects tends to assume that all substances will be classified as 'dangerous' and will thus face the full costs of preparing a registration dossier. In reality, a significant percentage of substances are likely to be classified as non-dangerous and thus face lower registration requirements. This should decrease the likelihood that such substances are withdrawn from production. In the case of fragrances and can coatings, as the substances are already subject to strict requirements in relation to human health, the main testing and registration costs arising from REACH will relate to registration in relation to environmental data.

Once the direct costs were calculated, it was possible to derive the much more complex indirect costs, largely dependant upon the bargaining power of companies up and down the supply chains and the market characteristics of each sector.

4. Indirect Costs of REACH

4.1 Overview

The first stage in developing the microeconomic model to quantify the indirect impacts of REACH was to review past studies on this subject to identify the different methodologies adopted and to understand some of the criticisms made of them. For this, we reviewed in great detail the approach and methodology adopted by three major economic studies of the economic impacts of REACH[6]: To the best of our knowledge, these three studies and a further one that is not publicly available were the only detailed studies to have been undertaken so far. These studies include the following

- Arthur D Little– Economic Effects of EU Substances Policies (2002, 2003) (study focuses on Germany);
- Mercer and Nera – Study of the impact of the future chemicals policy (2004) (study focuses on France)
- Canton and Allen (DG Enterprise, EU Commission) –A Microeconomic Model to Assess the Economic Impacts of the EU's New Chemicals Policy (2003) (study focuses on European chemicals industry);
- CIRC – Sectoral vulnerability analysis (not publicly available).

The models developed by Mercer and BDI were criticised for a number of reasons, including the failure to allow for suppliers from 'outside' the model's boundaries to supply a substance withdrawn from the market by a national company, substitution assumptions, and a failure to fully account for how costs are likely to pass through different actors within the supply chain and wider economy. It was concerns such as these that led the European Commission to develop its microeconomic approach (which has also been criticised for its assumptions concerning market structures – i.e. monopolistic competition in the chemicals market).

All three models were also criticised for failing to address adequately the trade implications of REACH. These implications include concerns that increases in costs for specific sectors could make EU production uncompetitive, resulting in the shift of production outside the EU and the import of finished articles.

It was essential that the model developed for the study captured the key characteristics of the supply chain, and in so doing, it focused on production costs, employment and other inputs, turnover and profitability of the application industries. By so doing, it was possible to take better account of the price sensitivity of final demand, market

6 Presentation by Enterprise Directorate-General, 'Assessing the impacts of REACH on Downstream Users', *workshop on REACH Impact Assessment 21 November 2003*.

characteristics (e.g. the importance of competition and vertical linkages actors in the supply chain), and substitution possibilities (chemical and technological).

The aim of the economic models was to assess how the economic costs arising from the requirements for registration under REACH are passed along the supply chain and the impact that they have on different actors within the supply chain[7]. The model developed to reflect these linkages covers:

- the impact on the prices of the chemical and of the products that successively use the chemical along the supply chain;
- how these changes in prices affect downstream producers and final users;
- the impact on availability of product varieties (product withdrawals); and
- how these withdrawals affect downstream producers and final users.

The model was developed to reflect the UK economy as a whole in response to the implementation of REACH, although it can also be applied at the sectoral level. The model drew on different sources from the economic literature to describe the competitive interaction along the chemicals' supply chain.

The BE-COMP framework that is described in more detail below is well explained in Richard Baldwin and Charles Wyplosz[8] book.

The approach also drew on the modelling techniques developed for DG Enterprise by Canton and Allen (2003)[9]. This model is particularly suited to address the reaction of chemical producers to the change in fixed costs that the REACH proposals entail but falls short of an analysis of oligopolistic interaction.

Thus a model of bilateral oligopoly was used to describe how a cost shock upstream will affect decisions and outcomes both upstream and downstream. This follows Corbett and Karmarkar (2001)[10].

4.2 The BE-COMP Framework

The BE Curve

The model assumes economies of scale in the production of chemical substances, represented by the presence of fixed costs. This signifies that unit costs decrease with quantity produced. Production costs have a fixed cost (FC) component and a marginal cost (MC) component. This assumption implies that in an equilibrium with larger number of firms, as each firm produces less output, average costs are higher and firms

7 It therefore does not cover the potential effects of the subsequent evaluation and authorisation phases, nor the associated potential benefits for human health and the environment.

