Europe Economics

Measuring the Benefits to UK Consumers from the Creation of the European Single Market: Feasibility Study and Test Case

A Europe Economics report for BIS

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Executive Summary

- This report was commissioned from Europe Economics by the Department for Business, Innovation and Skills (BIS). It sets out a methodology for assessing the effect of the Single Market on UK consumers and applies that methodology in the automotive and home insurance sectors.
- The benefits or disbenefits of the Single Market for UK consumers are understood in terms of effects on prices, quality and the range of goods available.
- Theory suggests the Single Market should produce benefits to UK consumers through direct effects — such as enhanced trade between Single Market members, increased competition and faster innovation— and "indirect effects" such as higher labour productivity and lower costs of capital (from the free movement of labour and capital) reducing production costs and thence prices.
- Theory also suggests there could be disbenefits to consumers from increased regulatory burdens raising costs, tariffs raising prices of imports from outside the Single Market, and tariffs reducing the range and quality of imports available from outside the Single Market.
- There are a number of ways to estimate the balance of impacts upon consumers, including cost-benefit analysis, macroeconomic simulation and international benchmarking. We argue in favour of using international benchmarking here, as it requires less subjective judgement about what would have happened absent Single Market membership and it requires a much narrower range of data to be available (albeit over a longer time horizon).
- International benchmarking can be implemented using econometric modelling in which the prices, quality, and choice in finished goods depend upon factors such as labour cost inflation, real interest rates, commodities inflation, exchange rates, and per capita GDP growth. We can then compare and disentangle trends in the UK, Europe and internationally (using a set of non-Single Market comparator countries: Australia, Canada, Japan, and the US) to see whether either those trends change or there is any step-shift following the start of the Single Market.
- We apply our methodology in the automotive and home insurance sectors. These are chosen as an example of a good and of a service where data was expected to be widely available and Single Market effects material. However, even in these sectors, we still faced significant data limitations.
- In the automotive sector, our analysis suggests that UK car consumers have paid lower prices in the era of the Single Market. However, the portion of that fall that should be attributed to the Single Market is more difficult to ascertain, owing to various data and methodological challenges. Using our preferred model we find some evidence of a direct effect of the Single Market on annual UK automotive price inflation, which warrants further investigation. Unfortunately, data on UK quality and variety is limited and we find no robust effect from the Single Market on these variables.
- For home insurance, whilst again we find some evidence that the Single Market has had an impact on prices, international data issues mean that these results should be treated with more caution.
- Overall, we recommend gathering additional sectoral data before applying any of the methods set out here any further — at present even in those sectors in which data is richest (e.g. the automotive sector) it appears to be difficult to obtain fully robust results.
- More generally, a closer exploration of the automotive sector might reveal more information on what factors were driving the reduction in prices that we have observed. This might include experimenting with a different approach that seeks to understand the various factors that have driven these trends and the role that the Single Market has played amongst those.

1 Extended Summary

1.1 Objective of the report

This report was commissioned from Europe Economics by the Department for Business, Innovation and Skills (BIS). The objectives of the report are:

- to propose a methodology to evaluate the effect of the Single Market on UK consumers in terms of prices, quality and variety of goods and services;
- to assess the feasibility of the proposed methodology in terms of data availability; and
- to test the approach on two case study sectors: automotive and property insurance.

This report attempts to describe how to estimate the benefits from the Single Market to the population of the UK in their role as consumers in a particular sector. We do not investigate the impacts of the Single Market in other areas, such as upon workers, business owners, investors or land owners. It should be emphasized that the main goals are methodological, not quantitative, and the quantitative results here are reported only to illustrate methodological points and should not be treated as standalone "findings".

1.2 The Single Market and the Single Market Programme

The European Single Market is the world's largest economically integrated area, geographically comprising the Member States of the European Union and of the European Free Trade Area (currently Iceland, Liechtenstein, and Norway). The Single Market is characterised by four fundamental freedoms: the free movement of goods, services, capital and labour. To deliver and protect these freedoms, a number of policies have been put in place. These include:

- a customs union with a common external customs tariff;
- mutual recognition of the regulatory and other requirements of other Member States;
- harmonisation of competition policy and regulatory and other requirements across the EU;
- common frameworks for economic regulation (e.g. of utilities); and
- the control of State aid.

The Single Market was officially established by 31 December 1992, through the Single Market Programme implementing the ambition of the Single European Act (the 1987 revision of the Treaty of Rome).

1.3 Benefits and detriments from the Single Market for UK consumers

1.3.1 Our definition of consumer benefits

This report considers consumer benefits as arising in three categories:

- Lower prices. If the Single Market produced lower consumer prices that would, under our definition, be a consumer gain. If, on the other hand, the Single Market produced higher prices (e.g. for consumers purchasing goods from outside the EU, subject to tariffs; or because the regulatory burden of complying with EU regulation raised production costs and, via that route, retail prices), that would be a consumer loss.
- Higher quality products. For economic purposes, quality can be defined as the value that consumers derive from purchasing a product. It is determined by the attributes of the product and consumers'

preferences. Quality increases can be driven by lower costs, productive innovation and competition. For many goods and services, the "standard" quality of a good or service evolves over time. For example, the average computer purchased today will have more and improved features compared to the average computer only a few years ago.

- Greater product variety. The Single Market gives consumers more access to goods and services produced in other Member States. Due to the differences in the comparative advantage of producers across the Single Market, consumers might enjoy a wider variety of product characteristics. Variety for a single firm implies an additional production cost. It might entail designing and maintaining several product lines, dealing with a larger group of suppliers and a more complex productive process.

We note that by focusing upon consumer benefits arising in these ways we abstract from other potential sources of consumer benefit and detriment that could be relevant in other contexts. For example, consumers might suffer detriment if they were the victims of scams, and if some regulatory programme meant consumers suffered fewer such scams that would benefit consumers. If there were reason to believe the Single Market had had a material impact on consumers in these dimensions, a methodology separate from that developed here would be required.

1.3.2 How benefits and detriments should be expected to arise

Means by which the Single Market might benefit consumers, in terms of reduced prices or greater quality or choice, include:

- Trade creation from trade liberalisation.
- Stronger competition.
- Economies of scale.
- Resource allocation efficiency.
- Faster product innovation.
- Cost reductions from legal and regulatory harmonisation.

The Single Market might also create a number of sources of consumer detriment:

- The common external tariff might raise prices for non-Single Market imports into the UK.
- The common external tariff might deter certain imports from non-Single Market altogether, reducing product variety and/or reducing lower quality.
- Regulatory burdens from EU regulation, where higher than those that the UK would create alone, might raise production costs and therefore consumer prices.
- EU regulation might result in the elimination of products previously purchased by some UK consumers, to those consumers' detriment.

1.3.3 How benefits and detriments might differ between goods and services

Some services are intrinsically less tradable than most goods. For example, it is much more difficult to export a haircut than a car. One might therefore expect impacts of the Single Market to be greater in respect of goods than of services as some of the channels for consumer benefits, such as trade, might play a smaller role.

However, services do not necessarily benefit from the Single Market to a lesser extent than goods. Even if the outputs of services sectors intrinsically involve more non-tradables, they might still experience a significant Single Market effect through the free movement of inputs (capital and labour).

1.4 Estimating the Single Market effect

1.4.1 Challenges

Assessing the effect of the Single Market upon our definition of consumer benefits involves overcoming a number of significant challenges:

- Measuring prices, quality and variety.
- Assessing what proportion of the effect of these measures is attributable to the Single Market.
- Establishing a date of commencement for the Single Market.
- The interactions between the three consumer-relevant outcome variables could be complex

In addition, we observe that the effect upon consumers – though important and interesting in its own right – does not in itself provide an analysis of the net overall impact of joining or being a member of the Single Market. Consumers could in principle lose while the economy or society as a whole gains, and vice-versa.

1.4.2 Candidate methodologies

We consider three main candidate methodologies for estimating Single Market effects:

- Cost-benefit analysis — set out a detailed and comprehensive list of costs and benefits, produce estimates for each item and compare total costs and benefits.
- International benchmarking — compare statistics for the UK or the Single Market with those of comparator countries outside the Single Market as benchmarks.
- Macroeconomic simulation — enter data into elaborate theoretical models of growth and trade, so as to predict the impacts of a policy or, as in this case, the effect of the Single Market.
- Meta-analysis — draw together the results of other studies into a new, synthesized assessment.

We assess these different methodologies according to a number of criteria summarised below.

Table 1.1: Assessment of methodological approaches based on judgement criteria

Methodology	Universal	Robust / comprehen -sive	Statistical evidence	Attribution	Implemen-tability	Interpretabi -lity	Data availability
Cost-Benefit Analysis	X	X	✓	✓	✓	✓	X
International Benchmarking	✓	✓	✓	?	✓	X	?
Macroeconomic Simulation	✓	✓	X	✓	X	X	✓
Meta-Analysis	✓	X	X	✓	✓	X	✓

Note: The definitions of the criteria are discussed in Sections 5.2 and 5.3.

Despite some weaknesses, we conclude that international benchmarking is the most appropriate to address the objectives. The rationale behind this conclusion is that international benchmarking is based purely in statistical evidence, it does not depend crucially on the details of the sector being analysed and that it minimises the risk that the choice of variables made by the researcher will affect the results. We consider also for this method that, while data requirements are not always satisfied, they are less restrictive than with cost-benefit analysis or macroeconomic simulation.

1.5 Outputs-based versus inputs-based models

The best way to measure the degree of integration within the Single Market is in terms of its effects — namely convergence in wages and prices. In one market there is one price. We term data that measures or assesses the Single Market in terms of the convergence delivered "output measures" and models based upon such measures "outputs-based models". Below we explain how such a model could work and illustrate the approach with the set of car prices data that we have available from 2003 to 2012. Unsurprisingly, given the very limited we have, the results are not statistically significant, but as they stand the additional convergence in prices that occurred within the Single Market from 2003 to 2012 is associated with 6.9 per cent lower prices in the UK than if there had been no additional convergence.

Given that we do not have data adequate for implementing an outputs-based model even in the most data-rich sectors (e.g. cars) our view is that an outputs-based approach is unlikely to be implementable at sectoral level (though we believe that it remains a good approach for the economy overall and for major sub-sectors thereof). Instead, to conduct sectoral analysis we believe it will typically be necessary to resort to "inputs-based" measures whereby the Single Market is measured/assessed in terms of the regulations that are intended to create or deepen it.

Such regulations could take very complex forms, developing a view as to the relative importance of this or that EU Directive. For our illustrative purposes here, we focus upon the highest-level consideration — namely measuring the Single Market by its official start-date at the beginning of 1993. For our illustrative purposes here we deem the Single Market to be a binary variable — it was not in place before 1993 and was in place in Member States from 1993 onwards.

It should be noted, however, that the main econometric techniques and issues that we raise in this report would be relevant (*mutatis mutandis*) to the testing of the impact of major individual Single Market measures as well as to the presence/absence of the Single Market overall.

1.6 Our methods for international benchmarking

The form of international benchmarking we deploy in this report uses econometric modelling. Our econometrics produces models in which the prices, quality, and choice in finished goods and services depend upon a range of factors such as labour cost inflation, interest rates, commodities inflation, exchange rates, and per capita GDP growth. We then compare and disentangle trends in the UK, Europe and internationally to see whether either those trends can be attributed to international or national changes or whether there is any step-shift as a result of the Single Market programme.

Our estimation captures trends that appear systematically while the Single Market was in place and cannot be attributed to national or global factors. This, however, does not necessarily imply causality. In principle, as far as our models could identify, events that occur at around the same time as the Single Market programme could be the causes of changes in prices, quality or choice. For example, it is possible that the break-up of the Warsaw Pact and transition from Communism in the early 1990s was an important factor in car price movements and that it would have occurred at that same date even absent the Single Market.

Our method should therefore be seen more as an attempt to estimate how much (if any) change there is during the time of the Single Market and in what direction (benefits or disbenefits to consumers) than as an attempt to prove or disprove that the Single Market causes any effect upon consumers.

1.6.1 Two forms of benchmarking

In our main econometric analysis, we consider how the UK differs from a sample of non-EU countries (Australia, Canada, Japan, and the United States) that serves as a proxy for international trends, and

attempt to identify whether there is any change in the relative positions or trends at or around the time of the Single Market programme. Intuitively, the idea is that, absent the Single Market, the UK might be expected to match world trends (except insofar as the UK had its own particularities, which the statistical model could identify). The effect of the Single Market upon the UK is then seen as what is "left over" of the UK's trends/changes after controlling for international trends and for the UK's own particularities.

As an alternative, one could have considered data from the Member States of the Single Market and compare that with the same non-EU countries. This approach would not be expected to produce exactly the same results as the first approach unless the effect of the Single Market upon the UK were exactly the average effect for the Single Market — the Single Market might affect some countries more than others or even affect them in different ways (e.g. prices for some products might rise in low-price parts of the Single Market but fall in high-price parts). We do this for quality but not for prices (where we already have multiple models).

Table 1.2: Dates of commencement of the Single Market

Member State	Date
EU 12 (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom)	1993
EEA (Norway, Iceland, Liechtenstein, Austria, Finland, Sweden*), Switzerland**	1994
EU 25 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia)	2004
EU 27 (Bulgaria, Romania)	2007
EU 28 (Croatia)	2013

Notes: * Austria, Finland and Sweden became members of the European Economic Area (and thus, by our definition, of the Single Market) in 1994 as members of EFTA, then joined the EU in 1995. ** Switzerland rejected membership of the EEA in a referendum, but then reconstructed a similar arrangement via a series of bilateral agreements — for our purposes we treat it as a Single Market member from 1994.

It should be noted that our approach assumes that the creation of the Single Market did not affect non-EU international trends, which is a strong assumption. That might be an incorrect assumption if, for example, the Single Market strengthened the EU's position in international trade negotiations and led to faster (or slower) international tariff reductions, thereby changing international as well as EU trends.

1.6.2 Direct versus indirect impacts

Our models consider two classes or "rounds" of effect upon prices, quality and variety:

- First, the Single Market might have direct effects itself, via competition or trade or other such factors directly reducing prices, enhancing quality or increasing variety (or the reverse).
- Second, the Single Market might have second-round or indirect effects, by reducing labour costs or the cost of capital or affecting the rate of foreign currency exchange with non-Single Market economies. For example, if the Single Market leads to reduced labour costs that might lead to lower production costs and thence to lower prices.

1.6.3 Data availability

The approach identified here does not require such elaborate or detailed data as would cost-benefit analysis or macroeconomic simulation. Nonetheless, the data requirements are significant and in particular for our approach to work more historical data is needed, for the relatively small number of variables we require, than would be the case for the cost-benefit or macroeconomic simulation approaches.

For certain sectors historic price data is available via national statistical agency inflation series. For other sectors it may be necessary to rely upon industry-produced public series or even, potentially, to access databases produced and sold privately (e.g. for marketing, accounting or finance specialists). Long-run historic time series for quality or choice indices are less widely available across sectors, though coverage in

some sectors is quite detailed, and new data may be obtainable via surveys or other field work. Economy-wide control variables such as exchange rates and GDP growth are straightforwardly obtainable, as are real cost variables such as commodities prices.

Some issues arise with international comparability, especially between EU data and non-EU data. An important form of this issue arises because EU-methodology data are typically only produced when, or shortly before, a new Member State joins the EU. This means that pre-Single Market and in-Single Market data may not be comparable. In the case of a long-established member of the Single Market data going back many decades may be required.

We note, also, that for a long-established member of the EU such as the UK, the Single Market was constructed gradually, with first the customs union then non-tariffs barrier reduction in respect of goods then increasing freedom of movement of capital and labour and latterly increasingly free movement of services. That means in addition to needing many decades of data to identify the entire UK-specific effect, there is also not a well-defined start date for the Single Market — it is more a process than an event.

1.7 Case studies

We illustrate how to apply our methodology in practice by using two case studies: automotive and home insurance. These sectors are not chosen at random and neither the results nor the methodological challenges we faced in those sectors should be considered either representative or typical of those expected in other sectors.

The automotive sector is chosen as a good, as versus the service of home insurance. Automotives are a helpful good to choose because they are widely-traded, both within and outside the Single Market, because data is abundant and has existed for many decades, and because there have been many previous studies of the sector and well-known Single Market measures and analysis, meaning we would expect to find some effect of the Single Market upon them (finding no effect might suggest that our methods were flawed).

Home insurance is the service chosen because there is a price series available within the European Harmonised Index of Consumer Prices and because it is a form of service that we would expect to be tradable across borders (one can export home insurance services much more easily than haircuts).

1.7.1 Data sources

Price data was obtained from Eurostat and from national statistical agencies as follows:

Table 1.3: Sources of price level information from national statistics offices

Country	Source	Starting availability	Other comments
Australia	Australian Bureau of Statistics	Cars – 1974 Insurance - 1989	"Insurance" category is used as a proxy for home insurance
Canada	Statistics Canada	Cars – 1974 Insurance – 1975	
Japan	Statistics Bureau of Japan	Cars – 1974 Insurance – 1975	"Fire insurance premium" used as a proxy for home insurance
United Kingdom	Office of National Statistics	Cars – 1974 Insurance – 1975	"Dwelling insurance & ground rent" used as a proxy for home insurance
United States	Bureau of Labor Statistics	Cars – 1974 Insurance - 1987	"Financial services" used as a proxy for insurance

Note: "Starting availability" is set to be harmonised with the UK; in some cases data are available earlier, but we restricted the time period of data collected to be harmonised data with UK availability.

1.7.2 Model illustrative results

Results for the Automotive sector

Direct Effects: Using our preferred model (in which impacts are defined as being upon real purchasing power), we find a statistically significant (at the 10 per cent level) direct effect of our Single Market variable on motor vehicle prices measured in real purchasing power terms. According to our range of estimates, we found that there is a reduction in annual real purchasing power price inflation of 0.34 to 6.8 percentage points per annum, relative to international trends.

We find no consistent statistically significant effect of the Single Market on UK quality or variety.

Indirect Effects: In the case of automotives, we find no significant indirect effects of the Single Market.

Total Effect: This translates into a cumulative effect over the lifetime of the Single Market of between 7 and 76 per cent.

We note, however, that this model is sensitive to specification, which suggests that these results may not be robust.

Result for Home insurance

Annual property insurance price inflation is found to fall around 5.9 percentage points per annum, which is again subject to model specification. We also have major concerns about data comparability in the property insurance models and would attach low weight to the specific estimates produced in that sector at this stage.

1.8 Recommendations

Even in the selected case studies, which were chosen partly in anticipation of higher-than-typical data availability, we have faced a number of significant data constraints, and even where data has been available we have not always been able to rely upon it (e.g. in the case of price data for home insurance).

- Overall, we recommend:
  - Gathering additional sectoral data before applying any of the methods set out here — at present even in those sectors in which data is richest (e.g. the automotive sector) it appears to be difficult to obtain fully robust results;
    - Rather than conducting primary field work and commissioning of new surveys, by data gathering we refer to compiling existing data and producing harmonised figures either by adjustment or by obtaining data produced under a harmonised methodology. Additional data could improve significantly the results obtained in the case studies if long and comparable time series for EU and non-EU countries can be constructed;
  - Once additional data has been gathered, where such data permit and where the question concerns the impact of Single Market integration, using the "outputs based" approach in which the "degree" of the Single Market is defined in terms of the level of price and cost convergence;
  - Where the question concerns the impact of having been in the Single Market, applying the methods explored here in other sectors
    - Our recommended concept of price impact is that upon real purchasing power prices
    - Extending the analysis to include more sectors would increase the opportunity to exploit cross-sectional (cross-sectoral) properties of the model, increasing the statistical confidence of certain key results
    - Extending the Single Market set to include countries joining the EU since 2004 (a set for which relevant comparable data should become available in due course — meaning that the task of obtaining additional relevant data should be feasible) would reduce the ability of the

model to assign impacts to the Single Market as opposed to contemporaneous events of the early 1990s (e.g. the collapse of the Warsaw Pact)

- More generally, a closer exploration of causality than has been feasible in the context of this study might increase confidence in the policy relevance of the statistical results. This might include looking further at the automotive sector and experimenting with a different approach that includes explanatory variables that are directly linked to the drivers of change.

2 Introduction

2.1 Objective of the report

This report was commissioned from Europe Economics by the Department for Business, Innovation and Skills (BIS). The objectives of the report are:

- to propose a methodology to evaluate the effect of the Single Market on UK consumers in terms of prices, quality and variety of goods and services;
- to assess the feasibility of the proposed methodology in terms of data availability; and
- to test the approach on two case study sectors: automotive and property insurance.

This report attempts to capture the benefits from the Single Market to the population of the UK in their role as consumers. We do not investigate the effect of the Single Market in other areas, such as upon workers, business owners, investors or land owners. It should be emphasized that the main goals are methodological, not quantitative, and the quantitative results here are reported only to illustrate methodological points and should not be treated as standalone "findings".

2.2 Outline

The report is organised as follows:

- Section 3 discusses how this report defines and measures "benefits to consumers".
- Section 4 discusses how theory suggests the Single Market might affect consumer-relevant goods and services in terms of prices, quality and variety.
- Section 5 derives, explains and justifies a methodology for assessing the consumer benefits of the Single Market.
- Section 6 illustrates how our preferred methodology works in practice through two case studies.
- Section 7 contains conclusions and recommendations.
- Appendix 1 discusses the data that would be most appropriate to implement our preferred methodology.
- Appendix 2 provides details of the econometric estimation performed in the case studies.
- Appendix 3 presents data sources that could be used for other sectors of household expenditure.
- Appendix 4 contains a summary of the literature on measuring the effects of the Single Market.

3 How this Report Defines and Measures "Benefits to Consumers"

3.1 Our definition of consumer benefits

This report considers consumer benefits arising in three categories:

- Lower prices.
- Higher quality products.
- Greater product variety.

We observe that by focusing upon consumer benefits arising in these ways we abstract from other potential sources of consumer benefit / detriment that could be relevant in other contexts. For example, consumers might suffer detriment if they were the victims of scams, and if some regulatory programme meant consumers suffered fewer such scams that would benefit consumers. If, therefore, there were good reason to expect the Single Market to have the result that UK consumers suffered materially less from scams (or materially more) our definition of consumer benefit in terms of just the three categories above would be incomplete. Having noted this caveat, we set it aside — although it is possible that the Single Market affects UK consumers in other areas than on prices, quality, and choice, theory suggests no strong reason to expect such effects (relative to UK-only policy-setting).

3.1.1 Lower prices

Our first category of consumer benefits arises from lower prices. If the Single Market produced lower consumer prices that would, under our definition, be a consumer gain. If, on the other hand, the Single Market produced higher prices (e.g. for consumers purchasing goods from outside the EU, subject to tariffs; or because the regulatory burden of complying with EU regulation raised production costs and thence retail prices), that would be a consumer loss.

3.1.2 Higher quality

For economic purposes, quality can be defined as the value that consumers derive from purchasing a product. It is determined by the attributes of the product and consumers' preferences.

Quality increases can be driven by lower costs, productive innovation and competition. For many goods and services, the "standard" quality of a good or service evolves over time. For example, the average computer purchased today will have more and improved features compared to the average computer only a few years ago.

3.1.3 Product variety

The Single Market gives consumers more access to goods and services produced in other Member States. Due to the differences in the comparative advantage of producers across the Single Market, consumers might enjoy a wider variety of product characteristics.

Variety implies a cost for the producer. It might entail designing and maintaining several product lines, dealing with a larger group of suppliers and a more complex productive process.

3.2 Challenges arising from our definition

Assessing the impact of the Single Market upon our definition of consumer benefits involves overcoming a number of significant challenges:

- Measuring prices, quality and consumer choice is not a straightforward exercise. First, there is no consensus as to the best way to measure quality and variety. Second, the existing available data has many shortcomings in terms of time series length, cross-country comparability and level of disaggregation.
- Even in respect of regulatory and other policy measures likely to have created costs and benefits to consumers, there is no universally accepted framework to assess what proportion of the impact of these measures is attributable to the Single Market. A significant challenge is to disentangle the economic impact of the Single Market from that of other trends (global and national) occurring simultaneously.
- The Single Market does not have an unambiguous date of its commencement. The treaties, directives and regulations affecting the Single Market have evolved substantially over time and continue to do so.
- The interactions between the three consumer-relevant outcome variables could be complex. For example, product variety might not necessarily have a positive effect for consumers. First, variety could be used as a means to price discriminate. Even if price discrimination has a total positive efficiency effect, consumers might find themselves worse off as producers might capture all the gains and more with higher prices. Similarly, there might be a trade-off between lower price and variety, especially in sectors where consumers have imperfect product information (e.g. about product quality). It is conceivable that some markets would be characterised by an homogeneous product (low variety) and strong price competition, while others might have high product variety coupled with higher prices.

In addition, we observe that the impact upon consumers – through important and interesting in its own right – does not in itself provide an analysis of the net overall effect of joining or being a member of the Single Market. Consumers could in principle lose while the economy or society as a whole gains, and vice-versa.

4 How Theory Suggests the Single Market Should Create Consumer Benefits / Detriments

The European Single Market is the world's largest economically integrated area, geographically comprising the Member States of the European Union and of the European Free Trade Area (currently Iceland, Liechtenstein, and Norway).[1] The Single Market is characterised by four fundamental freedoms: the free movement of goods, services, capital and labour. To deliver and protect these freedoms, a number of policies have been put in place. These include:

- a customs union with a common external customs tariff;
- mutual recognition of the regulatory and other requirements of other Member States;
- harmonisation of competition policy and regulatory and other requirements across the EU;
- common frameworks for economic regulation (e.g. of utilities); and
- the control of State aid.

4.1 Benefits / detriments to consumers

One main goal of the Single Market is the delivery of benefits to consumers, including access to goods and services at lower prices and higher quality and larger product variety. These improvements are expected to be delivered via:

- Trade liberalisation: by stripping away tariffs and non-tariff barriers, trade with Single Market partners increases (this is the "trade creation" effect of a customs union, amplified by the additional reduction in non-tariff barriers in a Single Market), allowing exploitation of comparative advantage.
- Stronger competition: In sectors where size, barriers to entry or other factors means markets are not fully competitive, increased trade may mean increased competitive pressure from abroad, reducing prices for consumers and increasing technical and allocative efficiency within and between firms and industries.
- Faster product innovation: The deep interchange of ideas and methods across different settings and cultures facilitated by a Single Market can be a driver of increased creativity in innovation
- Cost reductions from legal and regulatory harmonisation: Common legal and regulatory procedures, including a common intellectual property framework, allow lower-cost compliance systems in firms operating across multiple Member States because duplication is reduced (or even eliminated).

The overall impact of the above ought to be increased productive efficiency: productivity gains are defined as a decrease in the cost of producing a given amount and quality of output. Productive efficiency might increase in a Single Market because of a combination of:

- economies of scale and scope.

[1] Collectively, the Members of the EU plus EFTA usually comprise the European Economic Area (EEA). However at the time of writing Croatia is an EU member but not formally a member of the European Economic Area since its membership has not been ratified by all EFTA members. In most of our models we also include Switzerland as a Single Market country, even it is not a member of the EEA.

- faster technological progress.
- optimal allocation of productive resources (as a consequence of the freedom of movement for labour and capital).
- specialisation (that would exploit comparative advantages).

Consumers are likely to benefit most when these effects interact. For example, efficiency gains alone may be captured by producers if markets are uncompetitive. However, if the Single Market enhances the level of competition, it is expected that these gains in productivity would be passed through to consumers.

These are the expected sources of benefit. The Single Market might also create a number of sources of consumer detriment:

- The common external tariff might be set at a rate higher than the UK would set itself for imports from at least some non-EU countries, raising the prices of such non-Single Market imports into the UK.[2]
- The common external tariff might be sufficiently high that certain imports from non-Single Market countries might be deterred altogether, reducing product variety. Furthermore, the nearest equivalent product produced within the Single Market (or from a different non-Single Market source) might be of lower quality.
- The regulatory burdens of EU regulation might create compliance costs higher than those that would be imposed if the UK were setting (or deciding not to set) such regulations, with the result that compliance costs might be higher, raising production costs and thus raising consumer prices.
- EU regulation might result in the elimination of products previously purchased by some UK consumers, to those consumers' detriment.

4.2 Goods vs services impacts

While the Single Market creates and protects freedom of movement for goods, services, capital and labour, these freedoms operate to different extents in different areas of economic activity. In particular, services tend to have a larger non-tradable component than goods (e.g. it is intrinsically more difficult to export a haircut than to export a pair of scissors).

Given the lower levels of trade integration in services, one might therefore expect free movement of goods to, quite naturally, create larger benefits (for a given value of output) than the free movement of services. However, such reasoning risks ignoring that, even if the outputs of services sectors intrinsically involve more non-tradables, they might still experience a significant Single Market effect through the free movement of inputs (capital and labour).

[2] We note that the UK's 1973 entry into the European Economic Community (a forerunner of the Single Market) entailed the setting of tariffs upon imports from, for example, New Zealand that did not exist prior to joining.

5 Towards a Methodology for Assessing the Consumer Benefits from the Single Market

In this section we derive, explain and justify a methodology for assessing the consumer benefits of the Single Market, via the following steps:

- First we set out a number of candidate methodologies, explaining how other relevant studies have assessed effects upon prices, quality and range of products available, or upon consumer benefits more generally, and supplementing this with some additional methodological options drawn from economic reasoning.
- Next we explain by what criteria we contend selection of a methodology should be made.
- Then we evaluate our candidate methodologies by our stated criteria, identifying our preferred option.

5.1 Candidate methodologies

There are different approaches one could use to estimate the effect of the Single Market on economic variables of interest. In addition, some studies conduct 'meta-analyses' that combine the results of previous reports based on one or several such approaches. (Meta-analysis is not, in this sense, an approach on itself, but rather a method to aggregate and harmonise existing results.)

The economic literature includes three main methodologies for assessing the effect of agreements/arrangements similar to the Single Market. These are:

- Cost-benefit analysis.
- International benchmarking.
- Macroeconomic simulation.

In this subsection we elaborate briefly the main features of each of these approaches. Next, we provide a brief account of how these approaches have been used in the literature. We then establish a set of criteria that can be used to select a methodology. Finally, we judge the appropriateness of the different approaches according to these criteria.

5.1.1 Cost-benefit analysis

Cost-benefit analysis (CBA) is a 'bottom-up' estimation of the costs and benefits of the Single Market. The aim is to set out and then quantify all the relevant costs and benefits (or some relevant subset of them) individually. For example, many studies focus on gains from trade, productivity or the cost of compliance with regulations. The methodology can be tailored to the economy as a whole or groups of stakeholders of interest (in this case, UK consumers) without depending on differences or similarities with comparator countries.

The approach relies, first, on the production of a detailed and comprehensive list of costs and benefits and, second, on obtaining estimates for each item. An important drawback is that this list is usually not universally agreed. In fact, many previous studies differ in the nature of the effects to be estimated.

A second drawback is that this approach is very demanding in terms of data and it typically requires that the authors make strong assumptions to estimate unobservable variables. Differences in these assumptions could account for the high variation in the magnitude of the estimated effects found by different authors.

A third drawback is that the counterfactual is constructed via speculation, which makes the results of this methodology open to a high degree of subjective judgement and dispute.

The main advantage of this approach is that it provides a natural break-down of the total effects of the Single Market into its components. Therefore, the task of identifying the channels through which the Single Market operates is straightforward.

5.1.2 International benchmarking

This approach uses comparator countries (outside the EU Single Market) as benchmarks. An advantage is that is possible to determine which effects are due to national or global trends and which could be attributed to the Single Market.

The main difficulty of this approach is that no comparator country is likely to be similar to the UK in every relevant dimension, making the comparison less reliable. In addition, data might not be comparable across countries due to differences in their markets or in the practices of the offices that elaborate statistics.

A second drawback is that, while the data typically reflects the total effect of the Single Market, it could be difficult to assess which variables are driving the change. The magnitude, sign and significance of coefficients are important tools for the assessment. However, there is a risk that a statistically significant explanatory variable might reflect the effect of unobserved correlated variables (i.e. even with the use of international benchmarks, the risk of a "false positive" is fairly high). An example might be if countries often joined the Single Market shortly after experiencing periods of economic turmoil that included high inflation but without the Single Market itself contributing to that inflation's reduction. Then lower inflation would be correlated with being in the Single Market but would not have been caused by it.

The main advantage is that the counterfactual — what would have happened if the UK had not been a part of the Single Market or the Single Market had simply not existed at all — emerges naturally without significant judgement or speculation on the part of the researcher. Instead, the counterfactual is obtained straight from global trends.

5.1.3 Macroeconomic simulation

Macroeconomic simulation makes use of sophisticated general equilibrium models of growth and trade to elaborate predictions of the effects of a policy or, as in this case, the effect of the Single Market. These models include Computable General Equilibrium (CGE) studies as well as sectoral models of international trade.

While these models are calibrated using national and international data, simulation results typically involve very little or no statistical analysis. Rather than an assessment tool, they are particularly suitable for the prediction of the future effects of a policy for which there is little experience.

5.1.4 Literature

There have been a number of studies that estimate the costs and benefits of the Single Market in general or the effect on the UK of participating in (or exiting) the European Single Market. Appendix 5 summarises a selection of such reports that have attempted to estimate the effect of the Single Market on various economic variables.

A majority of the identified literature has focused on the cost-benefit approach. In addition, these reports have tried typically to establish the effect of the Single Market on macroeconomic performance variable such as GDP. In contrast to this report, there has been very little research aimed at variables faced directly by consumer, such as prices, quality and variety.

5.2 Criteria for assessing candidate methodologies

The methodologies discussed have advantages and limitations. In this section, we elaborate a list of criteria that would assist in evaluating the suitability of each approach for the objectives and constraints of this project.

We propose the following criteria:

- Universality: the framework should not depend crucially on the details of the sector being studied. Therefore, the methodology applied in one sector could be easily modified to analyse a different sector.
- Robustness / comprehensiveness: the methodology should not depend crucially on a particular choice of variables to take into consideration.
- Foundation in statistical evidence: the methodology should be based on objective statistical data rather than modelling, speculation or anecdotal evidence.
- Attribution: the framework should be convincing in separating the effect of the Single Market from other economic phenomena.
- Cost of implementation: a methodology that requires less effort to implement is preferred over a more costly one.
- Interpretability: the final effects can be traced back to the economic mechanisms or processes that drive them.
- Data availability: public and reliable data should be available, minimising the number of variables for which the authors need use strong assumptions in place of objective data.

5.3 Evaluation of our candidate methodologies

Based on our criteria, we evaluate the candidate methodologies:

Table 5.1: Assessment of methodological approaches based on judgement criteria

Methodology	Universal	Robust / comprehen -sive	Statistical evidence	Attribution	Implemen-tability	Interpretabi -lity	Data availability
Cost-Benefit Analysis	X	X	✓	✓	✓	✓	X
International Benchmarking	✓	✓	✓	?	✓	X	?
Macroeconomic Simulation	✓	✓	X	✓	X	X	✓
Meta-Analysis	✓	X	X	✓	✓	X	✓

The current project aims to develop a framework that is:

- applicable to multiple sectors;
- based on statistical data that is publicly and readily available; and
- able to provide objective estimates minimising arbitrariness in the methodology.

Based on the criteria summarised in Table 5.1 we conclude that International Benchmarking offers the most suitable characteristics for this project, based on the following balance of pros and cons. The main (and

decisive) advantages are that the method is based purely in statistical evidence, it does not depend crucially on the details of the sector being analysed and that it minimises the risk that the (conscious or unconscious) choices by the researcher (in particular concerning the counterfactual) will significantly steer the results. We consider also for this method that, while data requirements are not always satisfied, they are less restrictive than with Cost-Benefit Analysis or macroeconomic simulation. [3]

The International Benchmarking approach suffers also from some weaknesses, which are discussed in detail during the following sections. These weaknesses are:

- Attribution: International Benchmarking will capture systematic variations that occur in countries that are part of the Single Market and absent if they are not part of it. However, this methodology might pick the effect of other causes that may take place simultaneously with the Single Market. See sub-section 5.4.1 for an extended discussion of this important drawback of International Benchmarking.
- Interpretability: This methodology does not attempt any detailed analysis of the economic mechanisms that would drive the total Single Market effect. Instead it measures the effects of such economic mechanisms on certain key variables.
- Data availability: While less demanding that Cost-Benefit analysis or macroeconomic simulation in terms of the range of data required, this methodology does depend on historical data availability and, in addition, on the international comparability of such data in terms of units, measuring methods and dates.

5.4 Elaboration of our preferred methodology

We next explain in more detail the general features of how we implement our preferred methodology.

5.4.1 Counterfactual and test definition

Our international benchmarking approach requires two key elements:

- Some set of other countries combined together and appropriately adjusted so as to provide a "counterfactual" — a model of how matters might have evolved if the Single Market did not exist.
- Definitions of "the Single Market" and "Single Market membership" that allow a test of its effects.

In each case there are a number of alternative possibilities, which we shall now describe.

Our approach to the counterfactual

First, the question of the counterfactual. Our approach is to focus our attention upon selected non-EU OECD countries. The comparator countries we use include: Australia, Canada, Japan, and the United States. While these countries exhibit some obvious differences with the UK, they might present the most reliable basis for constructing an indication of how price, quality and variety would have evolved if the UK was not part of the European Single Market. It is important to note, however, that our method does not assume that the UK's experience would precisely track either any individual comparators nor any form of average across them. Rather, it assumes that any differences between the UK's economic circumstances and those of the comparators (or any trend for closing or amplifying such differences) would have been maintained had the UK not been in the Single Market.

Our econometric approach, described below, attempts to disentangle the effects of the Single Market from other global trends or other tendencies for the UK (or other Single Market members) to converge to or diverge from global trends. Ideally, this could be achieved by considering data from:

[3] We note that the main purpose of the present report is to assess the benefits for consumers in selected sectors of the economy. If the objective was to estimate the effects in all sectors, a general equilibrium approach, such as macroeconomic simulations, might be more appropriate.

- EU countries while participating in the Single Market.
- EU countries before participating in the Single Market.
- Non-EU OECD countries.

Therefore, our approach would require panel data from a wide set of comparable countries covering a long period of time. As will be discussed later in this report, we do not do this in our analysis as the data from other European countries was not sufficiently available and robust to be used in the context of this project.

The "synthetic counterfactuals method"

It is worth noting that an alternative form of international benchmarking that could be used is the "synthetic counterfactuals method" (SCM) used by Campos et al (2014).[4] Under the SCM a best-comparator for the period leading up to joining the EU is synthesized from a pool of comparator countries, then the actual performance post-EU membership is compared with that of the synthetic counterfactual. For example, for the UK Campos et al find that using 91.2 per cent New Zealand, 8.8 per cent Argentina tracks UK GDP per capita closely for the period leading up to 1973. In the period after 1973 UK GDP per capita rises much more rapidly than does 91.2 per cent of New Zealand GDP per capita plus 8.8 per cent of Argentine GDP per capita. Campos et al conclude that EU membership has raised UK GDP per capita by around 9.4 per cent ten years after entering the Single Market, as opposed to an EU average of 12 per cent.

If this methodology is rolled out to other sectors this approach to the counterfactual could be used as a viable addition or alternative to our approach.

Defining "the Single Market"

In our 2013 report for BIS, *Optimal Integration in the Single Market: A Synoptic Review*[5], Europe Economics distinguished between what it termed "input measures" of integration — which focus upon the policies used to attempt to promote Single Market integration — and "output measures" — which focus upon how much integration has in fact been achieved in terms of increased convergence in costs and prices. In the current context, in which we are considering methodologies for assessing consumer benefits in each sector, candidate output measures might include cross-Single Market price, labour productivity, or cost of capital convergence within the sector. Input measures might take the form of treating membership of the Single Market occurring at a particular point in time or the Single Market as being created gradually by a set of regulations and directives within the relevant sector.

Although our 2013 report tended to favour output measures as the ideal, their use for the current purpose presents certain drawbacks.

- First there is the ever-present problem of data. For many sectors, price and cost data is not available in any consistent form over the many decades during which the European Union (and before it the European Community and the European Economic Community) has existed. Even when data does exist, it often does so only after countries join the EU.
- Second, the question in this report concerns the effect of Single Market membership — a policy — not simply of integration within the European economy (which might or might not be directly the result of any policy). It might of course be possible to assess whether Single Market membership had or had not had an effect on convergence within a sector, but doing so would require some "input" definition, and once that is obtained on an accepted basis it might be thought most natural to use that directly.
- Third, in assessing consumer benefits we are interested in changes to prices both directly via the Single Market and indirectly via effects on labour productivity and upon the cost of capital. That means that

[4] See http://www.voxeu.org/article/how-poorer-nations-benefit-eu-membership and http://www.voxeu.org/article/how-rich-nations-benefit-eu-membership

[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224579/bis-13-1058-europe-economics-optimal-integration-in-the-single-market-a-synoptic-review.pdf

using "output" measures based on prices, labour productivity and the cost of capital present a risk of circularity — one risks measuring the effects of price reductions upon themselves.

Nonetheless, these caveats noted, and while we use an inputs-based approach in our main models, we suggest that "outputs" based models should where feasible be used as at least a cross-check. Below we provide an illustrative outline of such a model for car price inflation.

Defining "Single Market membership"

That leaves the question of whether Single Market membership should be treated as an event (using a one-zero variable to reflect whether one is in or out) or as a process with the Single Market being gradually built up over time (using some index variable for the amount of the Single Market, where a value of zero might indicate no Single Market at all and one would indicate a perfect Single Market).

For a country joining the Single Market in recent years, in a sector where the key regulatory measures to promote the Single Market have been in place for many decades, we believe an event-based approach is most natural — Croatia can reasonably be said to have joined the Single Market in automotives in 2013, where that Single Market can reasonably be said to be (more-or-less) complete.

For the UK the issue is more complex. The Single Market might be seen as built up gradually over a number of years even before the UK joined the EEC in 1973 and the Single Market programme commenced with the coming into force of the Single European Act in 1987 and had a target of "completing" the Single Market by 1993, but perhaps even after 1993 there might still have been some further progress even in the most developed sectors, for some years subsequently.

One approach for the UK might therefore involve some variable giving an index measure of how complete the regulatory process of creating the Single Market is in a particular sector. For example, this was the approach Europe Economics adopted in its report for the European Parliament of the impact of the Financial Services Action Plan of 1998-2006.[6] In that case there were 42 specific regulations and directives that constituted the plan, they came into force in different countries at different dates, and certain of the measures were widely acknowledged to be much more material than others. Reflecting these points, the index was constructed on the basis that the most significant measures had a high weighting, and other measures a lower weighting, and the index score for each country in each year was the weighted cumulative sum of the regulations and directives enacted in that country up to that point.

Where one has such a well-defined set of measures, and a sufficiently agreed basis for weighting them, we would recommend the use of such an index.

In the current context, however, we believe that across the broad range of sectors our methodology here needs to cover, it would be very difficult to secure agreement as to the significance and contribution of many Single Market-building regulatory measures. Furthermore, we believe the effort and uncertainty in producing such an index would not be proportionate to the added statistical robustness of the results, compared with the alternative we favour.

In the main approach we use below, the Single Market is treated as a one-zero event that occurs for existing EU members in 1993 and for others at the point at which they join the EU (or EEA). Furthermore, for some dimensions (specifically, quality) we produce two forms of our models — one set in which the UK experience is compared with international comparators' directly, and one set in which the experience of Single Market members is compared with international comparators'. For sectors in which the Single Market might reasonably be said to be near-complete by the early 1990s, that means the statistical contribution of a few years of an index of between 0 and 1 from, say, 1987 to 1995, for the UK (in the UK-only models set) and the EU15 (for the Single Market members models set) would be likely to be modest even if constructed perfectly. Most of the statistical "work" is done by the years outside the Single Market

[6] http://www.pedz.uni-mannheim.de/daten/edz-ma/ep/07/pe385.623_part_I-en.pdf see pp109-111

(where the index value or the Single Market one-zero dummy value would both be zero) or the years inside a near-complete Single Market (where the index value or the Single Market one-zero dummy value would both be one).[7][8]

Thus although in some sectors the construction of an index for Single Market implementation may be of value (e.g. where one is assessing the effects of a regulatory programme that was well-circumscribed, extended over time and recently completed — as was the case for the Europe Economics assessment of the Financial Services Action Plan) we do not believe it would add materially for the sorts of cases (e.g. motor vehicles) upon which we place most attention in this current study.

5.4.2 Country sample

UK and non-European countries

The sample contains the UK and a set of non-European countries, including Australia, Canada, the United States, and Japan.[9] These countries have been used previously as comparators with the UK.[10] The aim in sampling the UK and several non-European countries is to establish how prices have moved in the UK relative to some "world" trend. For instance, UK prices may have fallen since entry into the Single Market. This trend could be driven by global factors in the sector (e.g. cheaper labour inputs from declining unionisation internationally) or factors specific to the Single Market (e.g. price-based competition among suppliers in the Single Market). Thus, our sample seeks to isolate UK trends from trends in similar countries outside of Europe.

Note that one potentially useful approach would be to estimate the impacts for Single Market countries in general — i.e. by identifying when each Member State joined the Single Market and gathering data before and after that point, with the Single Market dummy set to one as that country joins and being zero for all non-Members. In that case the coefficient on the Single Market dummy should be interpreted as the average impact of the Single Market upon prices / quality / variety across the Single Market as a whole rather than for the UK per se. There is, of course, no guarantee that the Single Market impact would be the same for each Member State (indeed, there are strong theoretical reasons for believing that that would not be so), that the UK would experience the average Single Market impact or that the UK would even experience the same direction of impact (e.g. UK price inflation could in principle rise in some sectors when the average impact across the Single Market would be to cut prices, or vice versa — such effects would be expected for at least some countries where the Single Market resulted in price convergence, and might be quite common across sectors for real relative prices). To take account of this one can introduce a "UK in the Single Market" model which considers the interaction between being in the Single Market and being the UK, relative to the Single Market's impacts upon other countries.

We use this second approach for quality and variety but not for prices (where we already have multiple models to present), as the price data is not of sufficient quality to conduct this exercise.. However, the data we have has allowed us only to include EU15 Member States, all of which join at the same time as the UK, and certain EEA states that joined shortly thereafter. That means the added value of the second

[7] The problem of defining the start date of the Single Market is also easy to over-state. Any policy change whatever might be anticipated and might have effects that scaled up after the official start-date of the policy. Yet this difficulty does not prevent Event Study analysis, of which our methods here are a (perhaps the canonical) form, being commonly used in policy impact evaluation.

[8] Appendix 4 constructs a Single Market measure that captures the level of integration based on price dispersion.

[9] Due to the lack of data availability on key model covariates, New Zealand is often excluded from the econometric analysis.

[10] The economic performance of the UK is typically benchmarked by the academic and practitioner literatures using other OECD countries. See for example BIS (2012) "Benchmarking UK Competitiveness in the Global Economy" and Durlauf, Steven, Paul Johnson and Jonathan Temple (2005) "Growth Econometrics," in Handbook of Economic Growth, edited by P.Aghion and S.N. Durlauf, North-Holland: Elsevier, Amsterdam.

approach is more limited than it would be if it included more variation in the joining date (as would be the case if it included the accession states of the 2000s and 2010s. Extending our pricing analysis to include such an approach and including later accession waves in the quality analysis would be potentially interesting extensions of the illustrative exercises set out below.

Table 5.2: Dates of commencement of the Single Market

Member State	Date
EU 12 (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom)	1993
EEA (Norway, Iceland, Liechtenstein, Austria, Finland, Sweden*), Switzerland**	1994
EU 25 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia)	2004
EU 27 (Bulgaria, Romania)	2007
EU 28 (Croatia)	2013

Notes: * Austria, Finland and Sweden became members of the European Economic Area (and thus, by our definition, of the Single Market) in 1994 as members of EFTA, then joined the EU in 1995. ** Switzerland rejected membership of the EEA in a referendum, but then reconstructed a similar arrangement via a series of bilateral agreements — for our purposes we treat it as a Single Market member from 1994.

5.4.3 Choice of measure of sectoral prices

A key methodological decisions concerns what price series to test in investigating whether the Single Market has had an impact. Let us consider three candidates, each with its own strengths and weaknesses:

- Nominal prices
- Real relative prices
- Real purchasing power prices

Nominal prices

The most straightforward measure of prices will be a nominal price series. This might be obtained from sectoral or trade press data. Alternatively, some nominal prices appear as sub-components in official inflation indices.

If our models find an impact of the Single Market upon nominal prices via a year dummy — as per our main approach here — that identifies an overall impact that combines impacts upon production efficiency, competition and so on with impacts the Single Market may have had upon inflation management. Let us explore these in turn.

First, suppose that the Single Market had no impact upon inflation management. Then impacts upon nominal prices are purely "real" impacts. To see this, note that nominal prices can be seen as composed of a real element and a denominator element. The real element of prices is a measure of how many real resources — labour, capital, land, etc. — it takes to purchase a unit of the good or service — e.g. one way to express a real price might be the number of hours labour it would take to earn the funds to pay for the good.[11] The denominator element is simply the units in which prices are expressed — this is the "pure inflation" component.

So the price of a good — say, cars — can be expressed as

Nominal car price = real element + denominator element

Then the impact of the Single Market will be:

Single Market impact on Nominal car prices = Single Market impact on real element of car prices + Single Market impact on denominator element of car prices

[11] We shall explore this point in more detail below.

But if the Single Market impact on the denominator element is zero (i.e. the Single Market had no impact upon inflation management) then we have

Single Market impact on Nominal car prices = Single Market impact on real element of car prices

This means that, if the Single Market had no impact upon inflation management, measuring the Single Market's impact upon nominal car prices will give the impact upon real car prices.

On the other hand, there is strong reason to expect that the Single Market did have an impact upon inflation management — both in general across the EU and for the UK in particular. The Maastricht Treaty introduced a number of monetary management requirements upon all members in preparation for the introduction of the euro. This had a direct impact upon the UK, with at least two significant monetary reforms being introduced precisely and explicitly in order to prepare for euro entry — Bank of England independence (introduced in 1997, as per the requirements of the Maastricht Treaty) and the targeting of the Harmonised Index of Consumer Prices (HICP — which is termed the "Consumer Prices Index" in the UK but matches the HICP methodology) from 2003 (introduced at the time of the "Five Economic Tests" assessment in order to encourage convergence. Furthermore (and related to the above) it is well-known that the UK's joining the "Exchange Rate Mechanism" (ERM) in 1990 (in the run-up to the introduction of the Single Market) was at least partly (and most standard commentary has argued wholly) motivated by European Community agreements.

Given that monetary policy was explicitly modified to meet Single Market requirements, it is natural to imagine that the Single Market would have had an impact upon the denominator element as well as the real element. That means the use of nominal prices has the advantage of more accurately capturing the all-in impact of the Single Market upon actual consumer prices and thus upon consumers.

The key drawback of the use of nominal prices is that it exacerbates the attribution problem we shall discuss in more detail below.[12] Just as the use of a year dummy runs the risk that some contemporaneous or near-contemporaneous event to the Single Market (e.g. the break-up of the Warsaw Pact in the early 1990s) might drive some or all of the effect our model attributes to the Single Market, in the case of nominal prices there is the risk that changes in monetary management that were unrelated to the Single Market might in fact be a significant driver of changes in the denominator element. In particular, probably the single most significant monetary reform since the mid-1980s was the introduction of inflation targeting in late 1992. Beyond its indirect association with the ERM (since it was the successor monetary arrangement that followed the UK's exit from the ERM) there is only a tenuous connection, at best, between the introduction of inflation targeting and the Single Market. Yet the timing coincidence is very close — inflation targeting being introduced within months of the official commencement of the Single Market.

The consequence is that there is a risk that at least some of the nominal impact a model based upon nominal prices (or nominal inflation rates) would attribute to the Single Market would in fact be a measure of the impact of inflation targeting upon inflation rates.

Real relative prices

One standard measure of real prices is given by taking the nominal price and dividing by the price level. This produces a relative price for the good.

One way to implement this would be by using a price index for the good derived from a sub-category of the overall price level index used as an official inflation statistic and then dividing by the value of the index as a whole.

[12] See Section 5.6.2

This has the advantage and disadvantage over a nominal price series that it abstracts from nominal impacts. The disadvantage is that consumers may have been affected by ways that the Single Market had an impact upon monetary management (as explored above). The advantage is that the approach reduces the risk that changes in monetary management that are unrelated to the Single Market will not be inadvertently captured.

Another advantage of real relative prices is that it focuses the analysis upon relative impacts — upon how one sector does relative to another sector. The most important disadvantage, however, follows directly from this, namely that (if measured properly) the aggregate impact upon consumers across all sectors must by definition be zero.

To see this more concretely, suppose that we were considering the impact upon cars and found that the Single Market meant the real relative prices of cars had fallen. That means that, by definition, the impact of the Single Market upon the average relative prices of all non-cars goods and services must have been to raise them (if the relative prices of cars falls, the average relative prices of all non-cars must have risen).

That means that, whilst real relative prices are of their own interest, if the objective is to estimate an overall impact upon consumers, building up that impact sector by sector, real relative prices will not be an appropriate measure — since there can only ever, by definition, be a zero overall impact upon relative prices across all sectors.

Real purchasing power prices

When economists talk of "real" terms impacts, in most contexts that is understood in terms of impacts upon purchasing power. "Real wage rises" are impacts upon the ability of wage-earners to purchase goods and services (not simply, for example, rises in wages relative to returns on capital).

One measure of real purchasing power would be the number of units of a good or service that could be purchased at average income. The most straightforward and comprehensive aggregate measure of average income is GDP per capita. Hence the real purchasing power price is given by the nominal price divided by nominal GDP per capita.

This method still has the drawback that it ignores impacts upon consumers of Single Market-induced changes to monetary management and the advantage of a lesser risk of mis-attributing inflation targeting and other non-Single Market-related monetary reforms as Single Market impacts. It also has the advantage that the sum of impacts across sectors need not be zero.

In what follows we shall explore a number of models of impacts upon nominal, real relative prices and real purchasing power prices, but our recommended definition is the real purchasing power price.