8 Richard Baldwin and Charles Wyplosz, The Economics of European Integration, McGraw Hill, December 2003.

9 Canton and Allen (2003): "A microeconomic model to assess the economic impacts of the EU's new chemicals policy"

10 Corbett, C. J., and Karmarkar, U. S. (2001), "Competition and Structure in Serial Supply Chains with Deterministic Demand," Management Science 47, 966-978.

require a higher mark-up above MC in order to break-even. Conversely, when the equilibrium number of firms decreases, each firm produces larger output, has lower unit costs and requires a lower mark-up in order to break-even. This relationship is represented by the break-even curve (BE) in the diagram below. The BE curve is a reflection of the cost structure of the chemical industry.

For an individual firm the break-even condition is given by:

$$pq = FC + MCq$$

With n symmetrical firms we have that $q = \frac{Q}{n}$, so that for each firm

$$(p - MC)\frac{Q}{n} = FC$$

or

$$markup = \frac{nFC}{Q}$$ [11]

The interpretation of the expression above is that, as the number of firms increases, the mark-up has to go up. In addition, if FC (fixed costs) increases, break-even can be restored by a combination of higher mark-ups and lower number of firms.

The COMP Curve

Competition among producers of the chemical substance will be tougher as their number increases. This is consistent with the Cournot-Nash model as well as other commonly used models of competition in oligopoly markets. When the number of firms increases, competition among them is more aggressive and the mark-up consequently decreases. This relationship is represented by the "competition curve" (COMP) in the diagram below. In the limit, with a very large number of firms, mark-up tends to zero, the asymptote of the COMP curve. The COMP curve is a reflection of the demand conditions for the chemical substance.

In the model, producers compete as an oligopoly among them, but also have to consider the actions of a second group of oligopolists, the processors. This means that the COMP curve can be represented in the graph below as long as we hold fixed the number of oligopolists in the downstream market. It may however be the case that a change in the equilibrium number of producers will lead to a change in the equilibrium (or sustainable, or stable) number of processors.

There are however a number of particular cases where particular functional forms of the final demand curve imply that the equilibrium mark-ups in the upper tier of the market are independent of the number of firms downstream. Tyagi (1999)[12] identifies a number of these cases.

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11 Note also that this expression explains the straight-line shape that we see in the BE-COMP graphic depiction below: break-even mark-up levels increase linearly with change sin the number of firms.

12 Tyagi, R. K., 1999, 'On the effects of downstream entry', Management Science, 45: 59 – 73.

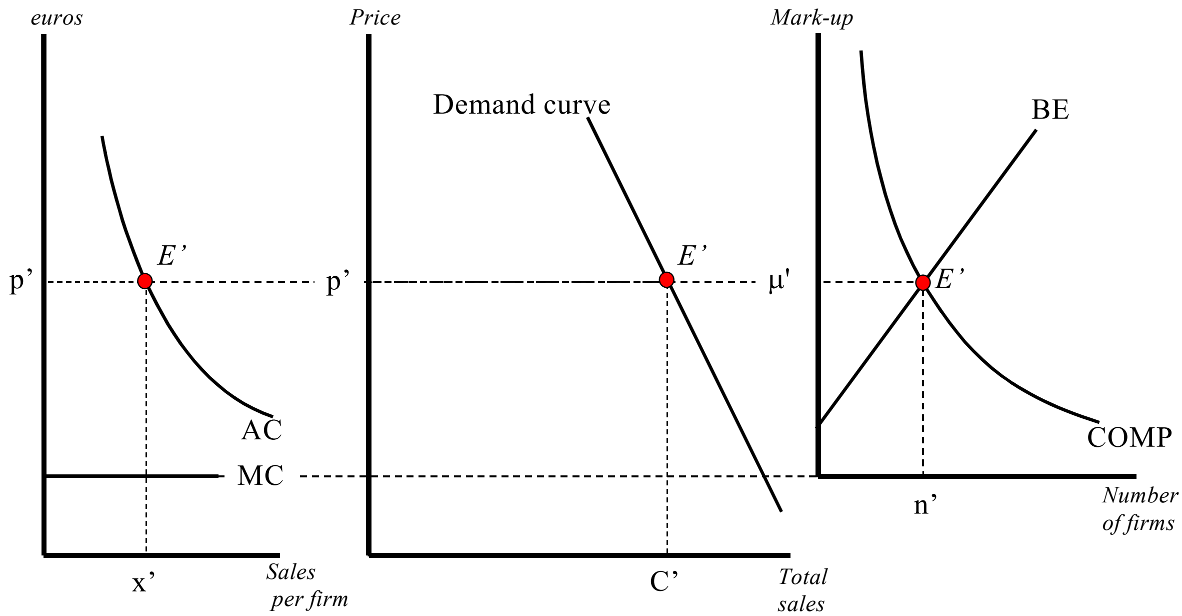
With this proviso, and for the particular case of a linear demand function of the form $p = a - bQ$ we can write the expression for the COMP curve as:

$$p = \frac{1}{n+1}\left(a - MC_d\right) + \frac{n}{n+1}MC$$

where MC_d is the marginal cost of the downstream tier. The explanation for this expression can be found in our section on the bilateral oligopoly model. In accordance with our intuition, the expression above tells us that as the number of competitors increases, the mark-up decreases. It also shows that the impact of an extra competitor on mark-ups is stronger when there are very few and becomes negligible as the number of competitors increases.

Equilibrium in the BE-COMP Framework

The intersection of the BE and the COMP curves gives us the equilibrium number of firms and the equilibrium level of mark-up. The mark-up added to MC gives us the corresponding price and using the aggregate demand we can figure out the total quantity sold in the market. Given this price and the break-even (or zero profit) condition, the level of sales per firm can be compiled.



From Baldwin and Wyplosz (2003) op. cit.

Impact of a Fixed Costs Shift

When a shift in fixed costs occurs (as in the case of that resulting from the implementation of the REACH program) the profits of chemical producers decrease and it is likely that some production of some substances will no longer break-even. Relative to the situation prior to the cost shift, firms now require a larger mark-up in order to break-even. This corresponds to an upward shift of the BE curve. A higher equilibrium mark-up in this market translates into higher input prices for downstream processors.

Processors, in turn, face a demand for their output as well as competition from other processors of identical or similar products. The ability for processors to absorb input price increases will depend on the level of competition that they face and the elasticity of demand for their products.

So far we have interpreted the diagram as a representation of a supply chain for a single product. It is however possible to think of this as a representation of a market where several varieties are being offered to buyers and where, as a result of a fixed cost increase, some of these varieties may be withdrawn from the market. In that sense, this diagram can also be seen as providing an intuitive representation of the mechanics of the model by Canton and Allen for DG Enterprise, although their model does not allow for more than one level of oligopolistic interaction.

4.3 A Simple Model of Bilateral Oligopoly

We present a model with three tiers – in the first two tiers we allow for the interaction of a small number of firms as a bilateral oligopoly. In the final tier, we have consumers who are represented by a demand function.

Fixed costs affect the decision to operate or not on a given market and/or the decision to initiate or cease the production of certain products.

We start with a characterisation of the initial equilibrium. This includes the number of firms producing at each tier; the quantity produced by each and in total; and the price in each tier. This information allows us to know the profit of each firm and thus the maximum level of fixed cost that can be sustained under the current market structure.

When a program such as REACH is implemented, it brings about an increase in fixed costs – this increase is not permanent but we may consider the present value of a flow of payments that would cover this increase in costs.

For example, if we have to spend an extra £1,000 on a given product for registration and certification this can be amortised over a period of say 5 years with a certain interest rate so that the increase in fixed costs may be only slightly more than £200. We take this increase and compare it with the current gap between operating profits and fixed costs. In some cases, we will find that the operation is no longer viable under the new level of fixed costs. In this case, we will consider the possibility of 1 firm leaving the market. We then recompute the bilateral oligopoly equilibrium, consider the new level of profits, and check whether this is now higher than the increase in fixed costs. We continue in this manner until enough firms leave so that the new level of profits is high enough to cover the new level of fixed costs. This will give us a new equilibrium with a different number of firms and different prices on each market.

It is possible that we will also see a change in the number of firms in the downstream tier. The fixed costs downstream have not changed but as the number of firms in the upstream tier decreases, it is possible that the downstream firms lose relative bargaining power as a group and their profits may be affected as well. This may necessitate that some firms leave the downstream market for a new equilibrium to be reached.