5.5 Elaboration of our econometric models

The Single Market could have two classes or "rounds" of effects upon prices, quality and variety:

- First, it might have direct effects itself, via competition or trade or other such factors directly reducing prices, enhancing quality or increasing variety (or the reverse).
- Second, the Single Market might have second-round or indirect effects, by reducing labour costs or the cost of capital or affect the rate of foreign currency exchange with non-Single Market economies. For example, if the Single Market leads to reduced labour costs that might lead to lower production costs and thence to lower prices. As will be seen below, because certain of our model specifications control for changes in labour costs or the cost of capital (treating them, in a statistical sense, as exogenous), such effects would be missed in the direct estimations and would need to be estimated separately.

This section discusses a broad range of methods available to construct the counterfactual. We focus in our illustrative examples on the fixed-effects modelling, but we elaborate on some common regression-based approaches to the sort of analysis we seek to conduct.

5.5.1 Econometric estimation models

The econometric techniques that can be used to estimate our model include ordinary least squares (OLS) regression and fixed-effects panel regression. We describe the features of the two estimators below.

OLS: trend and dummy models

OLS regression fits a linear combination of independent variables to a dependent variable, with the fitted line being that which minimises the squared errors between the estimated values and the actual values.

Our first model is a constant and time trend model:

$$growth_{c,t} = \alpha + \beta_1 * YEAR_{c,t} + \varepsilon_{c,t}$$

where α is a constant, β_1 is the time trend in the variable of interest, *YEAR* is the year of observation, and ε is the error term of the estimation. We include the year of observation as an independent variable to control for a possible downward trend in the growth of price, quality, or variety over time. This model corresponds to model (1) in our regressions in Appendix 2. This approach is somewhat unusual in that growth rate variables, such as inflation, do not usually have a time trend (i.e. are trend stationary). Nonetheless, inflation in particular categories or growth rates in quality or variety may have a trend over time due to decreasing cost of transportation technology, changing consumer tastes, or other factors that are either unobservable or that are not included in our model (typically due to data availability issues).[13]

This estimation can be expanded to isolate the effect of UK-specific influences on price inflation or the effect of being the UK and being in the Single Market. The estimated equation would be:

$$growth_{c,t} = \alpha + \beta_1 * YEAR_{c,t} + \beta_2 * SM_{c,t} + \varepsilon_{c,t}$$

where β_2 is the effect of, in this case, in the Single Market. We use three dichotomous variables to capture UK and Single Market effects on our consumer welfare variables. The UK dummy variable takes a value of one if the country is the UK and a value of zero otherwise. Models of this form correspond to (in most cases) models 2, 4, and 6 in our regressions in Appendix 2. The interpretation of the coefficient on the UK dummy variable is the difference in the dependent variable (e.g. rate of inflation) between the UK and other countries. The Single Market variable (called "SM" in the presentation of our models) takes a value of one for each year if the country is in the Single Market and zero otherwise. Like the UK variable, the interpretation of the Single Market is the difference between trends in the dependent variable for countries in the Single Market and countries not in the Single Market. The final dummy variable we use is an interaction between the UK dummy and the Single Market dummy, called "UKSM".[14] This is a captures the UK-specific effects of being in the Single Market. The coefficient on this variable is the difference between trends in the dependent variable in the UK during the Single Market period compared with trends in other Single Market countries and non-Single Market countries.

The interaction of the dummies and the time trend variable, which would indicate that a country in the Single Market has had a different time trend in the dependent variable than comparators:

$$growth_{c,t} = \alpha + \beta_1 * YEAR_{c,t} + \beta_2 * (YEAR_{c,t} * SM_{c,t}) + \varepsilon_{c,t}$$

[13] We note that even though this approach is slightly unusual, it should not impact the integrity of our results. If the year trend were not statistically significant, then the main risk would be that our model overfits the data and goodness-of-fit statistics, such as the R^2, would be artificially high. To address this risk, we report the adjusted R^2 for our models, which adjusts the R^2 downwards for each independent variable included in the mode.

[14] Note that this variable features in our quality models below but not in our prices models.

Models of this form correspond to (in most cases) models 3 and 5 in our regressions in Appendix 2.

OLS: models with controls

The trend and dummy specification can be expanded to include other controls, such as costs, GDP, and the exchange rate.[15,] Such a model would take the following form:

$$growth_{c,t} = \alpha + \beta_1 * YEAR_{c,t} + \beta_2 * SM_{c,t} + \sum_{i=3}^{n} \beta_i * CONTROLS_{c,t}^{i} + \varepsilon_{c,t}.$$

Models of this form correspond to (in most cases) models 6 through 11 in our regressions in Appendix 2.

Fixed-effects variants

It may be that unobservable factors unique to the countries in our data set are driving the relationships observed in the OLS estimations. For instance, if we estimate that labour costs have a significant effect on growth of our dependent variable that effect may be due to unobservable features of the country's labour market rather than labour costs as such.

To correct for any unobservable country-specific effects, we also employ the fixed-effects estimator in our analysis. The fixed-effects estimator is analogous to OLS regression where a dummy variable has been added for each country. Thus, in our fixed-effects models, we are estimating the effect of time, our Single Market indicators, and the control variables net of the effects that are specific to any one country in the sample.

What models do we present?

This paper presents the results of the fixed-effects models with full controls and fixed effects models with no controls as a "raw" reference. We ran other variations of the models, such as those described above, but prefer the fixed-effects model with controls as we believe this is the most robust approach given the data available and the problems we face. We include the fuller discussion above, however, in view of this study being a methodology development exercise.

Why not a pure "differences-in-differences" model?

Some readers may be familiar with the "differences-in-differences" (often referred to as "diff-in-diff") econometric model and have expected its deployment here.[16] We do not use a pure "diff-in-diff" model due to data constraints. A full diff-in-diff model would require information on treatment (Single Market countries) and control (non-Single Market countries) populations both before and after the introduction of the treatment (the introduction of the Single Market). As discussed elsewhere in this report, data on sub-index price levels were not widely available online from other Single Market countries, while data from Eurostat only begins in 1996. Thus, we do not have sufficient data from the pre-Single Market and post-Single Market period to use a diff-in-diff specification.

As we shall see below, our preferred model bears many similarities to the "diff-in-diff" structure, the key difference being that we cannot include all of the relevant interaction terms. This is because we only have one country — the UK — which is a member of the treatment group.

When should one consider time series controls?

Our method here is to use fixed-effects regression in an attempt to construct the counterfactual of how the economy might have evolved had the UK not joined the Single Market. If one had a time series for only one country, such as the UK, one could still conduct an analysis of the series. This would involve modelling

[15] The logic behind including such variables is discussed below.

[16] For a fuller discussion of the diff-in-diff model see: Angrist, Joshua D. and Pischke, Jorn-Steffen (2009) Mostly Harmless Econometrics: An Empiricist's Companion, Princeton University Press, Princeton, New Jersey, p. 227-241.

the time series using autoregressive or moving average terms and testing for a series break (with, say, a Chow Test). The key problem with pure time series modelling is the current context is that one cannot identify whether changes in patterns in the data are unique to the country analysed or something common to countries across the world.

5.5.2 Control variables

Costs influence prices, quality and variety via pass-through of cost increases to the consumer in the form of higher prices, lower quality and less product variety. Our methodology accounts for these changes in cost using a set of controls variables. We describe below the variables that we propose and that are used in our case studies. However, the methodology allows for the inclusion of additional control variables.

The cost variables that we propose are measured at the country-level and would typically vary between countries. However, the regression estimate is a single coefficient that measures the direct impact of the control variables on price, quality and product variety. However, these control variables are likely to be themselves affected by the Single Market. In a second step, our methodology measures the (EU-wide) effect of the Single Market on the control variables. Therefore, the Single Market would also have an indirect effect on prices, quality and variety via the control variables.

We use the following cost variables in our estimates of growth rates. Note that it is best to be consistent in one's use of nominal and real variables. In other words, where we are modelling impacts upon nominal prices, we use nominal control variables, whereas when we are modelling impacts upon real relative prices or real purchasing power prices, we use real control variables:

- Unit labour cost inflation — Economic theory typically breaks production inputs down into labour and capital. The unit labour cost (ULC) is defined as the cost of using one unit of labour (typically measured as one labour hour) to product one unit of output:

  $$ULC = \frac{total\ labour\ costs}{real\ output}.$$

  Total labour costs include wages, taxation payable by the employer, and other employment-related costs. The year-over-year change in ULCs is the inflation rate of ULCs. Our data on ULCs are obtained for each country from the OECD database. We have found that these data are most relevant for a cross-country estimation, covering the period from 1970 to present for the vast majority of countries of difference. ULCs are available at the whole-economy level and at the sector level, however the data are sparser in the latter.[17] For this reason, we use ULC data at the whole-economy level. It is important to note the ULC is a combination of a productivity measure (amount of output per unit of labour) and the price of labour. A reduction in the ULC could be caused either by an increase in productivity or a decrease in wages.
- Interest rates — The interest rate is a measure of the cost of capital, which is the other input in the production process. In addition, interest rates are the return to saving, the opportunity cost of consumption. Focusing upon real interest rates, the effect on consumer variables is ambiguous. For instance, in normal times, lower real interest rates are likely to be associated with higher rates of inflation, while higher real interest rates tend to coincide with lower rates of inflation. Thus, we would expect to find a negative coefficient on real interest rates.[18]

[17] Ideally, the unit labour cost figures would correspond to the sector of interest. For instance, analysis of the automotives sector would preferably use unit labour costs in the automotive manufacturing industry. We use data on whole-economy ULCs because data are more available at the whole-economy level. The implicit assumption, then, is that inflation in whole-economy unit labour costs is the same as the rate of labour cost inflation in the sectors of interest.

[18] There are a number of channels through which the real interest rate influences inflation. For our purposes, the most relevant channel would be through incentives of producers and consumers to borrow. If producers borrow

When modelling impacts upon nominal prices we use nominal interest rates. Where relevant, we calculate the real interest rate by using data on nominal interest rates and consumer price inflation from the OECD. Nominal interest rates are defined as long-term interest rates as measured by the OECD and inflation is the year-over-year inflation in the national all-items consumer/retail price index (the consumer price index for countries other than the UK; the retail price index for the UK). To obtain the real interest rate, the nominal interest rate is deflated by consumer/retail price inflation using the Fisher Equation:

$$r = \frac{(1+i)}{(1+\pi)} - 1$$

where r is the real interest rate, i is the nominal interest rate, and π is the inflation rate.

The first two measures of input costs may be affected by the Single Market, whereby ULCs and interest rates converge to some European average. Another key source of inputs for many firms — either directly or indirectly — are commodities. The key difference between commodities and ULCs or interest rates is that commodities are priced in the international market and it is unlikely that the creation of the Single Market had a large effect on world commodity prices.

We include two measures of world commodity prices.

- Energy commodity price inflation — This is a measure of energy input inflation, which would affect all firms to varying degrees through the production process or through the use of utilities in office-based operations.
- Metals commodity price inflation — Inflation in metals commodity prices, such as steel or iron ore, is more relevant for some products (e.g. car manufacturers and thus car prices) than others (e.g. home insurers). Nonetheless, we include metals commodity price inflation in all of our inflation regressions for consistency's sake.

When real commodity prices are required we deflate by the domestic country's all-items price index.

On the demand side, other than for our models of impacts upon real purchasing power (which is defined by dividing nominal prices by GDP per capita) we include:

- Growth in per capita GDP in purchasing power parity (PPP) — Annual growth in GDP in PPP per head is a proxy for consumer income. Household domestic final consumption expenditure was considered as a proxy for consumer income, but the data were not sufficiently available for our purposes. The GDP figures are adjusted for inflation and differential purchasing powers of domestic currencies have been controlled for by measuring GDP in PPP.

We use real GDP per capita in the real relative price models and nominal GDP per capita in the nominal price models.

Finally, we control for inter-country effects by including exchange rate effects.

- Rate of exchange rate change — The rate of appreciation or depreciation of the exchange rate controls for inter-country effects. Because we are testing relative to global trends we use the standard global exchange rate measure, namely the exchange rate versus the US dollar (rather than, say, versus the euro). Positive values indicate that the currency has appreciated. Effects on consumers of this variable are likely to come via trade channels. For example, if a country's currency appreciates, then imports are cheaper relative to domestic goods.

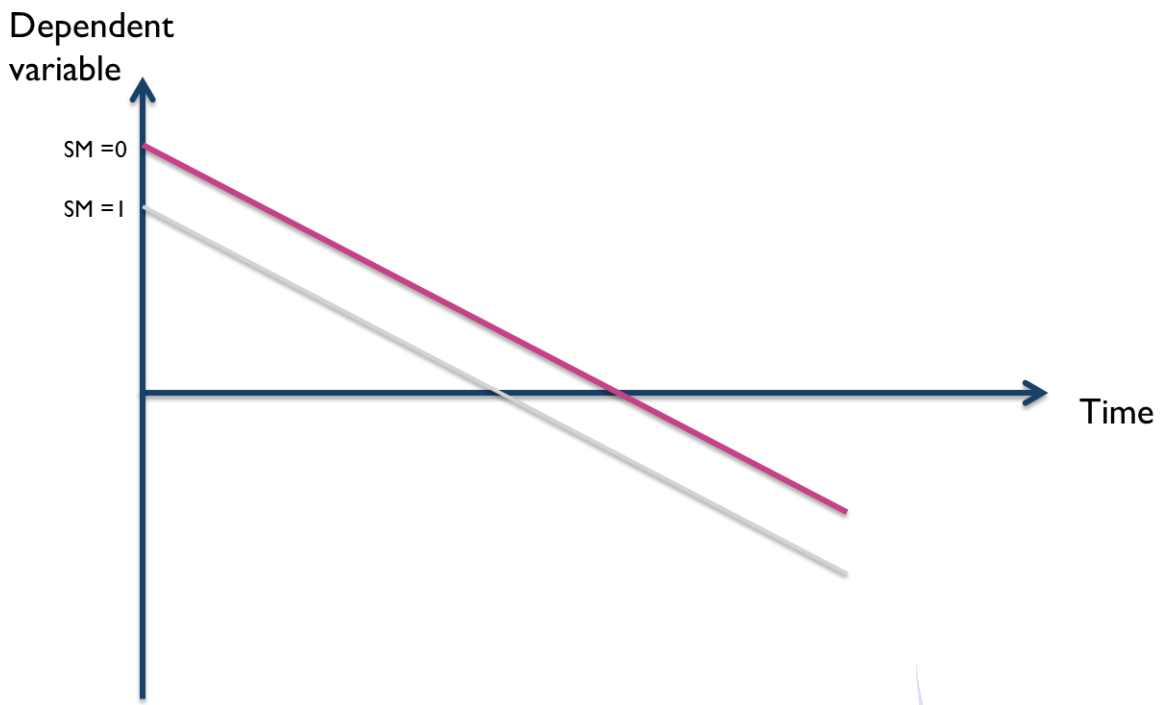
at lower real interest rates to fund production, then inflation will be higher if the economy is near or above the economy's sustainable growth rate. If credit is cheap for consumers, then consumers are more likely to take on debt to fuel consumption, which can be inflation if the productive capacity of the economy is not expanding sufficiently quickly.

5.5.3 Identifying the Single Market's effect

As explained above, one could envisage two measures to analyse the effect of the Single Market on UK consumers under the broad econometric methods we are exploring here. First, we could specify a dummy variable which is equal zero for non-Single Market countries in all time periods, zero for Single Market countries prior to 1993, and one from 1993 forwards for countries that are members of or join the Single Market. The year 1993 was chosen as the first full year since the signing of the Maastricht Treaty in 1992. Of course, the Single Market is and has been a process, rather than a single event, and a reasonable start date could have started back in the 1980s and gone forward into the mid-1990s. In a complete exercise one should therefore perform sensitivity analyses with the Single Market dummy starting a few years earlier and a few years later.

Including a dummy variable as a representation of membership in the Single Market has the effect of shifting the intercept of the estimated equation. If the Single Market had a negative effect on, say, inflation, then this would amount to shifting the linear estimate of the inflation rate downwards for Single Market countries relative to non-Single Market countries. In other words, one could say that inflation rates in the Single Market have been systematically lower than they were in non-Single Market countries, and that this effect corresponds to being in the Single Market.

Figure 5.1: Effect of including a dummy variable



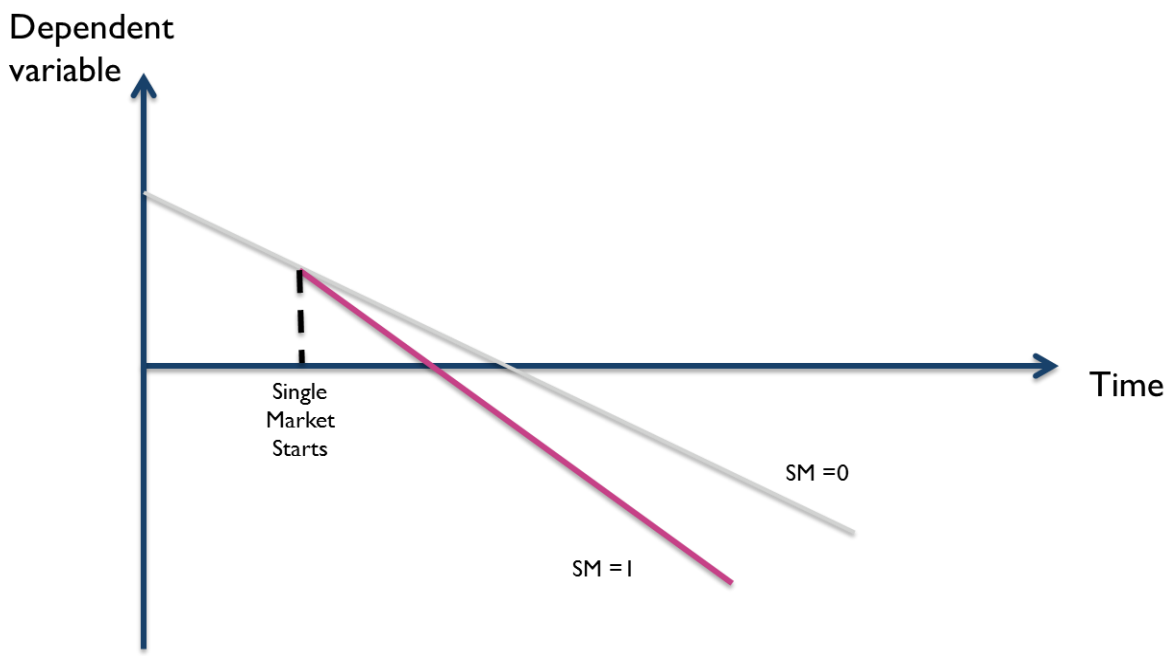
An alternative second measure of the effect of the Single Market (which we have explored in some of our models below) would be an interaction term. An interaction term is made up of a dummy variable multiplied by some other variable. The idea would be that the Single Market may have had an effect on the trend in the dependent variable over time. This would be investigated by including an interaction term made up of the Single Market dummy and the time trend.

Figure 5.2 illustrates the function of an interaction term. If the Single Market lowered the time trend in the dependent variable, this would show up in the econometric model as a negative coefficient on the interaction term. Its interpretation would be the time trend in the dependent variable relative to non-

Single Market countries. Prior to the advent of the Single Market, both Single Market and non-Single Market countries would be experiencing some trend in the dependent variable over time.

To illustrate, if this trend were estimated to be -1, that would imply a 1 per cent fall in the dependent variable per year. When the Single Market starts, the time trend for Single Market members changes -1.5 per cent. The coefficient on the interaction would be -0.5, and so the total time trend after joining the Single Market would be the 1 per cent estimated fall prior to joining the Single Market plus the "Single Market effect" of the addition 0.5 per cent.

Figure 5.2: Effect of including an interaction between the dummy and time



Finally, in the context of a broader model including more Single Market members, to test whether the Single Market has had an effect on the UK in particular, one could include a dummy that takes the value of one if the country is the UK and in the Single Market, and a value of zero otherwise. This would allow us to see whether effects of the overall Single Market differ from the effect of the Single Market on the UK. It is important to keep in mind that the Single Market dummy is the same as the UK Single Market dummy when analysing the sample containing only the UK and non-European countries.

Including a UK-specific dummy, a Single Market-specific dummy, and the interaction between them would amount to estimating a diff-in-diff specification.

5.5.4 Second-round effects of the Single Market

The effect of the Single Market on 'endogenous' costs

Some domestic cost variables, such as productivity, the cost of capital, exchange rates and growth, include factors of production that depend on domestic prices. These include typically labour and capital (and in some sectors might include land as well). The cost of these factors varies from country to country. Moreover, it is expected that these prices would be significantly correlated with the existence of the Single Market for EU countries.

To address this correlation, we perform auxiliary estimations to assess the effect of the Single Market on the domestic variables. To obtain a final estimate the effect of the Single Market in the main equation, it is

necessary to account for the direct effect plus the indirect effect. It is possible that indirect effects move in opposite directions. For example, if the Single Market causes gains in productivity and higher wages, the direction of the effect on the production costs is, *a priori*, ambiguous. This might, for example, be a case in which there are indeed economic gains from the Single Market (higher productivity) but those gains are captured by workers (in the form of higher wages) not consumers.

So, for example, suppose our model found the Single Market had a direct effect (via enhanced competition etc.) of reducing price inflation, for some good, by 0.2 per cent per year, and that, in addition, each 1 per cent reduction in labour costs cut price inflation for that good by 0.3 per cent per year. Then if in our auxiliary regression we found that the Single Market had (via free movement of persons etc.) cut labour costs by 0.5 per cent (and had no other effect), the total effect of the Single Market on annual price inflation for that good would be: 0.2% + 0.3 x 0.5% = 0.35%.

5.6 Caveats

In this section a number of caveats are outlined. These include issues that may relate our econometric approach, the data we use and its specification. There are also a number of important issues around the attribution of any effect to the Single Market, the implicit assumptions of our counterfactual and the nature of our analysis as necessarily one that is only a partial equilibrium.

We offer these caveats by way of transparency. However, the reader should note that, except insofar as we shall state so explicitly below, these caveats should not be taken as indicating we do not trust our method or the results obtained through it.

These caveats emphasise caution in the interpretation of the results, and suggest a number of areas for further research, but taken as a whole they do not reflect any fundamental problems with our methodology.

Further specific issues that may be raised in relation to our results for automotive prices are discussed in Section 6.3.

5.6.1 Risks and shortcomings of our econometric approach

The econometric approach entails some inherent risks, some of which are common and have already discussed more widely in the literature. We have identified mainly two: data quality issues and model specification. Quality of data is a risk, in particular in the current context where data for analysis is limited to a certain time period. This means that, in occasions, the number of points for estimating the Single Market parameters may rely on a few data points. We have recommended using data from official institutions which would ensure that data have already been standardised and checked for any potential errors and are being provided in time-series which have corrected for gaps or breaks. But when only short series are available or there are persistent problems in their quality it should be recognised that the results may suffer from some error or lack of precision in the estimates. It is important to note in such cases that the results of the analysis should be taken as an indication of the direction and magnitude of the change, but it would be less accurate to take them as precise estimates of change.

There are also risks in the specification of the model and this is related to the type of variables included and their relationship in the different proposed models. Omission of relevant variables may result in bias in the estimated parameters (when the omitted variables are correlated with both the dependent variable and one or more included independent variables) whereas inclusion of irrelevant variables may result in less precision in the estimates (parameter's variances will be greater than those of the true model). To correct for this one could test the robustness of the coefficients by comparing the results of specifications that have used different sets of explanatory variables.

The tests we run are outlined in full in Appendix 2 and relevant results are also reported for the case studies in Section 6 for our motor vehicle inflation analysis.

5.6.2 Issues of attribution

As noted above, we have checked the data for technical problems and, where present, addressed them. The data and technicalities of the statistics are sound. However, interpreting the output still requires thinking about attribution of effects, causality, and the magnitude of the estimated Single Market effect. Our model attempts to estimate the effect of the Single Market on various consumer-relevant variables by way of comparison with trends in those variables in countries that are similar to the UK but not in the Single Market. Our methodology does not explicitly test the various channels through which the Single Market may have had an effect on trends in the dependent variable, and therefore cannot eliminate competing hypotheses about the effect of the Single Market.

Additionally, the Single Market dummy as we have specified it captures a lot. Using econometrics to test the effects of policy using a dummy variable approach is not uncommon in policy evaluation. However, the interpretation of such tests is simply the estimated effect on the dependent variable after the policy intervention. The Single Market dummy in our core model covers the period 1993 to 2012. Although we attempt to control for several key variables, including country-specific effects and the overall trend in the dependent variable over time, it is possible that unobserved events or policies within the Single Market period and unconnected to the Single Market had strong effects on the dependent variable. In such a case, this would be captured by our Single Market dummy variable, but would be inaccurately attributed to the Single Market.

In particular, our method may struggle to identify Single Market effects from the effects of other events occurring in the UK, or in other Single Market members, but not affecting global trends — and thus not appearing in our comparator data — at around the same time. It is tempting to offer examples of drivers of such change, but in principle if one could identify such a driver one might be able to test for its effect. This problem would be particularly severe if there are additional events that occur at around the same time as the Single Market and have an effect on the variables of interest. If these events are not captured by the variables included in our regressions, our methodology might attribute the combined effect to the Single Market when it would be responsible only for a fraction of the effect. This problem is worsened by the fact that the Single Market itself is more of a process than an event. Often its commencement is dated to 1993, but in fact many of its measures were already being introduced (at least to some limited extent) a decade and more earlier. All we can do in practice is to seek for statistically significant changes at or around the time of the Single Market programme, and the risk that unidentified events distort our results is fairly high. Furthermore, even if we identify the effect of Single Market measures correctly, we have no guarantee that the UK might not have replicated the changes via regulatory decisions or trade agreements it would have made by itself even outside the Single Market.

The points above reinforce the need for rigorous thinking when interpreting the results of our estimates. For instance, one might argue that events unique to the UK that happened to occur in the Single Market period but that are unconnected to the UK are the key cause of patterns in the dependent variable. However, often there is some uncertainty as to whether seemingly UK-specific events or policies would have been otherwise in the absence of the Single Market — indeed this is precisely the sort of counterfactual we seek to construct. Questions of this sort are likely to arise in every sector. We caution, then, against bluntly attributing our quantitative estimates of the effect of being in the Single Market to the Single Market as such before thorough review of competing explanations on a sector-by-sector basis.

5.6.3 The counterfactual

Our methodology does not require us to explicitly construct a counterfactual scenario. Instead, the counterfactual arises naturally by assuming the trends pre-Single Market would otherwise continue. This approach is beneficial in as much as it removes the need for researchers to make choices about the counterfactual scenario that could in turn substantially guide the results. However, this approach does not account for the possibility that many of the changes may have occurred anyway, albeit perhaps over a longer time period.

For example, the Single Market has been the mechanism through which many sectors have been liberalised, barriers to trade reduced and competition facilitated. But our method cannot show to what extent such regulatory changes might have been introduced in Single Market countries to a greater extent than internationally (remember that our international comparators will have their own trends in regulation and competition which our model does control for) even if the Single Market had not existed.