Elements of the Model

At producer level:

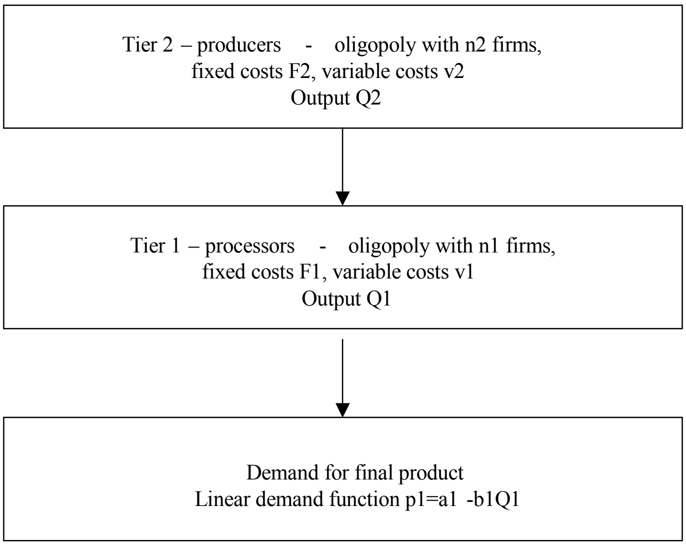
1. We will compute equilibrium mark-up levels in a market with n_2 producers and n_1 processors, and bilateral oligopoly interaction among them.
2. We will let n_2 (the number of producers) vary while holding fixed n_1 (the number of processors). This will allow us to construct an equation describing how the mark-up changes with the number of producers.
3. We will compute the break-even level of mark-up for producers, as a function of n_2 holding n_1 fixed.
4. When the REACH program enters into effect, there is an upward shift in the level of fixed costs for chemical substance producers. This will affect the break-even conditions described in 3 but will not, in a first approach, affect the competitive interaction between producers and processors.
5. As a result of the change in fixed costs, the equilibrium number of producers is likely to decrease, and in any event the equilibrium level of mark-up will go up. The increased mark-up will correspond to an increase in variable costs for processors.
6. We have to verify whether the number of processors (that we are holding fixed so far) also needs to change so that a new stable outcome is reached. When the number of producers changes, the number of processors may no longer be an equilibrium. If processors start making losses then we should see the number of processors decrease, while if their profits increase we may expect to see entry into that market.

At processor level:

1. Processors face a demand for their product which is mainly characterised by an elasticity of demand.
2. As a result of REACH, and as a result of the increase in mark-ups by chemical producers, processors see an increase in the price of one of their inputs. This will have an impact on the price at which they sell their output. This impact depends on: the weight of that input in total production costs; the competitive conditions describing interaction with other processors of close substitute products; and the elasticity of demand.

At final consumer level:

1. Consumers are described by an aggregate demand function.



Details of the Model

The impact of a change in costs upstream will reverberate throughout the supply chain in a way that depends on a number of factors, namely:

- the initial number of firms in each of the tiers of the supply chain;
- how significant the change in costs is relative to current levels of fixed costs and of variable costs; and
- the characteristics of final demand, namely its price elasticity.

In the model, REACH is assumed to take the form of a shock where fixed costs go up while variable costs do not. It is also assumed that there are a certain number of producers on each level of the supply chain. The analysis begins with a certain equilibrium, which will be disturbed by the change in fixed costs.

Working with just one substance at a time, consider a substance which is produced by an oligopoly of firms and bought by another oligopoly of firms. There is at present a certain cost of entry and a certain equilibrium number of firms in each tier. Next, an increase in the cost of entry is assumed and the equilibrium recomputed.

This is done following the model by Corbett and Karmarkar, which is described in more detail in the final report available online.

5. Findings

5.1 The Potential Impacts of REACH

The potential annual costs of REACH to the sectors studied are relatively low. For the silicon wafer manufacturer, the costs amount to between 0.07% and 0.15% of annual turnover. For fragrance manufacturers, the direct costs of REACH range from 0.06% to 1.8% of annual turnover (which could be equivalent to nearly 18% of annual profits).

One of the factors limiting the costs of REACH is the large volume of information already available for a significant number of the bulk chemicals acting as inputs to the manufacturing process. For example, the availability of information from the US EPA and ICCA HPV programmes reduces the costs associated with REACH significantly in the silicon wafer study. Where substances are already subject to other regulatory regimes, such as for food packaging and cosmetics, the additional costs of testing and registration under REACH will be further reduced.

The impacts of authorisation on the case-study sectors would appear to be limited by authorisation not being required where substances are "adequately" controlled under existing regulations, including cosmetic products and food contact materials and where uses are controlled under the IPPC permitting process, as in silicon wafer manufacture.