5.6.4 Other issues with controlling for global trends

Comparing outcomes for countries inside and outside of the Single Market allows some degree of control for international factors. That is, we can to some extent consider which economic effects might have been present in the UK irrespective of the Single Market and which ones cannot be explained by national or global trends.

We observe, however, that even if global trends exist and can be isolated by considering non-Single Market comparators, there remains a significant conceptual difficulty in the form of a strong implicit assumption. Specifically, our approach assumes that international trends would be the same in the absence of the Single Market. That might be unrealistic in areas where the EU, through its collective weight in international negotiations, is a significant influence upon world events. For example, certain global tariff reduction agreements might not have taken the same form absent the EU; or the Single Market might be a vital source and driver of innovations that then have an effect upon global trends. In principle it might be possible to estimate the effect of the Single Market upon global trends. However, we do not do this here as it would considerably amplify the scope of the analysis and the methods would inevitably be less robust than those we deploy here.

5.6.5 Convergence

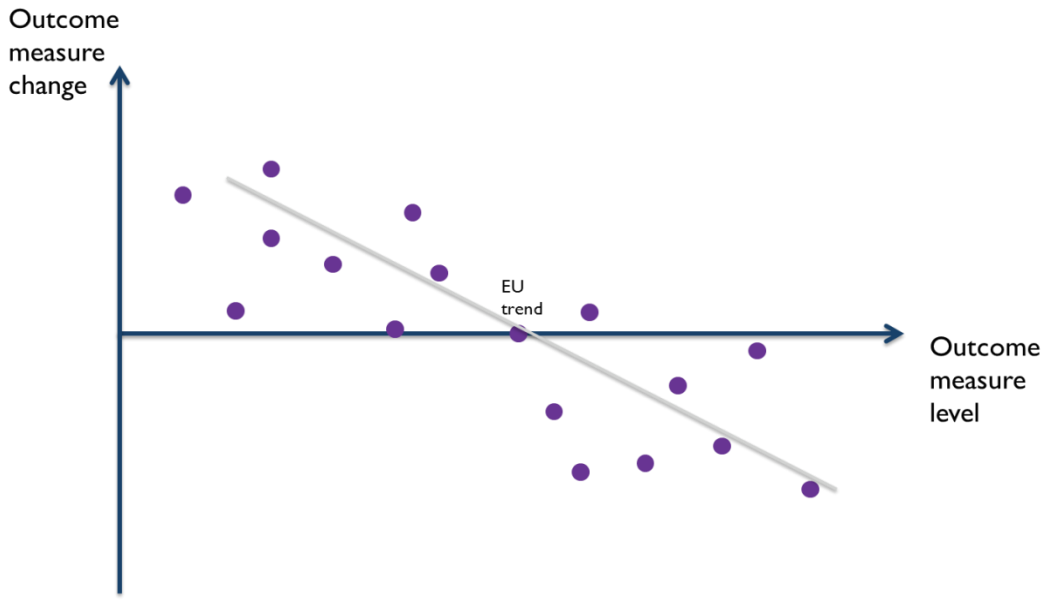
While not a drawback or challenge to our model as such, it is important to note that we would not expect that outcome variables are affected in the same magnitude or even in the same direction by the Single Market. One of the consequences of the four freedoms is convergence across Member States. Therefore, countries below the European trend of a particular variable might experience an increase while countries above the trend might experience a decrease. For example, the Single Market might mean wages rise in low-wage countries, raising production costs and thence prices. In their capacity as workers, households would gain from this (as their incomes would be higher), but in their capacity as consumers they would lose out (from higher prices).

Such convergence might occur either in levels (absolute convergence) or in growth rates (relative convergence). There might also be global convergence, especially since tariff barriers are low among OECD members. However, we would expect that the presence of non-tariff barriers would make global convergence slower than that within the Single Market.

The presence of convergence might imply that Single Market effects do not have a defined sign across all Member States. If Member States had differences in some of the outcome variables of interest before the creation of the Single Market, convergence effects imply that these variables will evolve to a single

European value. The point of convergence might be the top/bottom of the initial set of values or convergence to a new central European level. Figure 5.3 presents an example of "convergence to the centre", whereby countries with initial levels above or below the European trend converge upwards or downwards until reach uniformity in levels or the change rate.

Figure 5.3: Convergence to the centre



It is possible to test whether the convergence hypothesis holds for our variables of interest. Convergence can be tested by any of the following approaches:

- Sigma-convergence: the dispersion across countries is decreasing over time.
- Box-plot analysis: identifying an increase (decrease) trend over time in the first (third) quartile of the distribution.
- Beta-convergence: testing for negative correlation between growth rates and levels.

These tests have been used extensively in the literature of economic growth. See Barro and Sala-i-Martin (2003) for a discussion. [19]

5.6.6 Partial equilibrium analysis

Finally, our methodology is necessarily a partial equilibrium analysis. Although one can estimate an effect on, say, price, this says nothing about quantity. Without understanding how the full economic effect would play out in price and quantity, it can be difficult to extrapolate effects to the wider economy. Furthermore, there is no understanding of a how a change in quantity would in turn have an effect on price. This is a feature of all regression models, but it is important to understand that this is a weakness of using regression versus alternative methodologies, such as a computable general equilibrium model.

[19] Barro, Robert J. and Xavier Sala-i-Martin (2003), "Economic Growth, second edition", MIT press.

6 Illustrating our Methodology in Practice: Two Case Studies

In this section we illustrate and test our methodology further using two sectors relevant to household expenditure as case studies: motor vehicles and property insurance. We note that the selection of case studies is not random. We have selected motor vehicles and property insurance on the basis of five key criteria:

- Product coverage: They cover both goods and services.
- Data availability: Previous studies, including our own analysis for BIS,[20] have identified the motor vehicles sector as exhibiting relatively extensive and rich data availability over long timescales. Before settling upon property insurance we explored other insurance products and identified the likely availability of at least some relevant data for property insurance as a reason for its selection.
- Comparability across countries: Some products may be categorised or defined very differently in different countries, meaning that even if data is available it might not be suitable for our benchmarking-based econometric exercise. Motor vehicles and property insurance, by contrast, have more similar definitions internationally.
- Tradability: Some constructed products — e.g. a finished bridge – might not be highly tradable internationally. Many services (e.g. domestic cleaning, hotels, childcare) are by their nature likely to involve limited international trade. Motor vehicles and property insurance, by contrast, are tradable. Hence there is more scope for (perhaps, in particular, positive) Single Market effects with such products.
- Materiality to consumers in the UK economy — both motor vehicles and property insurance are products widely sold in the UK.

The non-random nature of our case study selection is likely to have two consequences:

- The feasibility or ease of implementing our preferred methodology is unlikely to be universal across products — for many goods and services data may not be available
- The effects we find for these sectors are unlikely to be indicative of "typical" or "average" changes across sectors — in many sectors, for example, there may be less trade in the Single Market or in the UK, meaning the effect of the Single Market upon prices and quality and variety should be expected to be less for that crude quantitative reason alone, even before one considered other complexities and specificities.

The remainder of the section is structured as follows:

- We briefly outlining additional information relevant to the econometric approach for automotive and property insurance. In particular our sources of data and a small number of sector-specific modelling choices.
- We outline the trends in prices, quality and variety for cars and then report our econometric estimates for each of these variables.
- We discuss potential issues and caveats with our results for motor vehicle inflation.
- The exercise is then repeated for property insurance, though a lack of data means the findings are not robust.

[20] Europe Economics (2013) "Optimal Integration in the Single Market: A Synoptic Review", prepared for BIS.

6.1 Data and sample

Price index data

Our dependent variables in this case are the growth rates in car and home insurance prices. This section describes our approach to collecting these data and the samples analysed.

There are usually trade-offs between data sources. For example, the OECD has good time and country coverage of consumer price indices, but does not offer a sufficiently granular disaggregation to examine particular product categories. Eurostat, by comparison, contains more detailed measures of consumer prices, but this data is not widely available outside of Europe and not available prior to 1996, which is well after the establishment of the Single Market.

To overcome these data availability issues, we collected data from national statistics websites of the UK and comparator non-European countries. Data were collected from the early 1970s to the most recently available whole-year period, which in each case was 2013. Where information was not sufficiently available for the precise category of interest, such as home insurance, we used the closest available item category as a proxy. Table 6.1 contains information on the national sources used to construct this first sample.

Table 6.1: Sources of price level information from national statistics offices

Country	Source	Starting availability	Other comments
Australia	Australian Bureau of Statistics	Cars – 1974 Insurance - 1989	"Insurance" category is used as a proxy for home insurance
Canada	Statistics Canada	Cars – 1974 Insurance – 1975	
Japan	Statistics Bureau of Japan	Cars – 1974 Insurance – 1975	"Fire insurance premium" used as a proxy for home insurance
United Kingdom	Office of National Statistics	Cars – 1974 Insurance – 1975	"Dwelling insurance & ground rent" used as a proxy for home insurance
United States	Bureau of Labor Statistics	Cars – 1974 Insurance - 1987	"Financial services" used as a proxy for insurance

Note: "Starting availability" is set to be harmonised with the UK; in some cases data are available earlier, but we restricted the time period of data collected to be harmonised data with UK availability.

RPI or CPI?

For our illustrative purposes here, we base our UK analysis upon the retail prices index (RPI), not the consumer prices index (CPI). The main reason for this is that the automobile prices sub-component of the RPI series is available back to into the early 1970s when our modelling whilst for CPI analogous data is available only back to January 1996.[21] Even the all-items CPI is available only from January 1988, which would constitute only a barely adequate pre-Single Market sample.

A secondary issue for our real relative price analysis is that the CPI basket excludes a significant portion of the products in the RPI basket — in particular housing. Since housing costs have, at times in our sample, constituted more than 20 per cent of the all-items RPI and since housing cost inflation was very significant in the late 1990s and early 2000s, with house prices rising in excess of 20 per cent in certain years, that means that the CPI cannot be considered a measure of the cost of living for households — and, in particular, changes in the CPI cannot be considered a measure of inflation in the cost of living for households — over much of the period most relevant to our exercise.[22] A specific problem in this context if that if the real relative price of cars or insurance fell as housing costs rose, the CPI will not detect that impact. So, for example, if the true impact of the Single Market was that inflation in other products had

[21] http://ons.gov.uk/ons/rel/cpi/consumer-price-indices/august-2014/cpi-time-series-data.html

[22] CPI is treated by a number of authors as a "policy index" — akin to the "RPIX" measure used as the Bank of England's inflation target from 1992 to 2003. For more on this, see Lilico, A. "The measure of inflation", *Economic Affairs*, 24(1), pp44–48, March 2004.

only a muted response to rises in house prices in the 1990s and 2000s, a CPI-based real price series will fail to capture the effect.

RPI has its own drawbacks, however. In particular, its use of arithmetic averaging in the Carli formula produces a so-called "formula effect" differential between the RPI and CPI. This formula effect differential had been reasonably stable up until 2010 (with the average formula effect being 0.5% from January 1998 to December 2009), when a change in the methodology for gathering clothing price data drove a large rise in the differential (adding more than 0.4% extra formula effect from January 2011 to October 2013). This was acknowledged by the Office for National Statistics (ONS) in its review of the Retail Prices Index (RPI), announced on 10 January 2013. In that review and its 10 January 2013 statement, the ONS

- announced that it will not change the methodology for computing the RPI, and committed to make only routine adjustments in future
- stated that the "*fundamental problem of the Carli formula is its propensity to have an upward bias*".
- concluded that "*the formula used to produce the RPI does not meet international standards*", with the UK Statistics Authority subsequently de-designating it as a National Statistic.

Insofar as the formula effect was stable over time, and in particular stable before and after the introduction of the Single Market, our econometric models should control for it. We are not attempting to measure the level of prices or of inflation but, rather, changes in them associated with the Single Market. Any systematic upwards bias in RPI is therefore not problematic for us for this purpose.

The change in the degree of the formula effect after 2010 is potentially more problematic, but our judgement is that that is a sufficiently small component of our sample that RPI remains the most relevant basis of calculation here.

6.2 Illustrative outline of outputs-based approach

In Sub-section 5.4.1 we noted that one option for defining the "Single Market" would be in terms of "outputs" — i.e. in terms of how much integration was actually achieved, as opposed to in terms of the policies enacted to attempt to achieve it. In this appendix we illustrate this approach by using Eurostat data which has a "Transport" price category in which the EU28 price level is defined as 100. This data is available for Switzerland plus all EEA members except Liechtenstein from 2003 onwards.

We define the degree of Single Market integration in respect of motor vehicles as being the inverse of the coefficient of variation in transport prices. So when price dispersion is lower this measure would indicate a higher degree of integration.[23]

[23] We note that this could be understood as implying we are using transport prices as a proxy for motor vehicle prices and (the inverse of) motor vehicle price dispersion as our measure of Single Market integration. But an alternative interpretation is that the relevant aspect of the Single Market is the Single Market in transport, such that our data is not a proxy but in fact the desired measure.

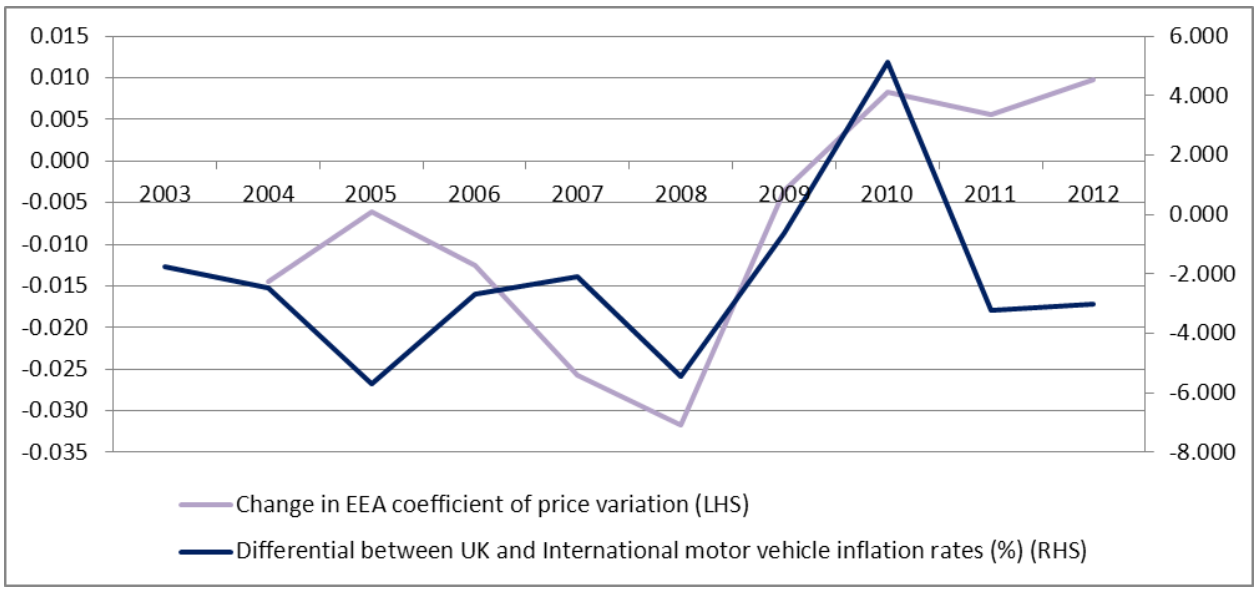
Figure 6.1: UK vs International motor vehicle inflation differentials compared with Single Market price dispersion

Year	Comparator set car inflation (%)	UK car inflation (%)	Differential between UK and International motor vehicle inflation rates (%)	EEA coefficient of transport price variation	Change in EEA coefficient of transport price variation
2003	-1.049	-2.780	-1.732	0.285	
2004	-0.631	-3.112	-2.481	0.271	-0.014
2005	0.475	-5.208	-5.684	0.265	-0.006
2006	-0.089	-2.747	-2.659	0.252	-0.013
2007	-0.558	-2.637	-2.078	0.226	-0.026
2008	-1.426	-6.867	-5.440	0.195	-0.032
2009	-0.113	-0.727	-0.614	0.191	-0.003
2010	0.849	5.962	5.113	0.199	0.008
2011	1.459	-1.777	-3.236	0.205	0.006
2012	0.985	-2.010	-2.995	0.215	0.010

We see in the table that the coefficient of variation in transport prices falls from 0.285 in 2003 to 0.215 in 2012. We consider how correlated this fall (this enhanced integration of the Single Market) is with the deviation of UK motor vehicles price inflation from that of our international comparators. The hypothesis we are investigating is that when the Single Market becomes more integrated, UK prices fall relative to international non-EU prices.

We take motor vehicle price inflation data from Australia, Canada, Japan, New Zealand and the US, which we weight by data (obtained from the OECD) on car sales or registrations to construct an "International average" motor vehicles price inflation rate (i.e. an average inflation rate across our five-country comparator set). We compare this rate with that in the UK over the period 2003 to 2012. We then relate the differential between the UK and the International price inflation rates to changes in the coefficient of variation in the EEA plus Switzerland (the Single Market). We graph these two series below.

Figure 6.2: Output measures of integration of Single Market in transport versus UK motor vehicles inflation relative to International rates



Notes: "International" = rates in Australia, Canada, Japan, New Zealand and US weighted by car registrations or sales
Source: Eurostat, OECD, national statistical agencies, Europe Economics.

A scatter-plot of these two variables produces a best-fit line (with a constant) with a respectable R-squared of 0.208, indicating a fair degree of correlation in movements over the period. Unsurprisingly, given the very small number of data points, regression analysis shows the coefficient on the Single Market integration variable not to be statistically significant. However, for reference the (non-statistically-significant) model here implies that the added price convergence, within Single Market countries, is associated with the UK having 6.9 per cent less price inflation, in aggregate, over the period 2003 to 2012, equivalent to 0.7 per cent lower inflation per annum.

With a longer time series the model could be made properly operational and could be used to produce a robust alternative estimated effect on UK car prices (adding in additional control variables we use in our main model). This could be a useful extension of our analysis in this report — indeed, where data were available this could be the basis for a preferred approach for the reasons explored in our previous BIS report.[24]

6.3 Inputs-based approach

6.3.1 Specific modelling choices

Most details of our econometric approach have already been set out in Section 5.4.3 as they would be common across sectors. It is useful to highlight here a set of additional choices we made in our modelling of the dependent variables in the automotive sector, reflecting the details of the data as we encountered them (choices that might in principle differ in other sectors).

First, we analyse the dependent variables in growth rates, rather than in levels. For example, rather than using price indices as the explained variable, we use the inflation rate constructed from these indices. This

[24] For details, see "Optimal Integration in the Single Market: A Synoptic Review", Europe Economics, April 2013 — https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224579/bis-13-1058-europe-economics-optimal-integration-in-the-single-market-a-synoptic-review.pdf

is due to the persistent upward trend in the dependent variable, which would suggest the possible presence of a unit root and that modelling in differences is more appropriate than modelling in levels.[25]

We take the approach of estimating simple models and building up to more complex models. This is to identify the effect of time or the Single Market without any intervening variables and then to understand how controlling for other factors changes the estimated effects. An alternative approach, sometimes adopted, is to start with a broader set of variables and pare down to those that are most statistically significant.

6.4 Motor vehicles

The automotive sector is highly relevant from a macroeconomic perspective. It is also highly relevant from the consumers' perspective, being a "big ticket" item in their expenditure.

From the point of view of consumers, the most relevant sector would include passenger cars but not commercial vehicles. However, due to limitations in the available data, we will consider the whole automotive sector for our case study.[26]

6.4.1 Nominal Prices

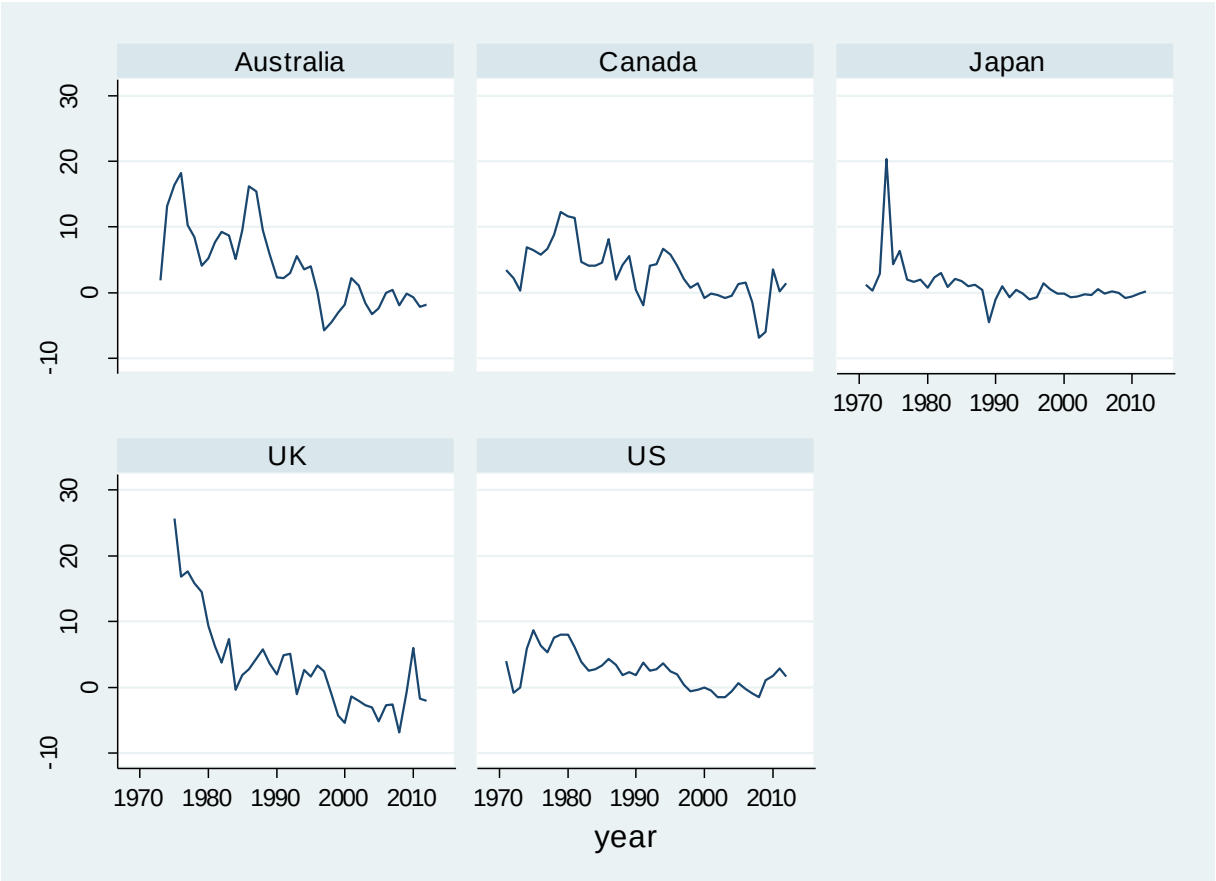
Trends in the dependent variable

Trends in car price inflation in the UK and our sample non-European countries are presented in Figure 6.3. Inflation was more volatile in the 1970s up to around the late 1980s and began to stabilise thereafter. This is unsurprising, as inflation in this period was general quite high and volatile. Figure 6.4 illustrates how the evolution of inflation of motor vehicles has differed substantially from the inflation in all items (goods and services) when comparing the UK with (non-EU) international comparators. Inflation in all items has a similar path in the 1990s and 2000s (until the 2008 financial crisis) as other comparators (EU and non-EU). However, the UK had larger inflation levels in the 1970s and also, to some extent, the 1980s and since 2008. In contrast, UK inflation in motor vehicles has been much lower than international comparators since the late 1990s.

[25] Modelling data that are non-stationary (i.e. that have a unit root) could produce to misleading results. Typically, modelling variables in differences (either raw differences or the per cent change) render variables stationary. This is why we model the price index data in growth rates rather than levels. Our unit root tests for the growth rate variables indicate that the variables are stationary. More details regarding stationarity and stationarity tests for the data used in this study are available in Appendix 2.

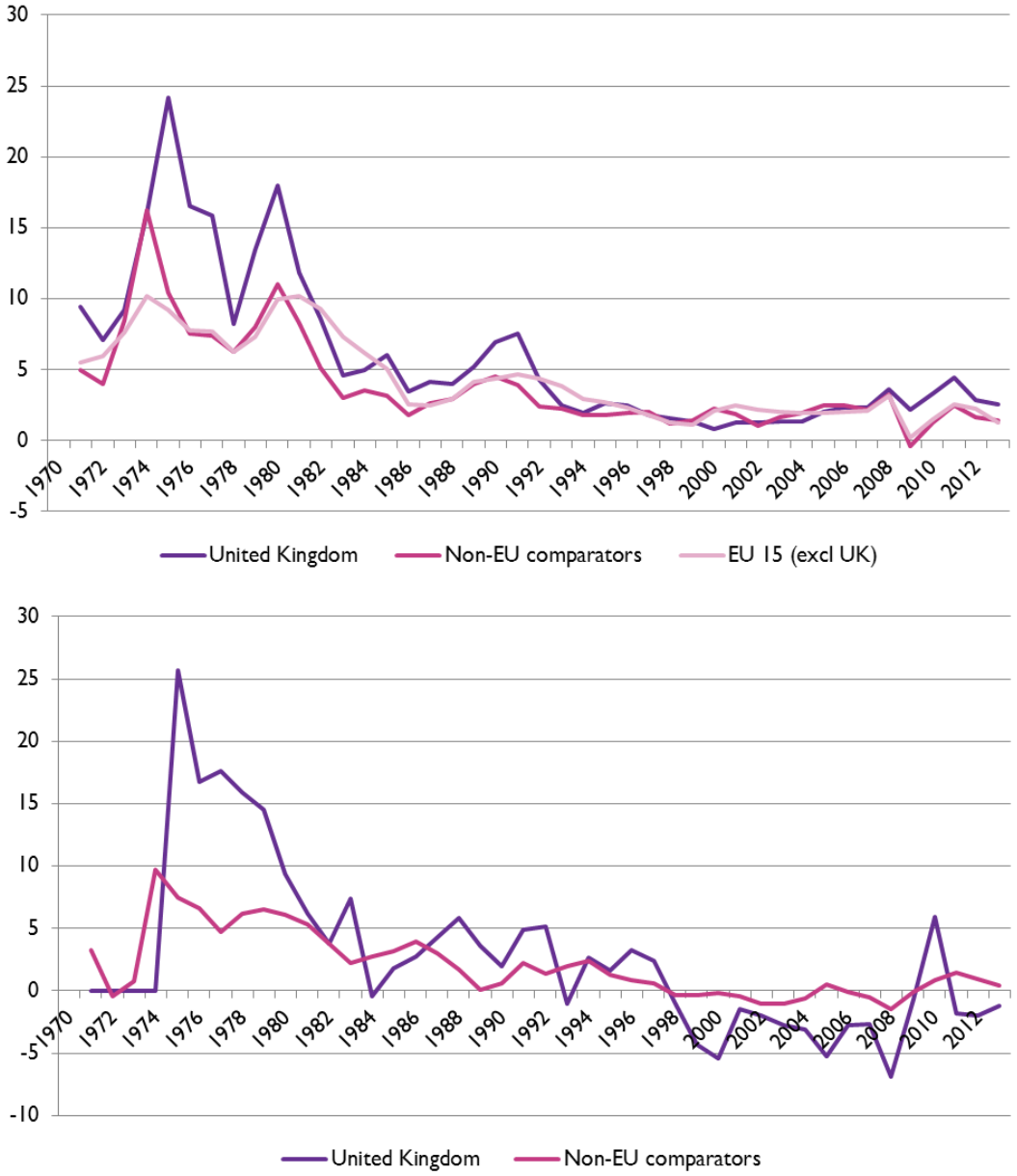
[26] According to data from the OECD, new passenger car sales / registrations in 2012 were 2,044,609 vehicles in the UK. Total vehicle sales / registrations in the UK in 2012 were 2,333,763 vehicles. In other words, passenger vehicles represented about 88 per cent of the market in 2012. New passenger car sales / registrations in the UK since 2005 have been between 86 per cent and 90 per cent of the market. Thus, our analysis of the entire car market is likely to be representative of the passenger car market, since the passenger car market is such a large part of the overall car market.

Figure 6.3: Inflation trends in car price indices, UK and non-European countries



Source: Various national statistics agencies; Europe Economics' analysis.

Figure 6.4: The inflation of all items and motor vehicles. UK and average of (non-EU) international comparators. Top panel: all items. Bottom panel: Motor vehicles.



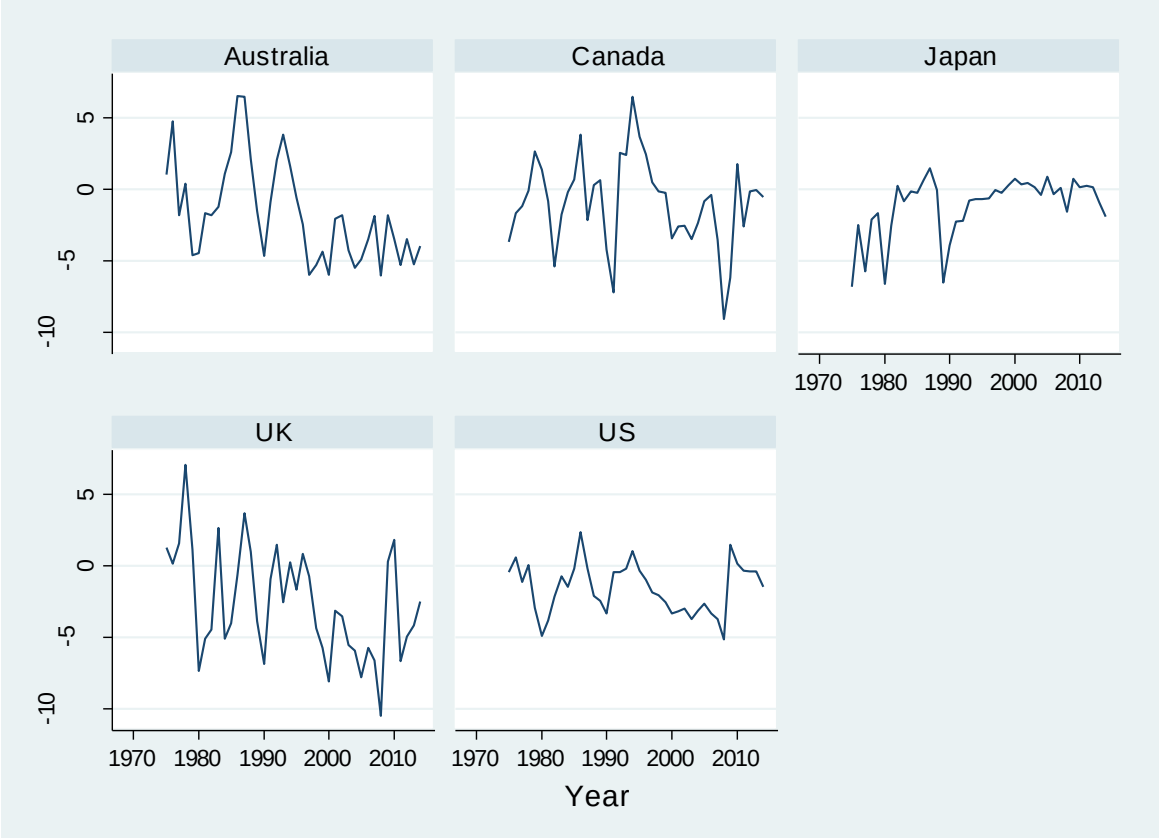
Inevitably, the features of the price indices we analyse are determined by the statistics authorities and their methodologies for constructing the price indices. For instance, motor vehicle price index data contains data on new and used cars, but it is not clear what the relative proportion or weight of each is. Car price indices are sometimes quality-adjusted via hedonic methods, but not all statistical agencies account for increasing quality in their car price indices. Finally, the price indices do not capture the dynamics of changing consumer taste, meaning that changes in demand for higher price cars would be reflected as a higher aggregate price, even if prices of cars on the broader market had not changed.

We note that the underlying data used in price indices come from list prices, which may differ from market prices. Transactional prices, however, might differ from list prices due to discounts, tax rebates, etc. While it would be desirable to consider transactional prices from a conceptual point of view, this is not feasible due to lack of available data. Our analysis is then based on list prices. Since our methodology is based on changes in prices (inflation), the difference between list and transactional prices would have a relevant effect in our estimations of the Single Market effect if policies about price discount differ between

countries and have some correlation with the Single Market. We are not aware on any evidence in favour of this hypothesis. In our monetisation, however, the quantification of savings might differ upwards materially because of the use of list prices instead of the prices effectively paid by consumers.

6.4.2 Real relative prices

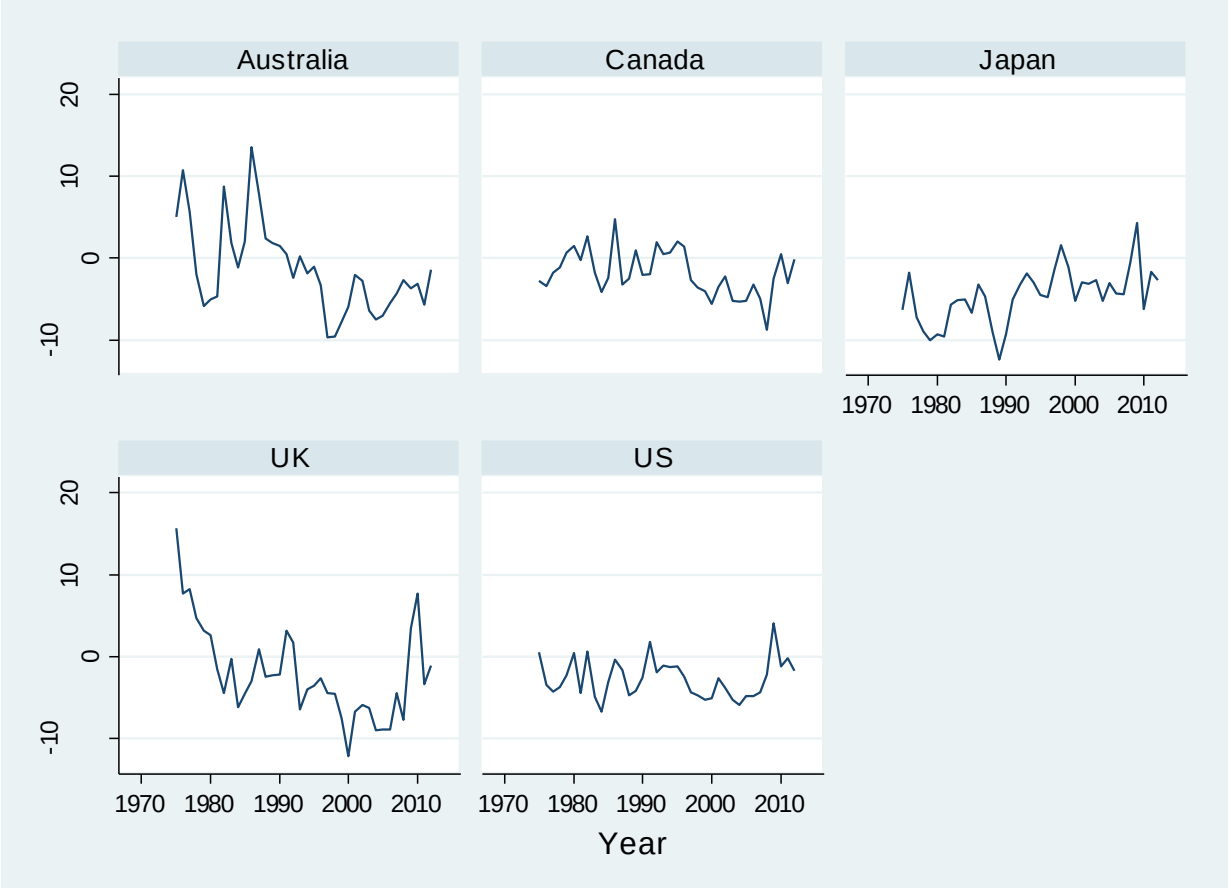
Figure 6.5: Year-over-year per cent change in car price index relative to all-items index



Source: Various national statistics agencies; Europe Economics analysis.

Real relative prices exhibit interesting differences between countries. In Japan, real relative price inflation was consistently materially negative in the 1970s and early 1980s, stabilising in the mid 1980s then fall again in the late 1980s before a more modest phase of low real relative price deflation interspersed with occasional positive price changes in the 2000s. Australia and the US both have frequent positive real relative car price inflation in the 1970s and 1980s moving into a phase of more consistent real price deflation in the 1990s and 2000s. Canada and the US exhibit a similar pattern to one another (though Canada's has greater variance) of reasonably frequent occasional real price rises against a generally falling backdrop throughout.

6.4.3 Real purchasing power prices



Source: Various national statistics agencies; Europe Economics analysis.

Real purchasing power prices have a qualitatively similar pattern to real relative prices, with Japan shifting from a falling purchasing power price in the 1970s and 1980s to more stable (though still generally falling) prices in the 1990s and 2000s. Canada and the US both have fairly consistent modest falls throughout. Australia and the UK both have a phase of rising real purchasing power prices in the 1970s with the UK shifting to more price stability during the 1980s then both have falling purchasing power prices in the 1990s and 2000s.

6.4.4 Quality

Approach

We have used the car quality dataset compiled by Frank Verboven and others.[27] This dataset has been used in Liberalizing a Distribution System: the European Car Market[28] (2006, Oct. 2002) with Randy Brenkers, Market Integration and Convergence to the Law of One Price: Evidence from the European Car Market (2005, Aug. 2001) with Pinelopi Koujianou Goldberg[29]. It consists of car data for the period 1970-1999 in five European countries: Belgium, France, Germany, Italy and the United Kingdom. The variables contained in this dataset include:

[27] The data can be found at https://www.econ.kuleuven.be/public/ndbad83/frank/cars.htm. We would like to acknowledge that Prof. Verboven kindly allowed us to use this dataset for this report.

[28] Brenkers, Randy, and Frank Verboven. "Liberalizing a distribution system: the European car market." *Journal of the European Economic Association* 4.1 (2006): 216-251.

[29] Goldberg, Pinelopi K., and Frank Verboven. "Market integration and convergence to the Law of One Price: evidence from the European car market."*Journal of International Economics* 65.1 (2005): 49-73.

- Car information (e.g. make, year, model).
- Car physical characteristics (e.g. size, horsepower, etc.).
- Volumes of sales (measured by the number of registrations at national offices).
- Prices (obtained from catalogues).

The first step of the analysis is to construct a measure of quality by country and year. For this purpose, we have used a hedonic price regression model. We have taken the approach used by Goldberg and Verboven (2005) and estimate the effect of a number of hedonic variables together with market segment dummies and firm dummies on a common price.

Our regression takes the form of:

$$\ln(rp_{i,k,t}) = w_{i,k,t}\gamma + \theta_c + \theta_f + \varepsilon_{i,k,t}$$

The subscripts i, k and t indicate brand i, country k and year t. $rp_{i,k,t}$ denotes the raw, pre-tax price of a given car model i expressed in Euro, the common currency. $w_{i,k,t}$ is a vector that includes all the observable car characteristics as summarised in the table below. Finally θ_C and θ_f are dummies that control for specific market segment and firm characteristics. $\varepsilon_{i,k,t}$ is a random error term which captures any unobserved characteristics of the regression.

Having run the regression we use the estimated coefficients to create a quality indicator for each car model for each country every year based on the fitted values of the dependent variable. The measure of quality by country and year is obtained via a weighted average across the quality of each car model. We have used the expenditure on each model as the weights for the average quality, using the following formula:

$$Avg\ quality = \frac{\sum quality * expenditure}{\sum expenditure}$$

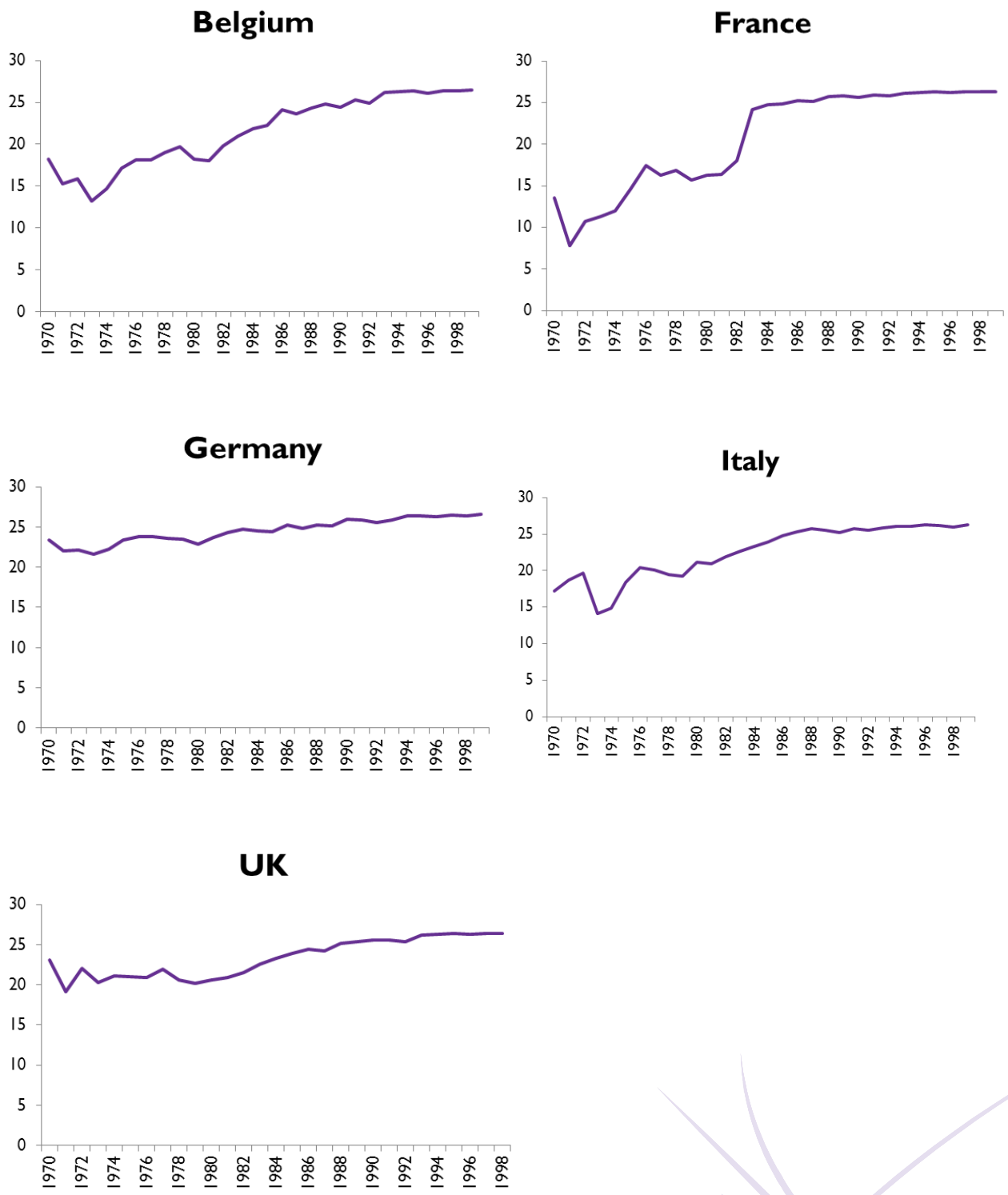
Trends in key variables

The figure below illustrates how the constructed measure of quality evolves in the period 1970-1999 for the countries in the sample. There are two main facts that can be observed from this figure. First, quality has systematically increased in all 5 countries of our sample during this period. The increase has been sharp in Belgium, France and Italy, but less so in Germany and the United Kingdom. In the former three countries, the period of the largest growth in the quality measure took place between the mid-70s to mid-80s. That this, the largest change observed in quality precedes the existence of the Single Market.

Second, this period has seen a process of strong convergence in levels (i.e. sigma-convergence). The countries with the lowest levels of quality at the beginning of the period experienced the largest growth rate. By the end of the period, all countries had practically the same level of quality.

Overall, the convergence process during period 1970-1999 was positive for the countries that had started with relatively low levels of quality (Belgium, France and Italy) but had a small effect for the countries that already enjoyed a relatively high level of quality (Germany and the UK). While at least part of this process may be attributed to European integration, such as the customs union, the effects clearly pre-dated the Single Market.

Figure 6.6: Trends in the quality measure of cars by country



Data

We employ the car dataset compiled by Frank Verboven and others because of its completeness. In this section we exploit the variables that give us the total expenditure on cars by country for each year and for each class to construct a measure of variety. This measure is based on the variation in consumer expenditure.

The measure we use to identify the movements of car variety across the EU Member States is the coefficient of variation of the expenditure made by consumers in each car model. The coefficient of variation is a normalised measure of dispersion for a given variable. It is defined as the ratio of the standard deviation σ to the mean μ: The formula for measuring the coefficient of variation is:

$$Coefficient\ of\ variation = \frac{\sigma}{\mu}$$

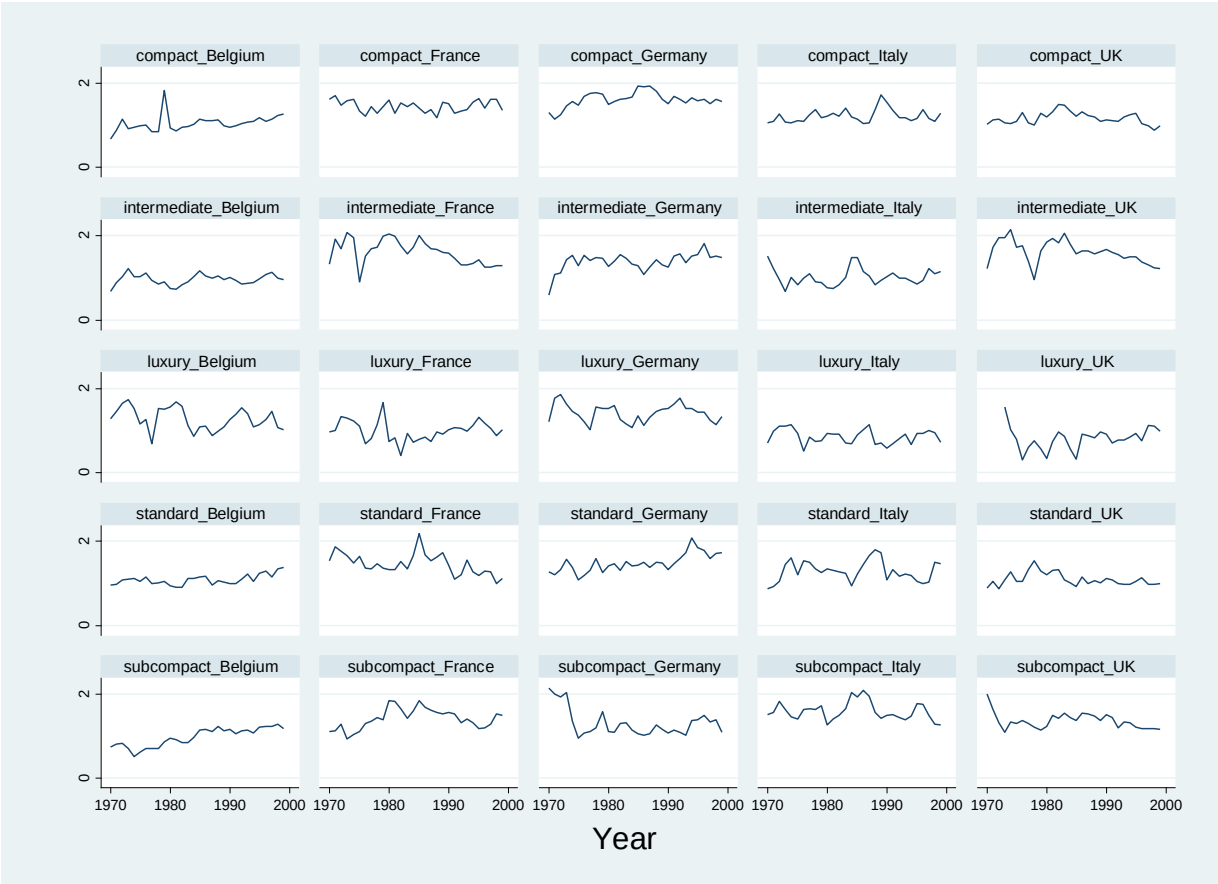
It shows the extent of variability in relation to mean of the population. To construct this measure we sorted our data by year, country and class of automobile. Then we took its mean, standard deviation and constructed the coefficient of variation for the total expenditure spent on each model within each category. Our results are illustrated in the diagrams below.

Trends in key variables

We constructed a global measure of variety of cars in each country combining the data from all categories. Our results are shown in Figure 6.7 and Figure 6.8. Throughout panels we see that there has been considerable variation in the variety of cars available to European citizens.

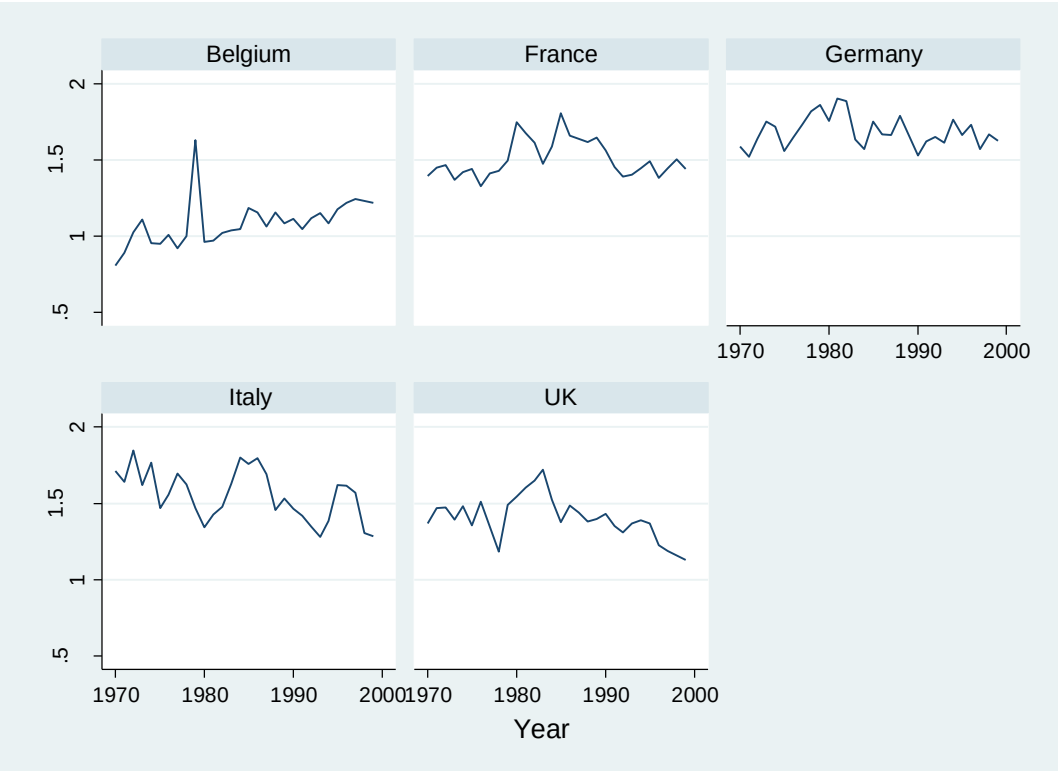
We observe in Figure 6.8 that there has been an increasing time trend in variety in Belgium and France, a decreasing trend in Italy and the UK, while there does not appear to be an obvious time trend in Germany. Comparing levels, however, we can conclude that there has been a strong process of convergence during the period 1970-1999. Unlike the process observed for quality in motor vehicles, the convergence has not led to the highest level of variety in the sample. Therefore, while some countries caught up with the European level, some other saw a decrease in their variety.

Figure 6.7: Measure of product variety across all car categories by country and category



Source: Verboven; Europe Economics' analysis.

Figure 6.8: Measure of product variety across all car categories by country



Source: Verboven; Europe Economics' analysis.

6.4.5 Estimates of the effect of the Single Market on price, quality, and variety on motor cars

Direct effects

Table 6.2 contains our estimates of the effects of the Single Market on the growth of price, quality, and variety in the UK. These effects are estimated using the statistical models discussed in Section 5. Choice of a preferred model depends upon a number of criteria, including theoretical considerations (e.g. fixed effects might be preferred since they account for country-specific differences; real purchasing power prices have the advantage set out in earlier sections) and indicators such as the AIC and the adjusted R^2 that would select the model that fits the data best after adjusting for the number of independent variables.

We present results for the various samples used in the analysis. For prices, we use a dataset contain only the UK and non-European countries. For quality and variety, we use data from the Verboven dataset, which contains data for the UK, Germany, Belgium, Italy, and France. We use fixed-effects regression with controls. For quality and variety, we also present results for the interaction between a UK dummy and a Single Market dummy in the appendix, though none of the models with controls give statistically significant results. We present only the Single Market dummy below.

Table 6.2: Estimated Direct Single Market effects in price, quality, and variety growth

Sample	Model	Car price inflation	Car quality growth	Car variety growth
Nominal Prices	FE - Year and SM only	-5.30***		
	FE - SM with full controls	-2.27		
Real Relative Prices	FE - Year and SM only	-2.19*		
	FE - SM with full controls	-1.51		
Real purchasing power prices	FE - Year and SM only	-4.96**		
	FE - SM with full controls	-3.56*		
Verboven data (UK, Germany, Belgium, Italy, France)	FE - Year and SM only		-1.46**	2.52***
	FE - SM with full controls		-0.6	3.92

Notes: ***: significant at $p < 0.01$; **: significant at $p < 0.05$; *; significant at $p < 0.1$.

Source: Various national statistics agencies; Eurostat; Verboven; OECD; World Bank; Eurostat; Europe Economics' analysis.

We see here that the Single Market is found to have a statistically significant impact upon car prices under all three definitions in "raw" models without control variables. In the cases of nominal prices and real relative prices, the introduction of full controls removes the significance of this "raw" effect.