One of the key factors affecting the impact of REACH for downstream users will be the extent of substance withdrawal and the resulting requirement for reformulation. The registration and testing costs of REACH for the case studies examined in the study do not appear to be high enough to lead to significant levels of substance withdrawal.

A characteristic common to all the sectors studied is the existence of constraints on substituting chemicals arising from the need to meet the safety, performance, quality and environmental requirements of downstream uses. This may take the form of qualification and verification procedures (as in semiconductors), a requirement to demonstrate that a substance complies with existing legislation (e.g. cosmetics legislation, food safety legislation) or policies of downstream users adopted in response to NGO and consumer pressures (fragrances and food retailers). Meeting such requirements can impose substantial testing and administrative costs on upstream suppliers and can take a period of 6-12 months or longer to complete. Consequently, if a chemical substance is withdrawn or an alternative needs to be found, there could be significant costs in reformulation or the development of new systems, creating barriers to the substitution of inputs and to new suppliers in the supply chain.

Vertical restraints and ties within all of the supply chains have maintained tough competition between suppliers in all of the sectors. As a result, it is difficult in general for companies to pass the costs of registration of new substances downstream. The implication for REACH is that larger companies with lower cost structures and greater market power will be in a better position to absorb additional costs, and pass them, on compared to SME suppliers and manufacturers.

Most of the suppliers and manufacturers participating in these case studies operate in worldwide markets rather than EU or national markets alone. Theoretically, any costs imposed on industry by REACH could have an impact on the competitiveness of EU operations compared to non-EU producers. This applies particularly where UK-based companies serve customers outside the EU, as in the silicon wafer and fragrance sectors. The estimated costs of REACH to these sectors would not appear to be significant enough on their own to lead to any re-location outside of the EU.

Overall, our findings suggest that industry is likely to be able to absorb the majority of the costs of REACH without impacting significantly on the competitiveness, location or market structure in the UK. However, should REACH result in a significant number of substances being withdrawn, due to the failure of manufacturers or importers to support them through registration, the considerable industry barriers that operate may result in unexpected impacts (even where substitutes already exist).

5.2 The Potential Benefits of REACH

Some formulators are supportive of REACH because it will provide a sounder basis for considering the risks associated with using different substances. This may mean that downstream users and retailers are less likely to impose restrictions on ingredients solely in response to NGO campaigns. However, this would depend on the willingness of retailers to use the information to challenge consumer and NGO perceptions of risk.

Downstream users believe that REACH could have benefits in the long term in improving access to information on the risks associated with chemicals, thereby reducing their potential liability for chemical related issues in their end-products. Effective enforcement of REACH will be important in ensuring that these potential benefits are realised. The current poor quality of safety data sheets shows the low level of enforcement of existing legislation. Better information and transparency also potentially benefits downstream users, as traceability is improved.

The retail sector believes that REACH could have significant benefits in addressing concerns about chemical ingredients expressed by customers and NGOs. Even in advance of REACH, the retailer participating in the fragrance case study considers that its suppliers have become more willing to share such information. However, it does have a concern that public availability of data may give NGOs greater scope for campaigning, and pressurising Competent Authorities to prioritise substances for evaluation that the NGOs consider significant. In this respect, it will be very important for the Chemicals Agency to ensure consistency between Competent Authorities.

6. Concluding Remarks

The outputs from the case study analyses have enabled predictions of the likely effects of REACH at the sectoral level, identifying the relative magnitude of compliance costs in relation to the different size companies. The microeconomic model, however, was not applied to all three case studies. This is due to the findings of the compliance cost work, which concluded that REACH would not have a significant impact on the costs faced by the downstream user sectors even if 100% of the costs were passed onto the downstream users. However, the microeconomic model assisted with assessing impacts that are more complex and proved both versatile and effective in the one case study in which it was applied, in addition to a number of test simulations to which it was subjected.

Symmetric and asymmetric costs were applied to the model in simulations, which can be reviewed along with MATLAB codes in the full report available online.

The implication for policy makers of introducing such modelling techniques to projects is the ability to no longer rely solely on largely qualitative information to draw conclusions. It is now possible with limited data to simulate possible downstream impacts, which in many cases can be more significant than direct costs if assessing competitive effects or changes to market structure because of a particular policy. In extreme cases, this could include the removal of the market completely where a product is banned or restricted to.