Conceptually, our preferred model is the fixed-effects real purchasing power prices model with full controls, for the reasons explained in 5.4.3. For prices, this model estimates that inflation was 3.56 percentage points lower per annum versus the counterfactual of not being in the Single Market, which is statistically significant at the 90 per cent confidence level. This is estimated for a "Single Market" period of 1993 to 2012, meaning that prices were 3.6 per cent lower each year over the whole period 1993 to 2012.

For quality and variety, the only statistically significant estimate of a direct Single Market effect is in the fixed-effects model containing only the year and the SM variable (i.e. the entire Single Market effect rather than the UK-specific Single Market effect).

Diagnostic checks on direct effects estimates

We ran a number of diagnostic checks on our baseline models of price, quality and variety. The results are reported more fully in Section 9.3.3 of Appendix 2, but we go over some of the important points here.

First, the data are heteroskedastic and exhibit serial correlation. These are addressed using robust standard errors clustered by country.

Our models are sensitive to the specification of the Single Market dummy, with results on the Single Market coefficient changing both in value and statistical significance depending on when the Single Market dummy

begins to take a value of one. This is one of a number of reasons for regarding these results as illustrative rather than as standalone "findings".

The Ramsey RESET test indicates potential omitted variable bias in our nominal and real (using all-items) car price inflation models, but suggests that the preferred real purchasing power car price inflation model does not suffer from omitted variable bias.

Stationarity tests indicate the presence of a unit root in the nominal interest rate variable. We have used the first difference of the nominal interest rate in our model of nominal car price inflation for this reason.[30]

For car quality and variety, we find that our baseline models are highly sensitive to the start date of the Single Market dummy. Results from the Ramsey RESET test indicate the potential omitted variable bias in the quality model, but not in the variety model. We have emphasised that the quality and variety models are not robust, and indeed offer very limited explanatory power. Further diagnostic checks on the core models reinforce this impression.

Indirect effects

In our preferred model, there is no impact of real unit labour costs upon purchasing power — potentially implying that, in this context, periods of higher unit labour costs are associated with higher wages and hence higher purchasing power.

We can, however, illustrate how indirect effects can be modelled using the nominal prices series. There, each 1 per cent fall in unit labour costs leads to a 0.44 per cent fall in prices. The exchange rate also has significant effects on nominal price inflation.

In our auxiliary econometric estimation, we find that the Single Market did not have a statistically significant effect upon unit labour costs. However, for purely illustrative purposes let us use the coefficient there of 0.036. Were that coefficient statistically significant, it would mean that, as well as the direct effects noted above, the Single Market will indirectly reduce prices (via the effect on labour costs) by 0.44 x 0.036 = 0.016 per cent. However, in this case the impact is nil.

Overall effect

The total Single Market effect can be estimated by combining the estimated effect from the full estimations presented above and the estimates of the Single Market dummy's effect on each control variable. Total effects are estimated only where the relevant coefficients are statistically significant.

As far as our model is able to establish, the Single Market has resulted in, on average, around 3.56 per cent lower annual price inflation from 1993 to 2012 relative to what prices would have been otherwise. This consists of 3.56 percent points annual lower price inflation from the Single Market directly, with no indirect impacts.

We use our central estimate of the potential annual Single Market effect on inflation in 2012 (3.56 per cent) to calculate a lower and upper bound estimate based on the 90 per cent confidence intervals for the direct and indirect effects, and combine these to arrive at our range for the estimate price savings. The estimated range for the total Single Market effect is 0.34 per cent to 6.8 per cent, implying an overall impact on prices from 1993 to 2012 ranging from 7 per cent to 76 per cent.

We cannot estimate a total effect for quality and variety as we do not have statistically significant coefficients on the direct effect estimates.

[30] More details on the logic behind this are included in the technical discussion of the regression diagnostics.

6.4.6 Comparison with findings of previous studies

The car market has been a closely studied case in the literature assessing the effect of the Single Market and the level of integration across member states. Goldberg and Verboven (2000) document the evolution of car price dispersion across Member States. Based on their results they conjecture that the Single Market will substantially reduce the year-to-year volatility observed in the car price data, but without further measures to increase European integration, it will not completely eliminate existing cross-country price differences.

In 2005 Gil-Pareja and Sosvilla-Rivero revisited the topic and tried to estimate the level of price convergence in the European car market. The results indicate that there is a clear evidence of price convergence among the EU15 countries, but not before 1999. Moreover, countries of the Economic and Monetary Union started convergence previously to the EU15 as a whole. Finally, exchange rate changes have significantly contributed to price dispersion over time across countries.

The results of Gil-Pareja and Sosvilla-Rivero suggest that most of the Single Market benefits estimated by our methodology may have been obtained largely after 2000.

6.5 Discussion of potential issues with motor vehicle inflation results

For motor vehicles in our best model the Single Market variable is correlated/associated with a 0.7-6.8 per cent per annum reduction in the rate of real price inflation, a cumulative effect of some 7 to 76 per cent over the period 1993-2012.

A first point to be clear about is that this is a result for one sector, based on a partial equilibrium analysis, and should in no way be considered a general or "typical" result of the Single Market — indeed, as we shall see below, there is good reason to think it likely that there will be other sectors (or collective groups of sectors) for which the result here is reversed — i.e. for which the Single Market is statistically associated with a material rise (not fall) in their price inflation rates.

Nevertheless, even simply in terms of movements in one sector, the range includes a very large effect and may give rise to a number of questions which this section discusses in detail. While this section emphasises caution in the interpretation of the results, and suggests a number of areas for further research, taken as a whole the issues discussed do not reflect any fundamental problems with our approach.

6.5.1 Could this be the result of some other event that occurred at around the same time as the Single Market?

Concern: *The model works by considering the differential between UK (or other Single Market member) real car price inflation before and after Single Market entry. But the result could be a statistical coincidence. Something else could have happened at around the same time, which would have happened even absent the Single Market.*

Assessment: We believe that this is possible, but the risk should not be over-stated, and an extension to our approach could render the risk relatively low.

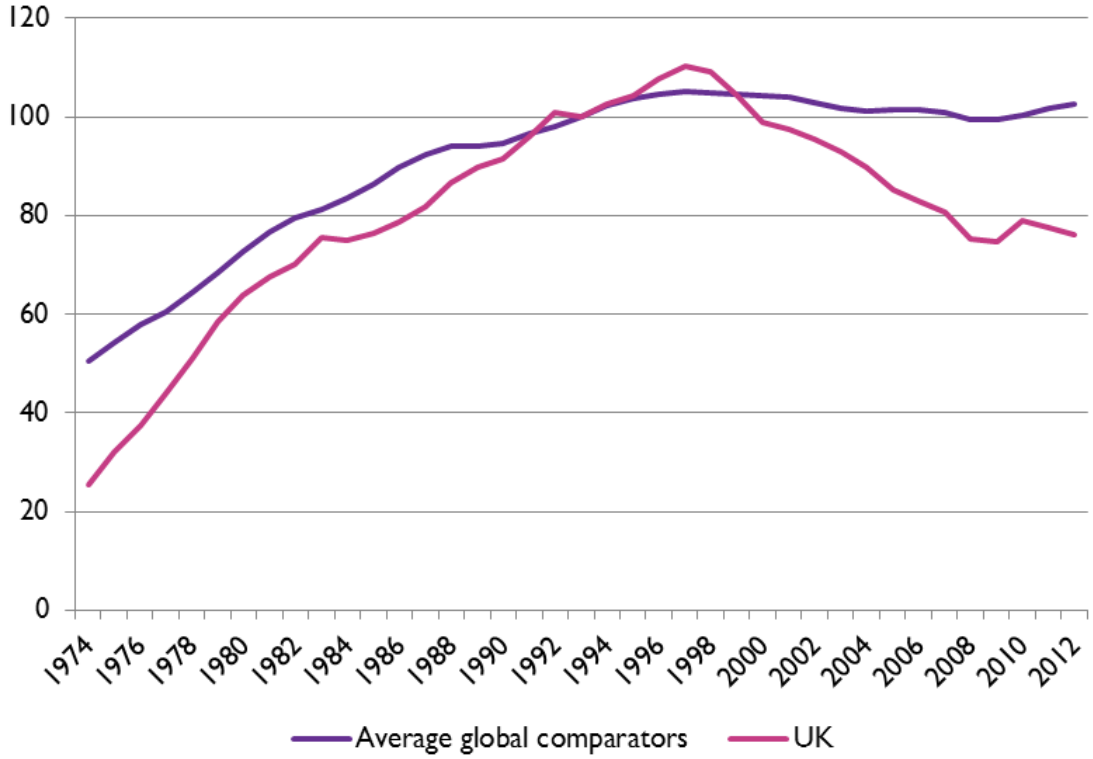
As has been noted in Section 5 and in Appendix 2, one potential weakness of our preferred methodology in this report is that it cannot attribute the effects it identifies decisively to the Single Market, because it does not establish any unambiguous causal economic mechanism. (That is the flip side of one of the key strengths of our methodology — namely that it runs a relatively low risk of building in the result via the assumptions about causal mechanisms.)

Our model does control for a wide variety of potentially relevant factors, including international developments, movements in relevant commodity prices (metals and energy), labour productivity changes, movements in the cost of capital, and others. Nonetheless, it does remain possible that effects our model

attributes to the Single Market arise instead from events that occur at around the same time as the Single Market.

Consider Figure 6.9, depicting UK versus international comparator nominal car price inflation.[31] We see here both the large turnaround in the relative inflation rates before and after the early to mid 1990s and that the date of that turnaround is not obviously 1993. The turnaround date in this raw data is in fact 1997.

Figure 6.9: UK and Average global comparator nominal car price movements (1993=100 for each series)



Source: National statistical agencies, Europe Economics.

Relatively little importance should be attached to this raw data turnaround date, especially as there is clear volatility in the inflation series in the 1990s. Furthermore, the raw data does not include the controls we introduce for other variables, and as noted elsewhere one should consider a number of different start dates for and glide paths in for the "Single Market". Nonetheless, it remains possible that there were other changes occurring in Europe in the mid-1990s that would have occurred even absent the Single Market, which our models incorrectly attribute as "Single Market effect".

For example, it is possible that the break-up of the Warsaw Pact and transition from Communism in the early 1990s was an important factor in car price movements and that it would have occurred at that same date even absent the Single Market (though it might well be disputed whether the collapse of European Communism at around that date could correctly be regarded as entirely independent of the existence of the European Union — given that European solidarity against the Warsaw Pact was a more-or-less explicit purpose of the European Union).

[31] The data in Figure 6.9 has been normalised so that the price indices are equal to 100 in 1993 for all series. While this chart is useful to show the evolution over time of each series, the levels are not comparable across series. We acknowledge that, for comparability, it would be preferable to have direct car prices from each country expressed in pounds sterling (or some other currency) instead of price indices. However, we have not found a data source that provides this information consistently across countries and for a significant time period.

Again, it is possible that if there have been international agreements, occurring during (perhaps relatively early in) the Single Market period, that would have occurred absent the Single Market, and that have had a materially higher effect on the real prices of UK and other Single Market member cars than on the cars of non-Single Market members, and those differential effects would have occurred even absent the Single Market, then indeed our models will incorrectly attribute them to the Single Market.

It is critical to note that it is primarily events that occur around the introduction of the Single Market and disproportionately or solely affect EU Member States that could be conflated in our model into the Single Market effect. Global trends or events that occur around the Single Market, but affect all developed countries in similar ways should be controlled for in our model through our international benchmarking.

It is also important to note that our modelling approach does attempt to minimise the risk of false attribution through any single start date. Although our preferred model compares the UK with international comparators and thus depends upon the 1993 date (and our sensitivity tests around it), we cross-check our preferred model with our Single Market model which includes multiples dates for the commencement of the Single Market in multiple countries. This showed that the models are indeed sensitive to the specification of the Single Market dummy. If the model could be extended to include the Accession States of 2005, 2007 and 2013, then in order for our result to arise from a coincidence of dates (other non-Single Market-related events occurring at about the same time as the Single Market) there would need to be multiple such coincidences across the many member countries of the Single Market and across the many different dates at which those countries joined.

So although we cannot rule out altogether the possibility that our method falsely attributes changes to the Single Market that merely occur at around the same time, our initial cross-checks do not indicate as such and we believe such checks could be extended such that the risk of such false attribution became relatively low.

6.5.2 Could the form of the Single Market's effect be mis-specified?

Concern: *The model (deliberately) assumes no causal mechanism by which the Single Market has an effect on real motor vehicle inflation. The use of a one-zero dummy variable implicitly assumes the effect is linear. That is relatively harmless, in statistical terms, when assessing whether a variable such as the inflation rate is materially correlated with an event such as the Single Market (i.e. whether there is an effect) but can be highly material for the assessment of how large coefficients are (i.e. how much effect there is).*

Assessment: In principle this could be a genuine methodological problem, but our cross-checks have established that varying the specification here makes relatively little difference to the final result and that those specifications that produce the greatest difference are the least statistically supported.

However, our tests to determine whether there are any material non-linearities or omitted variables in our models do provide mixed results. Our Ramsey RESET test for some, but not all, of our models of car price inflation suggests that omitted variables or specification may be a material concern for our model of car price inflation. However, different forms of the RESET test for car price inflation give different results so at this stage it is difficult to determine definitively if the car price model has omitted variables or specification issues.

Future tests of this methodology could try using different functional forms or, where available, more data or different explanatory variables to reduce model specification error or potential omitted variable bias.

These results are reported fully in Section 9.3.3 in Appendix 2.

6.5.3 Can we establish what underlying factors have driven the change in car price inflation?

Concern: *While the methodology finds an effect on car price inflation, even if the Single Market is driving much of this effect, it cannot establish what underlying changes may be driving the effect on price inflation.*

Assessment: It is true, and as we note in the preceding subsection, attribution of the effect we find to the Single Market is a challenge in our methodology. Furthermore, our model offers only some limited insight on the channels that cause the large effect identified in section 6.4.5 through the included control variables. Additional analysis could be conducted to try and establish what causal links there may be between the price inflation effect we observe and variables not explicitly included in our model. [32] This analysis may shed additional light on to what extent and how the Single Market is driving the change in price inflation.

6.5.4 Is this simply the result of inflation in the 1990s and 2000s being lower than in the 1970s?

Concern: *In the UK, inflation during the 1970s was much higher than in the 1990s and 2000s. One concern about our results, therefore, might be that they simply re-express this well-known fact as a falsely attributed "Single Market" effect.*

Assessment: We believe there is nothing significant in this concern.

There are two key reasons why this is unlikely to be an issue. The first and simplest is that our models here are not models of general price inflation. They are models of price inflation in the motor vehicles sector — i.e. they are models of how car prices evolve, either in nominal terms, relative to other prices or in terms of purchasing power. Our preferred model is that of real purchasing power. There is no clear reason why general price inflation being higher in the 1970s than the 1990s and 2000s would imply the real purchasing power prices of cars rising more rapidly in the 1970s.

The second, and most decisive, is that our models control both for international inflation (via the use of international comparators) and for differential evolution of UK versus international inflation (via an exchange rate control, a time trend variable, and a UK-specific fixed effect variable). If it were relevant to car price inflation (which is doubtful, for the reasons explained above), the fall in international inflation would be reflected internationally, in price developments amongst our international comparators.

6.5.5 Has this result been "baked in" in some unconscious way by the way the model is set up?

Concern: *In complex economic or statistical models, a natural concern is that the results may follow almost automatically from the assumptions underpinning the model (whether or not those assumptions are explicit or deliberate).*

Assessment: We believe there is nothing significant in this concern.

The key reason we do not believe this is a material concern is that our modelling assumptions do not increase the Single Market effect — they decrease it. In other words, the "raw" effect in the data, before our statistical controls are introduced is even larger. In Table 6.2 coefficient on the SM variable in our model without controls is higher than with controls.

[32] As discussed in section 5.6, the omission of relevant variables might bias the estimation and provide misleading coefficients by capturing the effect of variables that were not included as controls. However, the Single Market dummy would, by construction, correctly estimate the effect of unobserved variables that change because of the Single Market.

Thus we believe it is clear that the magnitude of the effect has not been introduced by our models. On the other hand, as noted in the above sub-section, we cannot rule out the possibility that there is some factor or event we are not aware of that, if introduced into the model with the correct specification, would control away much more of the effect our models attribute to the "Single Market".

6.5.6 Could the model be missing the effect of key regulatory changes in the car sector?

Concern: *The 1990s and 2000s saw a number of important changes in the regulation, trade and competition rules applied to the car sector. Perhaps the models falsely attribute the effect of these regulatory changes to the "Single Market".*

Assessment: It is important to remember that the Single Market is a process of regulatory, trade, and competition rules changes. Such changes to the rules, to the extent they are driven by the Single Market process, are rightly captured in our model.

It is of course possible that the UK and its trading partners would have introduced similar regulatory changes to those associated with the Single Market, at about the same time (or even earlier, perhaps) absent the Single Market process. Our models are unable to speculate on that point.

Our models also automatically incorporate the international effect of international regulatory developments that would have occurred even absent the Single Market (noting the caveat that since the European Union is a major player in international trade negotiations, the assumption that international agreements would have been the same absent the Single Market is a strong — probably implausibly strong — one), via the effect on our comparators.

6.5.7 Is this an effect of the Single Market or of the EU more generally?

Concern: *The European Union includes a customs union, establishing a common tariff, across EU members, on imports from outside the EU and abolishing tariffs between EU members. Could it be this, rather than the regulatory and competition rules of the Single Market, that is really being measured?*

Assessment: We believe there is unlikely to be anything significant in this concern.

The EU (at the time, EEC) customs union was established during the late 1960s and early 1970s (the UK joining in 1973). Our preferred model considers differential effects between the pre-1993 and post-1993 periods for the UK. In principle, perhaps one could not altogether rule out the possibility that the abolition of the customs union meant that the European car industry reacted in some very different way to the recession of the early 1990s than it would otherwise have done, so the effect we attribute to the Single Market was in fact a delayed effect of the customs union. We do not deny that such a story could in principle be told, but we do note that it would be rather strained to claim the customs union had a much greater effect from 1993 onwards (some twenty years and more after it commenced) than over the previous two decades.

6.5.8 Is the size of the change simply "too big to be plausible"?

Concern: *A central estimate modelled difference of 3.56 per cent annually is larger than the average economy-wide inflation rate, average productivity growth rate across the economy or the average growth rate of GDP. Perhaps the sheer size of the effect implies that there has been some mistake.*

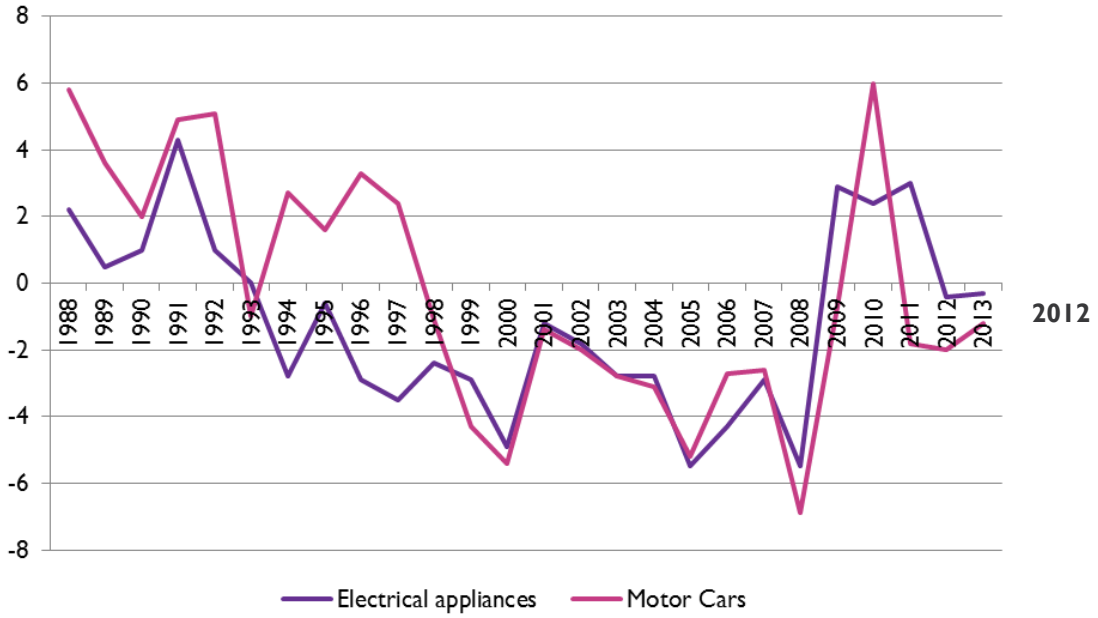
Assessment: We share some of this concern but ultimately do not consider it to be convincing.

The key point to note here is that the aggregate inflation and GDP growth rates are effectively averages across many sectors, some of which will have, say, inflation higher than the average and some lower. The price movements we identify for motor vehicles are far less than for certain well-known sectors with

inflation systematically wildly different from average inflation — of which perhaps the best known is computer hardware (which fell more than 90 per cent in price from 1997 to 2010).

Consider the following graph.

Figure 6.10: Motor vehicles vs Electrical appliances inflation, 1987-2013



Source: UK National Statistics, RPI data series.

This diagram illustrates two important things. First, the broad magnitude both of levels of motor vehicle inflation and the volatility thereof are similar to those for electrical appliances. Second, the sign of inflation (i.e. whether it is positive or negative) is not always the same across sectors in the same year or even over a number of years in a row — note the period in the mid-1990s when electrical appliances inflation was consistently negative but motor vehicles inflation positive.

One corollary of the above is that, if (as seems very likely) the GDP and overall inflation rate effect of the Single Market are less than those we identify for motor vehicles, it seems likely that there are products or groups of products for which the effects found here are reversed — i.e. for which the Single Market is statistically associated with a rise (not fall) in their real price inflation rates.

6.5.9 Could the lower inflation rate in the Single Market be because quality rose more slowly in the Single Market than amongst international comparators?

Concern: *Higher quality would be expected to be associated with higher prices. If quality rose more rapidly outside the Single Market than inside, one might expect that to appear in the form of an inflation differential.*

Assessment: We cannot rule this out as a factor, and believe it an area for potential further research.

General price inflation series in a number of countries are subject to "hedonic adjustments" for improving or declining quality, but for most countries the main product grouping this has affected is computer hardware. In the case of motor vehicles the only countries in our sample for which motor vehicles price series are quality-adjusted are Germany and New Zealand. The vast majority of our price data is not quality adjusted.

We have conducted separate analysis of quality in the motor vehicle market, but the only data we have for this is European. We have no quality data for the countries that serve as our international comparators for our inflation analysis. That means that we cannot exclude the possibility that average car quality has risen

systematically faster outside the Single Market than inside, and that the more rapid price falls inside the Single Market reflect a growing quality differential. This could be partly a question of the quality of what is available, but might also be simply a reflect of differing evolution in tastes.

However, to the extent that such quality or taste differentials existed even before the Single Market, they would be captured in our inflation models by our fixed effects and trend variables. But if the Single Market itself drove a change in quality trends, that could potentially appear in our model as a change in trend inflation of the sort seen.

We believe this is a potential area for further research.

6.6 Property insurance

Property insurance is defined as building insurance (e.g. against the risk of structural damage due to fire or subsidence) combined with contents insurance (i.e. insurance for the personal possessions in the property, against risks such as fire, burglary and so on) for each profile.

Insurance is a relevant cost item for consumers. Unlike motor vehicles, property insurance is a service and faces therefore more difficulties in being tradable. However, the Single Market offers the freedom of establishment and provision that increases the degree to which service providers can operate in Member States different to their own.

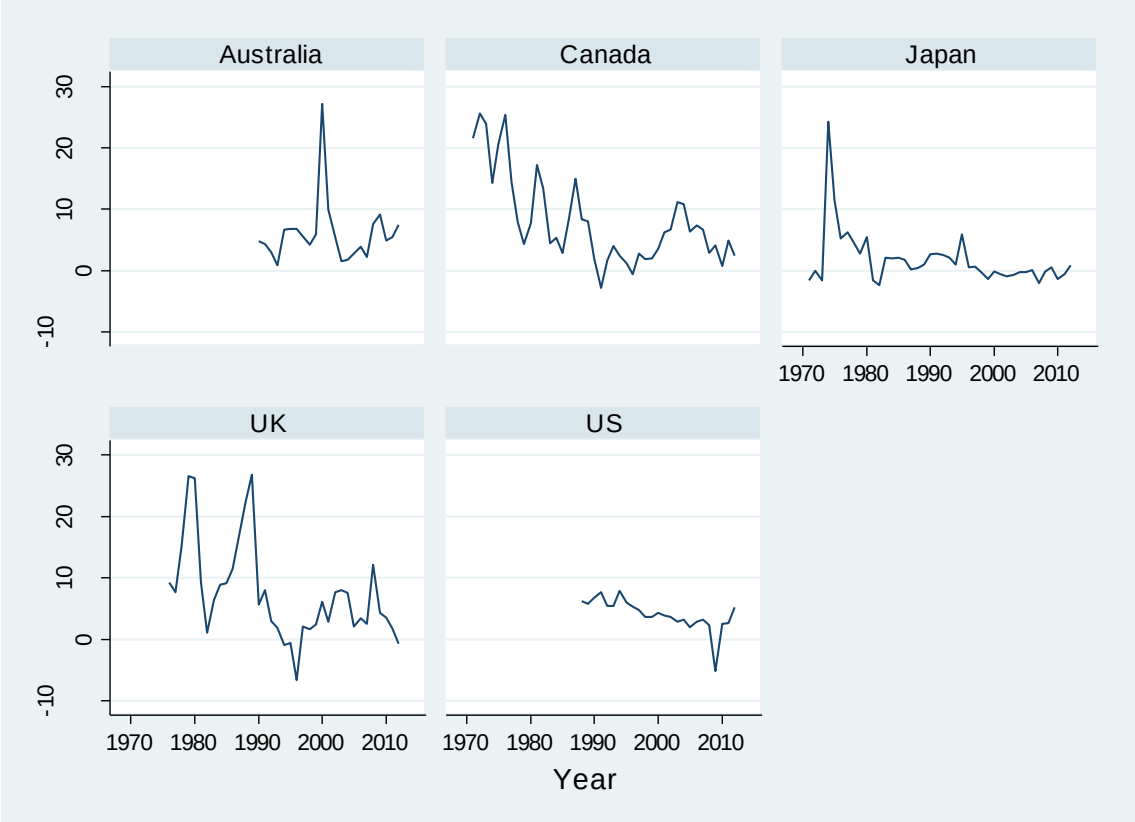
Similarly to the automotive sector, data on property insurance might contain items not directly relevant to consumers, such as insurance for commercial properties. However, due to data limitations, it might be necessary to consider the sector as a whole.

6.6.1 Prices

Trends in the dependent variable

Home insurance inflation, plotted below Figure 6.11 for the UK and non-European countries, has been considerably more volatile than car prices. Furthermore, this volatility is observed in the 1990s and 2000s in addition to the 1970s and 1980s. This is in contrast to car inflation, which was volatile in the 1970s and 1980s but much more subdued in the 1990s and 2000s. UK home insurance inflation was very high in the late 1980s but has fallen significantly since then.

Figure 6.11: Inflation trends in home insurance price indices, UK and non-European countries



6.6.2 Quality

Our preferred approach to measure quality would be based on a hedonic estimation, as conducted above for the automotive sector. Unfortunately, we are not aware of a data set that would allow us to perform the analysis with any degree of confidence. Moreover, we have not found appropriate data to pursue any of the alternative approaches to measuring quality. Therefore, it is not possible to quantify the effect of the Single Market on insurance quality using our methodology.

In order to estimate a hedonic measure of quality, we would need time series data from EU and non-EU countries, dating from before the existence of the Single Market until a recent date. Examples of variables that could be used in the analysis include:

- the cost of insurance (i.e. the level of the premium),
- the characteristics of the contract (e.g. excess/deductible),
- the characteristics of the object insured (e.g. value of the house and of its contents),
- the characteristic of the policy holder (e.g. age) and
- the characteristics of the area (e.g. crime levels)

There is some literature that has examined these variables, although they do not provide sufficient data to construct a panel. However, it might be possible to obtain some preliminary lessons from this literature.

Regarding the attributes of home insurance, Europe Economics (2009) found that the main determinants of home insurance premiums are the value of the property to be insured and of its contents.[33] Additionally, they did not find evidence of a significant correlation of natural disasters (measured by floods, storms, etc) or crime (measured by registered burglaries). This qualitative evidence indicates that the characteristics of the area are not a significant determinant of quality.

Range of products available

Similarly to the analysis of quality, we do not have sufficient data to implement our methodology to assess the effect of the Single Market on product variety in home insurance. In the absence of quantitative results from our approach, it is possible to obtain some stylised facts that would shed some light on the evolution of product variety in home insurance.

In a comparison within EU distribution channels for insurance, Europe Economics (2013) found that:[34]

- The emergence of price comparison websites, in particular in the UK and the Netherlands has led to the polarisation of the insurance market into a price- and quality-conscious segments. These websites tend to be more relevant for products that are more standardised (e.g. non-life insurance).
- The Single Market for services has led to a strong period of consolidation in the insurance industry.

Access to more advanced tools for price comparison suggests that there might be a tension between price competition and variety of products. However, even in the case where price comparison websites are responsible for a decrease in the variety of home insurance products available, this would correspond to a global trend that is not correlated with the existence of the Single Market.

There have been multiple reports documenting the process of consolidation in the European insurance market due to the Single Market, particularly the three generations of Insurance Directives. In addition to Europe Economics (2013), Beckman, Eppendorfer and Neimke (2002) find that, on average, the proportion of foreign-controlled companies in national non-life markets increased from 19.6 per cent in 1993 to 24.7 per cent in 1999.[35] The process of integration might suggest higher levels of product variety since consumers have more access to products previously only offered in other markets. However, this fact has not been verified empirically.

6.6.3 Estimates of the effect of the Single Market on home insurance

Direct effects

The table below contains our estimates of the coefficients on the Single Market dummy in our models of home insurance price inflation discussed in Section 5. We are somewhat cautions when viewing the results of these estimates, however, given certain data quality issues explored below.

[33] Europe Economics (2009) "Retail Insurance Market Study", commissioned by DG Internal Market. Available at http://ec.europa.eu/internal_market/insurance/docs/motor/20100302rim_en.pdf. The data for this report was collected by interviewing market participants and conducting a "mystery shopping" exercise.

[34] Europe Economics (2013) "Distribution Channels in Insurance", commissioned by ANIA (Association of Italian Insurers). Available at http://www.panoramassicurativo.ania.it/get_file.php?id=15327

[35] Beckman, R., Eppendorfer, C. and Neimke (2002) "Financial integration within the European Union: Towards a single market for insurance", M., MPRA Paper No. 5280. Available at: http://mpra.ub.uni-muenchen.de/5280

Table 6.3: Estimated Single Market effects in price for home insurance

Sample	Model	Home insurance price inflation
Nominal Prices	FE - Year and SM only	-5.1***
	FE - SM with full controls	-2.54**
Real Relative Prices	FE - Year and SM only	-4.1***
	FE - SM with full controls	-2.37**
Real purchasing power prices	FE - Year and SM only	-7.16***
	FE - SM with full controls	-4.25**

Notes: ***: significant at p < 0.01; **: significant at p < 0.05; *; significant at p < 0.1.
Source: Various national statistics offices; Eurostat; OECD; World Bank.

6.6.4 Diagnostic checks on direct effects estimates

We ran a number of diagnostic checks on our baseline model. The results are reported more fully in the appendix, but we highlight a few of the key takeaways here.

First, the data are heteroskedastic and exhibit serial correlation. These are addressed using robust standard errors clustered by country. The coefficient on the Single Market variable is very sensitive to specification. If the Single Market dummy starts taking a value of one prior to or after 1993, the estimated effect can change markedly. Results from the Ramsey RESET test and examination of alternative functional forms suggest that the real (using NGDP) price inflation model is not incorrectly specified, but that the nominal and real (using all-items) price inflation model may be.

In sum, the technical properties of the data are broadly sound, but the model itself is unstable. These observations reinforce caveats regarding the home insurance price inflation model more generally and the data that underlie it, and give us further reason to believe the estimates from these models are not robust.

Overall effect

The overall annual effect of the Single Market on home insurance is summarised below.

Table 6.4: Overall effect for insurance price inflation — Real purchasing power prices model

	Full estimation	SM effect	Total
Direct Effect	-4.25**		-4.25
Indirect Effects			
Unit labour cost inflation	1.19**	-1.39*	-1.65
Interest rate	23.1*	-0.011	N/A
Exchange rate change	0.02	N/A	N/A
Total			-5.9

Note: "Total" effect not calculated unless both component coefficients are statistically significant.
Source: Various national statistics offices; Eurostat; OECD; World Bank.

Given the lack of available data on quality and variety, Table 6.4 reports only the effect on insurance price inflation. We emphasise again that, due to concerns about the comparability of international data, we do

not consider these estimates to be robust, for reasons we shall now explain. They do, however, illustrate the method for the application of indirect effects.

Data quality caveats

There are certain reasons to be suspicious of the robustness of our results for property insurance. Our main panel is unbalanced because for much of the Single Market data are available only for recent years whereas for many non-Single Market countries the data go back much earlier and also exhibit somewhat odd patterns. Use of an unbalanced panel is not problematic in itself, but there is a systematic reason why these data are missing: they are European countries (except the UK) for whom data comes from Eurostat. It is well known that estimates using data that has systematically missing values can produce biased — or at least inaccurate — estimates. This is especially true for the insurance inflation data, where there is a considerable difference in inflation levels and volatility before 1990 and after 1990.

7 Conclusions and Recommendations

- In this report we have considered how one should assess the benefits to UK consumers, in particular sectors, of the Single Market.
  - The Single Market might have effects upon UK households in many other dimensions additional to their role as consumers — e.g. it might affect them via workers, business owners, investors, landowners, or voters. This report focuses purely upon consumer benefits.
- We propose to define consumer benefits / detriments in terms of changes in the prices, quality and variety of goods and services.
  - We acknowledge that there are other ways to define consumer benefits / detriments that might be more appropriate in other contexts (e.g. if one were considering changes to regulatory enforcement policy to combat scams then a reduction in the risk of falling victim to a scam might be a relevant dimension of consumer benefits that is not reflected in our definition here).
- Theory suggests that the Single Market may have both benefits (e.g. increased trade and reduced tariffs amongst Single Market members, greater competition reducing prices, greater product variety, reduced prices because compliance costs are reduced by compliance duplication being eliminated through harmonisation) and detriments (e.g. higher regulatory burdens raising costs and thence prices, the common external tariff raising prices for non-Single Market imports, greater product variety facilitating price discrimination) to certain consumers.
- Our proposed methodology uses trends and changes in international, non-Single Market country data as a benchmark for how UK consumer prices, quality and variety of products might vary absent the Single Market.
  - Our approach uses econometric estimation, based on panel datasets, taking account of both supply and demand variables, and estimating both direct effects (e.g. acting directly to reduce prices through competitive pressure) and indirect effects (e.g. prices falling because the Single Market leads to higher labour productivity, reducing unit labour costs)
- This approach, relative to other approaches, has the advantage of requiring a narrower range of data to be available (albeit over a longer time horizon) and providing results, in the form of measurement, that allow for intuitive interpretation.
  - We consider that for BIS' purposes this is more appropriate than the more elaborate, highly data-intensive and unintuitive simulation (not measurement) exercises entailed in sectoral macroeconomic or computable general equilibrium models — exercises that might be more appropriate if, for example, one were estimating the effects on taxation receipts of leaving the Single Market.
  - We also regard it as more general and more based upon hard data than the kinds of cost benefit exercises that are often appropriate when forecasting what would be the effect of various changes to regulation.
  - We do, however, acknowledge that our preferred approach suffers from the conceptual weakness of assuming that the Single Market does not affect global trends. Such an assumption risks overlooking the contribution collective EU trade negotiating makes to global tariff reduction accords, agencies such as the WTO, and policies in areas such as climate change mitigation coordination. We recommend that this caveat should be borne in mind when interpreting results.

- We have applied our preferred methodology in two sectors: retail motor vehicles sales and property insurance.
- We find a statistically significant (at the 10 per cent level) positive (i.e. purchasing-power-enhancing) effect of the Single Market on annual car price inflation in the UK, using our preferred model (in which impacts are defined as being upon real purchasing power). We find no effect on UK quality or variety, but cannot exclude the possibility that the relative inflation fall we find for motor vehicles is partly because the Single Market is associated with slower quality rises than amongst the non-Single Market international comparators.
- Our diagnostic tests provide mixed results on whether there may be omitted variables in our model for car price inflation. As noted repeatedly throughout the report, a key issue with our methodology is the ability to decisively attribute the effect we find to the Single Market. Additionally, our estimates are sensitive to the definition of the Single Market dummy, suggesting the results are not robust to specification.
- We find a wide range of potential impacts of the Single Market upon car prices, with the impact in our main models being that our preferred measure (real purchasing power prices) is between 7 and 76 per cent lower over the lifetime of the Single Market, relative to what would have happened outside. We note, however, that this result is sensitive to specification.
- In the case of property insurance, though we identify changes in terms of annual inflation reductions around 5.9 percentage points, we have concerns about the data available in the property insurance models and would attach relatively low weight to the specific estimates produced in that sector at this stage.
- Drawing together the findings of this study, we recommend:

  - Gathering additional sectoral data before applying any of the methods set out here — at present even in those sectors in which data is richest (e.g. the automotive sector) it appears to be difficult to obtain fully robust results;
    - Rather than conducting primary field work and commissioning of new surveys, by data gathering we refer to compiling existing data and producing harmonised figures either by adjustment or by obtaining data produced under a harmonised methodology. Additional data could improve significantly the results obtained in the case studies if long and comparable time series for EU and non-EU countries can be constructed;
  - Once additional data has been gathered, where such data permit and where the question concerns the impact of Single Market integration, using the "outputs based" approach in which the "degree" of the Single Market is defined in terms of the level of price and cost convergence;
  - Where the question concerns the impact of having been in the Single Market, applying the methods explored here in other sectors
    - Our recommended concept of price impact is that upon real purchasing power prices
    - Extending the analysis to include more sectors would increase the opportunity to exploit cross-sectional (cross-sectoral) properties of the model, increasing the statistical confidence of certain key results
    - Extending the Single Market set to include countries joining the EU since 2004 (a set for which relevant comparable data should become available in due course — meaning that the task of obtaining additional relevant data should be feasible) would reduce the ability of the model to assign impacts to the Single Market as opposed to contemporaneous events of the early 1990s (e.g. the collapse of the Warsaw Pact)
  - More generally, a closer exploration of causality than has been feasible in the context of this study might increase confidence in the policy relevance of the statistical results. This might include looking further at the automotive sector and experimenting with a different approach that includes explanatory variables that are directly linked to the drivers of change.

8 Appendix 1: What Data Would Work Best in Implementing our Preferred Methodology?

8.1 Variables required

Our counterfactual methodology depends on observing what has happened in the UK since being in the Single Market and comparing that with the hypothetical scenario that the UK was not in the Single Market.

8.2 Variables for which data must be obtained

8.2.1 Core outcome measures

We posit that membership in the Single Market leads to benefits for UK consumers through lower prices for the same or higher quality goods and services, a general increase in the quality of goods available, and greater consumer choice. Thus, as a minimum, we require variables that measure prices, quality, and variety of consumer products in the UK.

Prices

Among the most straightforward sources of data to obtain are data on prices. National statistics offices collect data on prices to construct prices indices, and price index classification systems are typically broken down by category. For example, the Classification of Individual Consumption by Purpose ("COICOP") categorisation is used by Eurostat in constructing their harmonised indices of consumer prices ("HICPs") and is broken down by into four sub-levels, which each sub-level dividing categories into finer divisions.

The GDP deflator is often used as a measure of price inflation, and one can also analyse the deflator for a relevant component of GDP measured under the expenditure approach: household final consumption expenditure (HFCE). The HFCE deflator can be interpreted as inflation in those items that households purchase in a given year. From this perspective, year-over-year changes in the HFCE deflator is a proxy for the change in consumer prices more broadly. So, while changes in GDP and GNI deflators measure inflation in aggregate economic activity or national income, changes in the HFCE measures inflation in household expenditure or consumer prices.[36]

Prices also have the advantage of being directly observable and available over time. Private sources of data, such as cost of living measures from human resources consultants or data collected by academics, use

[36] An advantage of analysing the GDP deflator over the CPI or HICP as a measure of price inflation is that the GDP deflator makes no assumptions about the consumption basket. A key issue associated with using output deflators for the type of analysis we are proposing is the potential for circularity. For example, our model uses unit labour costs and real GDP is explanatory variables for changes in prices. Both measures are related to output. Using measures related to output to explain prices measures that have themselves been derived from measures of output creates a circularity of logic, which could lead to biased estimations. Another shortcoming of using output deflators is the limited potential for disaggregation.

surveys of current prices or extracts historical pricing information from catalogues, registries, and other sources.

Despite these attractive features, price data do have some downsides. Historical actual prices may not be available in a ready-to-use format, and could require significant archival work if the researcher requires a long time series. Prices may also reflect country-specific idiosyncrasies, such as consumption preferences, tax rates, or regulatory frameworks. Where prices are measured as an index, such as in HICP or the UK's retail price index (RPI), making cross-country comparisons can be difficult due to differing price levels in different countries.

Quality

There is not commonly acceptable measure for estimating the quality of goods and services, either in the academic or applied literatures. We have identifies three widely used measures for quality in the literature that could be appropriate for the purposes of this report. We present them below together with an evaluation of their merits and disadvantages. The measures we will analyse are:

- Consumer Surveys.
- Implicit quality based on trend patterns.
- Hedonic Estimations.

We discuss each of the above in turn.

Consumer Surveys

Consumer Surveys are a method for collecting data by asking directly the individuals of interest a set of questions coming from a well-designed questionnaire. They can be particularly useful when trying to measure quality because the interviewer can ask how exactly the interviewee perceives the quality of a given product according to their preferences. This method can measure the perceived overall quality for a product or the quality of each of its components or attributes.

There are two approaches to measuring quality through questionnaires.

The Product-based Approach

This approach is based on the objective characteristics of a product. For example, early economic research focused almost exclusively on durability as a measure of quality, simply because it was easy to measure and interpret. Since durable goods provide a stream of services over time, increased durability implies a longer stream of services — in effect, more of the good. Quality differences could, therefore, be treated as differences in quantity, considerably simplifying the mathematics. The type of questions that would be analysed under such sort of surveys would be for how long a consumer would expect to use a particular product even if its official product life is longer.

The User-based Approach

User-based definitions start from the opposite premise that quality "lies in the eyes of the beholder." Individual consumers are assumed to have different wants or needs, and those goods that best satisfy their preferences are those that they regard as having the highest quality. This is an idiosyncratic and personal view of quality, and one that is highly subjective. In the marketing literature, it has led to the notion of "ideal points": precise combinations of product attributes that provide the greatest satisfaction to a specified consumer; in the economics literature, to the view that quality differences are captured by shifts in a product's demand curve.

The advantages and disadvantages of consumer surveys as measures of quality are:

Advantages:

- Costs: surveys are relatively inexpensive. Online surveys and mobile surveys, in particular, have a very small cost per respondent. Reach: surveys are useful in describing the characteristics of a large population via a sample.
- Flexibility: surveys can be administered in many modes, including email surveys, social media surveys, paper surveys, mobile surveys, telephone surveys, and face-to-face interview surveys. Further, they can be adjusted to provide exactly the information that is needed rather than tangentially relevant information
- Dependability: The anonymity of surveys allows respondents to answer with more candid and valid answers and capture their precise assessment of quality rather than expecting consumers to make a choice in order to reveal their preferences (revealed preferences approach or credit card approach).

Disadvantages:

- Not available as public information.
- Difficulty of international comparisons, unless at high cost (e.g. Eurobarometer).
- Subjective measures.

A disadvantage of using surveys is that it would be very challenging to run a survey that captures the preferences of the entire population (in terms of time and willingness of a significantly larger number of consumers to provide answers to a questionnaire) and hence it would be difficult to draw conclusions about the quality of products produced by an entire country in aggregate.

Trade-based measures

Another way of inferring product quality is by looking at trade patterns to induce preferences which implicitly depend on the quality of the product. The main idea here is that countries that produce goods of a higher quality (as perceived by the countries that import these products) are able to charge a higher price per unit for a similar product (excluding tariffs).

There is a substantial literature in international trade that uses a "revealed preference" approach to infer the quality of tradable products based on the direction of trade. Examples of this literature are Hallak & Schott (2011) (http://ideas.repec.org/p/nbr/nberwo/13807.html), Feenstra and Romalis (2012) [37] which is based on the UN COMTRADE database[38], and Hallak (2008)[39] .

The most widely used trade-based measure for quality is the one developed by Feenstra and Romalis in 2012. Feenstra recognises that the unit values of internationally traded products are heavily influenced by quality. They employ a demand system to model consumer demand in which quality and quantity multiply each other in the utility function. They also use a gravity equation to complement his findings and more accurately measure quality. The intuition behind the gravity equation used is that the higher the quality of the product the higher the distance it will "travel". Goods of higher quality are shipped longer distances[40]. Feenstra and Romalis report a measure of quality that is proportional to the ratio of export prices to productivity adjusted wages.

The main dataset which was used was the United Nation's Comtrade database. Further in order to clean these data from any tariffs imposed the Wold Banks' TRAINS Database is used together with the International Custom's Tariffs Bureau data.

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[37] Feenstra, Robert C., and John Romalis. *International prices and endogenous quality*. No. w18314. National Bureau of Economic Research, 2012.

[38] Feenstra, Robert and John Romalis (2012) "International Prices and Endogenous Quality", NBER Working Paper No. 18314. Available at faculty.chicagobooth.edu/john.romalis/Research/Prices_Quality.pdf

[39] Hallak, Juan Carlos. "Product quality and the direction of trade." Journal of International Economics 68.1 (2006): 238-265.

[40] Also known as the "Washington apples" effect. See Hummels, David. "Toward a geography of trade costs." *GTAP Working Papers*(1999): 17.

Another way of using trade data to measure quality is the one adopted buy Juan Carlos Hallak and Peter Schott (2011). They develop a model for decomposing a country's export price into quality and quality adjusted components. The presumption in this paper is that holding observed export prices constant, countries with trade surpluses offer higher quality goods than countries running trade deficits. The authors make sure that they control of variations in product differentiation and estimate the evolution of manufacturing quality for top exporters.

Advantages:

- Data availability for several countries.
- Data available for a number of years which allows comparison across time.
- Inexpensive to collect data.
- A large fraction of the literature to follow and copy to derive measures of quality.

Disadvantages

- Not possible to establish quality of non-tradables.
- The quality of exports of a country might differ from the quality of all goods produced domestically.
- The methodology can sometimes be complicated.
- Different methodologies may result in different conclusions.

Hedonic quality adjustments

Hedonic quality adjustments are econometric methods that use the attributes of a product to "explain" their prices. The adjustment estimates how much consumers value the features of the corresponding good or service. Combining these estimates into an index would create a measure of product quality. In addition, they would allow the possibility of distinguishing between pure price changes and the changes due to quality variation.

In the UK, the ONS has used this approach recently for selected products. There are precedents of national statistics offices using hedonic quality adjustments:

Table 8.1: International use of hedonic quality adjustments in price indices

Country	CPI Hedonic items (Date Introduced)
Australia	PCs (2005)
Canada	PCs, Laptops, Printers, Monitors (all 1996) & Internet Services (2008)
New Zealand	Used Cars (2001)
USA	Clothing, Footwear, Refrigerators, Washing Machines, Clothes Dryers, Ranges & Cooktops, Microwave Ovens, TVs, DVD Players
Germany	Used Cars (2003), PCs (2003), Laptops (2004), PC Tablets (2013)
Sweden	20 Clothing & 12 Footwear items (before 2009)
UK	PCs (2003), Laptops (2005), Tablet PCs (2013), Digital Cameras (2004), Smartphones (2011) & Mobile Phones (2007)
Switzerland	PCs & Laptops (2012)

Source: ONS (2014) "Review of Hedonic Quality Adjustment in UK Consumer Price Statistics and Internationally". [41]

There is also a large body of economics literature on this topic. For example:

- Dvir and Strasser (2013).[42]: Hedonic prices here are constructed by looking at the various versions of a specific car that are available in different countries. This means that producers vary the type of car

[41] http://www.ons.gov.uk/ons/guide-method/user-guidance/prices/cpi-and-rpi/review-of-hedonic-quality-adjustment-in-uk-consumer-price-statistics-and-internationally.pdf

options and features available in each country according to the observed preferences of the local consumers. These options are aggregated together to create an index of quality

- Goldberg and Verboven (2001, 2005)[43]: The purpose of the paper is to document car price dispersion in the European Union. However, to do so they need to identify whether the price dispersion is random or systematic. To do so they construct hedonic price indices for each year. They ensure that these indices control for quality differences as measured by a number of characteristics such as horsepower and size.

Advantages:

- Quick way to construct a quality index.
- Relatively inexpensive.
- Hedonic measures are useful because the goods that they usually analyse are not homogeneous and their value to consumers and producers vary systematically with their characteristics.
- Accurate.

Disadvantages:

- The data availability could be limited and confined to a specific number of industries.
- It is easy to ignore some features of the product which consumers value a lot and not include them in the model.
- Hard to disentangle the effect of preferences upon perceived quality.

Variety

As it was the case with quality, there is no universally accepted measure of product variety in the economics literature. There are conceptual and practical difficulties associated with constructing an appropriate index. From a conceptual point of view, variety could be measured in different levels of disaggregation. It would be possible to consider the number of products in a sector or any segment, the number of brands available to consumers or the degree of customisation that each product offers. For example, in the automotive sector, it would be possible to consider the number of makes per size segment, the number of models, the number of trim levels per model in a category or the number of options available for each trim. It is not possible to decide *a priori* which is the most appropriate level of disaggregation for an arbitrary sector. The decision should be based on the nature of the product and the availability of data in each sector.

From the practical point of view, it is typically required to obtain highly disaggregated data of the sector in question, including all the different specification of the products and, possibly, data on prices and/or volumes in each subcategory. This type of data might be readily available for some sectors, but difficult to construct for others.

We note that we are concerned only with measuring the so-called external variety (the one offered to consumers) rather than the internal variety (the one from the producer's point of view of, for example, dealing with multiple specifications and suppliers).[44] The latter, however, is relevant for our analysis, since an external variety is likely to be correlated with internal variety, which in turn results in a higher cost for producers.

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[42] Dvir, Eyal and Georg Strasser (2013) "Does Marketing Widen Borders? Cross-Country Price Dispersion in the European Car Market".

[43] Goldberg, Pinelopi and Frank Verboven (2005) "Market integration and convergence to the Law of One Price: evidence from the European car market" Journal of International Economics, 65.
Goldberg, Pinelopi and Frank Verboven (2001) "The Evolution of Price Dispersion in the European Car Market", *The Review of Economic Studies*, 68.

[44] See for example, Pil and Holweg (2004) "Linking Product Variety to Order-Fulfillment Strategies" Interfaces 34(5), pp. 394–403.

We discuss below some of the approaches used in the literature to measure product variety:

Purely combinatorial

This approach consists of defining the relevant attributes of the product and counting the number of possible options that consumer have in each of these attributes from products available in the market. Examples of applications of these measures are Pil and Holweg (2004) and Fisher and Ittner (1999). [45] They propose an index that multiplies across attributes the number of options offered for each of them.

The main advantages of this measure are its simplicity and the modest data requirements. The disadvantage is that it is based purely on products that exist somewhere on the market, but might necessarily not be easily accessible by most consumers. In addition, this measure might be difficult to implement for attributes that can take a continuum of values.

Option Variability

This measure is based on using the fractions of products that present each option in a given dimension or attribute. The variability is the standard deviation of a multinomial distribution using these fractions as probabilities. An average is then obtained across attributes. This measure was used by MacDuffie, John Paul, Kannan Sethuraman and Marshall L. Fisher (1996).[46]

The data requirements for this approach are moderate: not only it is necessary to identify the set of attributes, but also count the number of products that fit in each category. A disadvantage is that further information might be required to average across attributes if a simple average approach is not appropriate.

Variation in consumer expenditure

Similarly to previous measures, this index is based in relation to a set of attributes and different product specifications. However, this measure computes the expenditure made by consumers on each of these options and estimates the variation based on its standard deviation, coefficient of variation or entropy as proposed by Alexander (1997).[47]

The main advantage of this measure is that it weights observations according to their relative importance in terms of consumer spending. A disadvantage is that it is demanding in terms of data requirements: prices and volumes sold for each product need to be known.

Trade-based measures

The literature of international economics has developed measures of relative product variety among trading countries. These measures are based on the set of varieties that are observed in a country but not in its partners. This approach was developed by Feenstra (1994)[48] and Feenstra and Markusen (1994)[49].

The advantage of this approach is that they can be constructed from publicly available databases such as UN COMTRADE. However, this approach measures export variety, which might differ considerable from the variety of products experienced by domestic customers. In addition, these measures rest on the assumption of specific models of trade (namely, monopolistic competition models and consumers with

[45] Fisher, M. L., C. Ittner (1999) "The impact of product variety on automobile assembly operations: Empirical evidence and simulation analysis" Management Science 45(6) 771–786.

[46] MacDuffie, John Paul, Kannan Sethuraman and Marshall L. Fisher (1996) "Product Variety and Manufacturing Performance: Evidence from the International Automotive Assembly Plant Study", Management Science, Vol. 42, No. 3, pp. 350-369.

[47] Alexander, Peter (1997) "Product variety and market structure: A new measure and a simple test", Journal of Economic Behavior & Organization Vol. 32 pp. 207-214.

[48] Feenstra, Robert C. (1994) "New Product Varieties and the Measurement of International Prices," American Economic Review, 84(1), 157-177.

[49] Feenstra, Robert C., and James R. Markusen. "Accounting for growth with new inputs." International Economic Review (1994): 429-447.

preferences that exhibit constant elasticity of substitution). While the measures developed can be sophisticated, they might be also sensitive to misspecifications of the model.

8.2.2 Control variables

Any estimated "Single Market effect" may, however, be spurious if the estimated effect is mediated by some intervening variable. For instance, a simple univariate model could detect an effect of the Single Market on prices, but this could be through the Single Market making workers more productive and lowering unit labour costs. Once unit labour costs are taken into account, the Single Market effect may disappear.

We identify two general classes of potential intervening variables, or "control variables", that would be useful to include in estimations. The first class of variables is the supply side class. These variables primarily affect producers and the cost of production. If inputs into the production process become more expensive, then firms can choose to respond to higher input prices by raising the retail cost of products, reducing quality of the final product, or restrict the number of products produced to rationalise production processes.

Supply-side factors

Traditional inputs into the product process are labour[50] and capital[51]. Labour costs can be measured in a variety of ways, and a commonly available measure of labour costs is unit labour costs (ULCs), which measures the total labour cost to produce one unit of output. There are also a number of candidate measures for capital costs. We use the real interest rate as our measure of the cost of capital, since data on interest rates and inflation — and thus real interest rates — are widely available across countries and over time.

Costs of labour and capital may be affected by the Single Market. Labour costs, for example, would be affected through EU Directives regulating the labour market and the free movement of labour around the Single Market. Also, famously, interest rates on European sovereign bonds converged considerably during the Single Market period and especially in the run-up to the creation of the euro.[52] Therefore, it is also import to include costs that are priced in the international market and therefore less affected by the Single Market. Commodities are a strong candidate measure, since they are present in nearly every operational process and internationally priced. We use energy commodity prices and, for motor cars, metals commodity prices as measures of internationally-priced input costs.[53]

Demand-side factors

[50] Labour productivity and costs have been used in the literature by Dreger et al. (2007) "Price Convergence in the Enlarged Internal Market.", Layard, et al (2005) "Unemployment: macroeconomic performance and the labour market", Pérez and Rebollo Sanz. (2006) "The use of permanent and temporary jobs across Spanish regions: do unit labour cost differentials offer an explanation?", Darvas (2012) "Compositional effects on productivity, labour cost and export adjustments", and van Ark, Bart, and Erik Monnikhof (2000) "Productivity and unit labour cost comparisons: a data base. International Labour Organization".
includes labour productivity as a control variable in their model when they set to estimate price convergence in the single market

[51] For example, Henry (2003) "Capital account liberalization, the cost of capital, and economic growth" uses the interest rate as a control variable.

[52] The exchange rate was used as a control variable by Rogers, Hufbauer and Wada (2001) "Price Level Convergence and Inflation in Europe" and Gil-Pareja and Sosvilla-Rivero (2005) "Price Convergence in the European Car Market".

[53] For example, Égert (2007) "Real convergence, price level convergence and inflation differentials in Europe" uses crude oil prices and Rogers (2007) "Monetary union, price level convergence, and inflation: How close is Europe to the USA?" includes energy prices as control variables.

Demand-side factors also play a role in determining price, quality, and variety. If, for instance, household income increased dramatically without a similar increase in productivity, then an economy may experience inflationary pressures through increased demand and stable supply.

The preferred measure of income for consumers is household income. This, however, is not generally available in a comparable format across countries with sufficient time series availability. As a proxy in our analysis, we have used the growth rate in national income. The cost of doing so is that this includes non-consumer income, but the benefit of having greater time and country availability for this data, in our view, outweighs the cost.

Cross-country factors

Finally, we include a measure that could capture cross-country influences on our consumer welfare measures. The exchange rate between two countries is a key determinant of international goods and services flows over the long-term. Furthermore, data on exchange rates are readily available for countries around the world, making the variable a strong candidate for a general methodology.

Table 8.2: Variables for which data must be obtained

Variable	Potential measure
Prices	• Price indices (CPI, HICP, RPI) • National output deflators • Actual prices of products
Quality	• Hedonic price regressions • Customer Surveys • Trade-based measure
Variety	• Combinatorial • Option variability • Variation in consumer expenditure • Trade-based measure
Supply-side factors	• Labour costs • Capital costs • Costs of internationally-priced inputs
Demand-side factors	• Income
Cross-country factors	• Exchange rates

The economic growth literature has tested a large number of control variables to perform international benchmarking. For a comparison and discussion of the results obtained using these control variables, see Durlauf, Johnson and Temple (2005).[54]

8.3 Potential sources for obtaining data

8.3.1 Price data

We explore these issues in more detail with reference to specific sources of data below.

[54] Durlauf, Steven, Paul Johnson and Jonathan Temple (2005) "Growth Econometrics," in Handbook of Economic Growth, edited by P.Aghion and S.N. Durlauf, North-Holland: Elsevier, Amsterdam Available at http://irving.vassar.edu/faculty/pj/growtheconometrics.pdf

National statistics offices

National statistics offices contain a number of useful data series on prices. Typically, national statistics offices compile indices of consumer prices at varying levels of granularity. Consumer price indices are indexed against a particular year or time period (e.g. January 2005 = 100) and observations for the price index in subsequent periods are obtained by adding the per cent change in prices to the index. Price inflation, then, is calculated as the period-over-period change in the consumer price index.

The overwhelming advantage of consumer price indices is that they are made-for-purpose; that is, the measures are designed to capture changes in prices that are relevant to consumers. This is done by specifying a basket of goods and services that consumers purchased and weighting each item in that basket by the proportion of income a representative consumer spends on that good or services. This means that the consumer price measures are methodologically sound from the perspective of examining *consumer* welfare and does not conflate other prices, such as prices of goods and services relevant to businesses, in the price measure. Furthermore, consumer prices are usually broken down into specific categories, such as "motor vehicles" or "insurance connected with the dwelling", allowing for investigation of price trends for specific goods or services.

A key shortcoming of price index data is that it does not give any information about price levels in the country. Additionally, availability of data from national statistics offices varies considerably. For non-European countries, data on most item categorised can be found back to around the 1970s. Data availability in many European countries, however, is significantly sparser.

Table 8.3 contains a sample of data availability on the two case study items in this report, motor vehicles and home insurance, to illustrate the amount of variation in data availability form European national statistics offices. The table contains the first year data are available for the relevant price index categories. As a point of comparison, Eurostat offers data on these subcategories of consumer prices starting in 1996, although not all of the countries have data starting from 1996.

Many of the European countries do not have data starting from before 1996, the first year of Eurostat availability. Belgium, France, Ireland, Spain, and the Netherlands do not have data from before 1996 available on their websites. Furthermore, in some cases the national statistics websites do not offer categories that are analogous to home insurance, such as Germany, Italy, and Sweden.

Table 8.3: Availability of price index data from select European national statistics offices

Country	Vehicles	Home Insurance
Belgium	2006	2006
France	1998	1998
Germany	1991	N/A
Ireland	2003	2003
Italy	1996	N/A
Portugal	1991	1998
Spain	2002	2002
Sweden	1980	N/A
The Netherlands	1996	1996
UK	1987	1987

Source: Various national statistics offices.

In some cases, the methodology, categorisation of items, or weighting schemes the national statistics offices uses has changed and the data have not been back filled using the new approach. This is the case in Ireland, where the data are available only since 2003. Alternatively, it may be that national statistics offices have fewer resources available to maintain a long time and updated time series of detail price indices with the

advent of Eurostat. This could explain why data for European countries is less widely available than data for non-European countries.

In addition to lack of availability, data from national statistics offices sometimes face comparability issues along several dimensions. For example, measurement of the price index can differ for national measures of consumer price indices, where product categories or weights differ substantially from measures of consumer prices in cross-country databases. There may be entirely different bases for measuring the price index, such as the Retail Price Index in the UK versus the Consumer Price Index in the US. Finally, countries use different item categorisation frameworks that render like-for-like comparisons difficult. For example, various countries measure home insurance as "insurance connected with the dwelling", while the Japanese price index uses "Fire insurance premium", Canada uses "Homeowners' home and mortgage insurance", and UK RPI measures "Dwelling insurance & ground rent". The US does not identify home insurance specifically, and the closest comparable category is "Financial services" and contains several non-insurance products and services.

Eurostat

Eurostat data also has a considerable amount of information on prices, and in particular price indices. Eurostat publishes the HICP, which is a cross-country price index for which the item categories and collected methodology are the same across countries. This data begins, in general around 1996 and is available for European countries and select non-European countries.

Eurostat holds the same advantages of using national statistics offices for consumer prices data (i.e. they are made-for-purpose and contain granular item category breakdowns). The key advantage of using Eurostat data over data from national statistics offices is that measures are directly comparable. Unlike data from national statistics offices, which use varying methodologies and item categories, the HICP allows for direct country comparison since they are compiled on a harmonised methodology across countries. Problems of trying to match analogous but differing item categories are not present in Eurostat data.

However, this advantage over national statistics data comes at some costs. First, Eurostat data is not available before 1996 and in some cases after then. Data becomes less available over time as one moves into increasingly granular item categories. Although Eurostat data is actually more up to date than some European national statistics office measures, other national statistics offices have longer available time series (e.g. UK RPI and its breakdowns). What is more, the country coverage for Eurostat is limited to European countries and a very small selection of non-European countries. Among the non-European countries surveyed in this study, only information for the US and Japan is available on Eurostat. Thus, relying solely on Eurostat data for constructing the Single Market counterfactual is not feasible.

Comtrade

The United Nations Commodity Trade Statistics Database (UN Comtrade) provides international merchandise trade statistics for 140 countries from 1962 to present. The data available has some variations by country and trade classification. UN Comtrade is considered the most comprehensive trade database available with more than 1 billion records. A typical record is – for instance – the exports of cars from Germany to the United States in 2004 in terms of value (US dollars), weight and supplementary quantity (number of cars). While this database does not report directly information about prices, it is possible to infer average prices from expenditure and volume data. This approach has been used frequently in the trade literature. The database is continuously updated. Whenever trade data are received from the national authorities, they are standardized by the UN Statistics Division and then added to UN Comtrade. The main benefits of using this database include comparability, completeness (very few missing observations) and ease of use. Additionally, the UN Comtrade database has a sister website, the UN Service Trade database. This database contains data on trade of services from 2000 to present. Both datasets use US dollars as the exchange currency.

Advantages:

- Wide number of variables.
- Few missing observations.
- Up to data.
- Easy to use.
- Variables already standardised.
- Comparability.

Limitations:

- The values of the reported detailed commodity data do not necessarily sum up to the total trade value for a given country dataset due to confidentiality reasons
- Data are made available in several commodity classifications, but not all countries necessarily report in the most recent commodity classification
- Imports reported by one country do not coincide with exports reported by its trading partner. Differences are due to various factors including valuation (imports CIF, exports FOB).

Supranational sources

Other supranational sources, such as the OECD, the IMF, or EU KLEMS, offer a wide variety of information on prices. These are often in the form of price indices, but these sources also offer measures of national output from which output price deflators can be constructed.

The key advantages of these data are availability and comparability. By construction, these sources contain harmonised information on several countries and across time. As with national statistics offices sources and Eurostat, data availability becomes poorer as one goes further into the past or deeper into particular item categories. Given the wide country and time coverage, however, these data sources are strong candidate measures for a general methodology and have been used in our case studies as data sources where the measures did not require significant granularity (e.g. exchange rates, labour costs, interest rates, etc.).

Privately collected data

The final category of price data comes from private sources and measures price directly in local currency (e.g. the price of a car in pounds and pence, rather than a price index). We have identified two general sources of this type of data.

The first private source of price information is based on data used to price compensation packages for sending employees abroad. This information is usually available from human resources consultancies, such as Mercer HR Consulting[55], but is also available from research houses such as the Economist Intelligence Unit (EIU)[56] and UBS[57]. The advantage of using these sources is that they have comparable price level information as well as comparable inflation information. Furthermore, very specific items are priced and the items are available across countries, allowing case studies on very detailed items. Finally, the time series coverage extends back to the 1970s, allowing for pre- and post-Single Market comparisons.

Private surveys, however, do have some disadvantages. The restricted item set naturally limits the set of potential case studies to the items surveyed, which may not be of interest to the researcher. Although the time availability of the surveys is generally good, the surveys are usually updated every three years. The infrequent updating of the information could pose difficulties for econometric analysis of the data, as changes in prices between the three year period could be masked by virtue of the collection frequency. Finally, these surveys tend to focus on large cities rather than entire countries. Thus, these surveys are

[55] http://uk.mercer.com/press-releases/cost-of-living-rankings
[56] https://www.eiu.com/public/topical_report.aspx?campaignid=Wcol2014
[57] http://www.ubs.com/global/en/wealth_management/wealth_management_research/prices_earnings.html

likely to contain a bias towards urban areas and may not be representative for the country as a whole. This may be of importance in estimating the effect of the Single Market on UK consumers if, for instance, one presupposed that the Single Market would affect London differently than the rest of the UK.

A second source of private information is academic sources. For instance, several economists have been interested in the question of price convergence in the Single Market, and have studied particular categories of items. One particularly relevant study for our purposes is by Goldberg and Verboven (2005)[58], for which the raw data is available online from the author.[59]

This is a highly granular data set that contains price information for cars by country. In addition to the price information, this dataset also contains information on car features and macroeconomic / demographic data on the countries considered. This rich dataset can be used in an analysis of prices, but also can be used for a hedonic analysis of quality. The key advantage of this sort of data is that the data are often far more granular and contain more relevant features for a particular product category. This allows the researcher to delve into specific aspects of the product of interest at a level that would probably not be possible with other data sources.[60]

Data from academic or other researcher private sources suffer from some disadvantages. These data typically cover a very particular time or geographic range and are collected with the author's researcher agenda in mind. It may be difficult, then, to re-purpose the data for a different research question. The Verboven car data set contains information only for Belgium, France, Germany, Italy, and the UK and only from 1970 to 1999. This is not sufficient for a cross-sectional counterfactual model, since there are no non-Single Market countries in the sample. Furthermore, there is only limited availability since the advent of the Single Market. A final disadvantage of using data collected by a third party researcher is replicability; the researchers will have often gone to great lengths in collected the data and recollecting the data from scratch as a sense check or to expand data availability could be very costly. Verboven and his collaborators collected car price data from historical catalogues and national registry bureaus.[61]

8.3.2 Quality data

Product attributes

Data on attributes could be obtained from:

- trade associations;
- systematic collection of information from catalogues (e.g. the data available from Verboven); and
- national statistics offices that conduct hedonic adjustments for selected products.

Customer surveys

Customer satisfaction surveys are regularly performed by public bodies (e.g. Eurobarometer), market research companies and trade associations (e.g. the Institute of Customer Service elaborates the UK Customer Satisfaction Index)

[58] Goldberg, Pinelopi K. and Verboven, Frank (2005) "Market integration and convergence to the Law of One Price: evidence from the European car market" 65(1), p. 49-73.

[59] https://www.econ.kuleuven.be/public/ndbad83/frank/cars.htm. Please note that we obtained permission to use this data from the author (Dr Frank Verboven). Any subsequent use of the data should be confirmed with the author.

[60] As discussed in our section on hedonic methods, some countries adjust price indices for particular classes of products by quality. These data are not routinely available, but could be available if the researcher were to submit a request to the relevant statistics office for the underlying micro data.

[61] Goldberg, Pinelopi Koujianou and Verboven, Frank (2000) "The evolution of price dispersion in the European car market" 68(4), p. 811-848.

8.3.3 Variety

Similarly as with quality, data on attributes and volumes sold could be used to construct appropriate indices. These could be obtained from:

- trade associations; and
- systematic collection of information from catalogues (e.g. the data available from Verboven).

8.3.4 Summary on data sources

Table 8.4 contains information on the advantages and disadvantages of various sources of price data. In general, sources closer to the countries in question, such as national statistics offices, have more detailed item breakdowns, but can lack time series availability and are less comparable due to different methodologies.

Data further from the countries in question, such as Eurostat or supranational organisations, are more directly comparable due to harmonised methodologies. The more "supranational" one goes in terms of sources, the better the country and time data availability becomes (e.g. the OECD has more cross-country information going further back in time than Eurostat). However, the more supranational the organisation, the less granular the data (e.g. the OECD has fewer detailed item breakdowns in their price index data compared with Eurostat).

Finally, privately collected data tends to be more specific and can add value where the product of interest is extremely niche or the intended methodology cannot be implemented with publicly available data. Privately collected data should be used as a last resort, however, as most private sources are limited in country and time availability and may be difficult to re-purpose for different research questions.

Table 8.4: Advantages and disadvantages of various data sources

Data source	Advantages	Disadvantages
National statistics offices	• Collected specifically for consumer prices. • Detailed item breakdowns.	• Differing methodologies and item categories among statistics offices. • Sparse data availability for European countries.
Eurostat	• Harmonised methodologies and item categories	• Very limited availability for non-European countries. • Price information not available before 1996.
Comtrade	• Wide number of variables • Few missing observations • Up to data • Easy to use • Variables already standardised • Comparability	• Inconsistencies due to confidentiality reasons • Inconsistencies in commodity classifications • Data validation: Imports reported by one country do not coincide with exports reported by its trading partner. • Data available only from 2000 in some sectors such as services
Supranational organisations	• Good cross-country and time series availability. • Methodologies are similar across countries.	• Little data available at more granular levels. • Potential for urban bias.
Privately collected data	• More detailed than national statistics data. • Data are internationally comparable.	• Limited time and cross-sectional availability. • Data collected for a specific research question or purpose. • High collection costs.

Given these features of the sources of data, the approach we would recommend for a general methodology — and the approach we have taken in our case studies — is as follows:

- Where the data sought is highly specific, such as a particular item category (e.g. motor car inflation), it is preferred to sample the data directly from the national statistics website. National statistics websites have better detailed item coverage over time. The shortcoming of this approach is that item categories may not be directly comparable, but we feel that this is a less significant concern than enhancing data availability.
- If the national statistics office has little data, then investigate data availability for a supranational source with sufficient granularity. Thus, data from Eurostat can stand in for national statistics data from European countries where the Eurostat data has a longer time series.
- Where the data sought is less specific (e.g. whole economy price inflation), supranational sources are preferred. Supranational sources tend to have better cross-country coverage of variables over time, and comparability of data is typically less of a concern.
- Where public sources do not allow for implementation of a method, privately collected data are better. We did not encounter this scenario in our analysis of prices, but we do take this approach in our estimation of quality.

9 Appendix 2: Details of the econometric estimation of the case studies

9.1 Motor cars

9.1.1 Prices

Econometric analysis

This section presents the results of our econometric analysis of inflation in motor vehicle prices. We start with a sample containing only the UK and the select non-European countries discussed above. We present results for both OLS and fixed-effects regression.

Direct effects: Results from UK and other non-European country estimates

Using the sample comparing the UK with non-Single Market countries the models of nominal price inflation and real (using all items) price inflation do not detect a statistically significant effect of the Single Market. We estimate that the Single Market — as proxied by our dummy variable — has lowered real (using NGDP) car price inflation by around 3.56 per cent annually since 1993. The real (using NGDP) model is the only model that detects a statistically significant effect of the Single Market on inflation. The only other covariates that are statistically significant are the international commodity inflation variables.

Table 9.1: Results of three models of car price inflation

Model	Nominal	Real (using all-items)	Real (using NGDP)
Year	-.25**	0	0.18
SM	-2.27	-1.51	-3.56*
Labour cost inflation	0.44	-0.02	0.08
Interest rate	0.05	9.7	33.41
Metal commodities inflation	0.06**	.04***	0
Energy commodities inflation	-0.03	-0.06***	-0.05**
Change in exchange rate	0.05**	-0.1	0.03
Per capita GDP growth rate	-0.05	0.23	N/A
Adjusted R^2	0.61	0.24	0.31
AIC	860	809	912
N (Groups)	168 (5)	170 (5)	170 (5)

Notes: ***: significant at $p < 0.01$; **: significant at $p < 0.05$; *; significant at $p < 0.1$; constant calculated but not reported; errors are robust and clustered by country.
Source: Various national statistics offices; OECD; World Bank; Europe Economics' calculations.

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9.1.2 Quality

Econometric analysis

This section presents the results of our econometric analysis of the changes in the quality of motor vehicles arising from the introduction of the Single Market. We present results for both the Single Market dummy and the interaction between the UK and the Single Market dummy.

Direct Effect

The tables below present the full details of the econometric models of the effect of the Single Market on the growth of motor vehicle quality in the UK. In general, our estimated models explain little of the variation in the growth rate of quality. None of the coefficients are statistically significant, suggesting that our model is not a good model of car quality growth.

Table 9.2: Regression of car quality

Model	Model with SM	Model with UKSM
Year	0.11	0.05
SM	-0.6	
UK*SM		3.48
Labour cost inflation	0.49	0.55
Interest rate	0.28	0.38
Energy commodities inflation	-0.01	-0.01
Change in exchange rate	-0.06	-0.06
Per capita GDP growth rate	-0.39	-0.52
Adjusted R^2	0.00	0.01
AIC	860	859
N	124 (5)	124 (5)

Notes: ***: significant at $p < 0.01$; **: significant at $p < 0.05$; *; significant at $p < 0.1$; constant calculated but not reported.
Source: Various national statistics offices; OECD; World Bank; Eurostat; Verboven; Europe Economics' calculations.

9.1.3 Range of products available

Econometric analysis

This section presents the results of our econometric analysis of the effect of the single market on motor car variety, looking at the effect of the Single Market on change in total choice of cars. Again, none of the coefficients are statistically significant and the R2 of the models are quite low, indicating that our models do not adequately model changes in car variety.

Table 9.3: Fixed effects estimation of the effect of the single market on total variety of motor cars

Model	Model with SM	Model with UKSM
Year	-0.36	-0.2
SM	-3.92	
UK*SM		1.58
Labour cost inflation	-0.05	-0.19
Interest rate	0.61	0.24
Energy commodities inflation	0.04	0.04
Change in exchange rate	0.02	0.01
Per capita GDP growth rate	-1.34	-1.42
Adjusted R^2	0.02	0.01
AIC	914	915
N	124 (5)	124 (5)

Notes: ***: significant at p < 0.01; **: significant at p < 0.05; *; significant at p < 0.1; constant calculated but not reported.
Source: Various national statistics offices; OECD; World Bank; Eurostat; Verboven; Europe Economics' calculations.

9.2 Home insurance prices

Econometric analysis

In Table 9.4 we can see the results of our three models of home insurance price inflation. In each model the Single Market dummy is statistically significant, ranging from -2.30 to -4.25. Unit labour cost inflation is also statistically significant, but it is the only control that is significant.

Table 9.4: Results of three models of home insurance price inflation

Model	Nominal	Real (using all-items)	Real (using NGDP)
Year	-0.03	0	0.12
SM	-2.30**	-2.46*	-4.25**
Labour cost inflation	1.05**	1.24**	1.19**
Interest rate	0.42	3.18	23.05*
Energy commodities inflation	-0.01	0	0
Change in exchange rate	0.03	0	0.02
Per capita GDP growth rate	0.17	0.45	N/A
Adjusted R^2	0.42	0.21	0.23
AIC	792	778	810
N (Groups)	139 (5)	140 (5)	140 (5)

Notes: ***: significant at p < 0.01; **: significant at p < 0.05; *; significant at p < 0.1; constant calculated but not reported; errors are robust and clustered by country.
Source: Various national statistics offices; OECD; World Bank; Europe Economics' calculations.

9.3 Regression diagnostics

This section explains and details select regression diagnostics run on our models to test if they are robust to specification and meet the assumptions of linear regression. We examine the specification of the Single Market dummy, the specification of the econometric model, and the stationarity of individual variables. Although we ran a series of other tests, such as those for heteroskedasticity and serial correlation, we do

not report all of the results as they are typically corrected during estimation. For example, although our data are heteroskedastic and exhibit serial correlation, we use clustered robust standard errors, which corrects for the adverse effects of these data properties. The section is structured as follows:

- A discussion of the various diagnostic tests that have been conducted.
- A discussion of the technical underpinning of one of our tests for models specification, the Ramsey RESET test.
- We then present the results of our tests for the specification of the single market dummy, specification of the econometric model and stationarity in series. The results are presented first for cars and then for home insurance.

Some of our models may suffer from omitted variable bias. As noted in our caveats section the key drawback of our model is the ability to decisively attribute the effect to the Single Market. These results suggest there may be other variables of relevance to car price inflation that are omitted from our specification. However, we cannot say what effect these would have on our coefficient for the Single Market.

9.3.1 Diagnostic tests

Heteroskedasticity

One of the assumptions of ordinary least squares (OLS) regression — which is the foundation of the methods used to estimate the Single Market effect in this study — is that the distribution of the error terms of the estimates are independent and identically distributed. In other words, the difference between the estimated values of the dependent variable and the observed historical values of the dependent variable should not depend on differences estimated and actual values in previous time periods and the difference's distribution should not become wider or narrower at different points in the sample. This latter issue is called "heteroskedasticity", and refers to a situation in which the errors of a linear estimate are *not* identically distributed across the sample.

Coefficient estimates are not affected by heteroskedasticity. That is, heteroskedasticity does not introduce "bias" into the estimated effects of the independent variables are the dependent variables. However, heteroskedasticity can affect the estimate of the standard error, which in turn affects t-statistics for individual independent variables. Heteroskedasticity depresses the estimates of standard errors and inflates t-statistics. The result, then, is that coefficients are more likely to appear statistically significant if heteroskeadsticity is present. This poses considerable problems for policy evaluation, since the materiality of the effect of the policy intervention depends partly on whether or not the intervention has a statistically significant effect.

The traditional statistical methods to detect heteroskedasticity are the Breusch-Pagan Test or the Cook-Weisberg Test. These methods test whether the value of the variance of the estimate depends on the value of the independent variables. If they do, then heteroskedasticity is present. The results of the tests give Chi-squared statistics, which is then compared to the critical value of the Chi-squared distribution of the same degrees of freedom. The null hypothesis is that heteroskedasticity is not present. Thus, if the test statistic exceeds the critical value, then the data are heteroskedastic.

As mentioned above, heteroskedasticity does not affect the estimated coefficients, but does affect the estimated standard errors. Correcting for heteroskedasticity, then, involves correcting the regression errors by using robust standard errors. We note that this correction has no negative consequence for any of the regression outcomes. We apply this approach to estimating standard errors in all of our regressions.

Serial correlation

Another key assumption of OLS regression is that the errors in one time period or at one point in the sample do not affect the errors in other time periods or at other points in the sample. That is, the error

term in one period is independent of the error term in other periods. If this is not the case, then the data are said to be serially correlated or autocorrelated. The effects of serial correlation are very similar to those of heteroskedasticity: regression estimates report depressed standard errors, inflated t-statistics, and the greater the likelihood of identifying "statistically significant" effects that are not actually present.[62]

For time series data, the Durbin-Watson test identifies whether the presence of positive serial correlation (meaning positive errors in previous periods increase the chance of a positive error in the current period) and negative serial correlation (meaning positive errors in previous periods increase the chance of a negative error in the current period). This test is not valid, however, for panel data with observations on multiple countries over time. For panel data, the Woolridge test for serial correlation in estimates is appropriate.[63]

Addressing serial correlation in panel data also entails correcting the error term such that serial correlation does not affect the estimates of coefficient standard errors. Robust standard errors — which are "robust" to (i.e. not affected by) both heteroskedasticity and serial correlation — grouped by country addresses both heteroskedasticity and serial correlation in panel data where the cross-sectional panel variable is countries. Panel tests for serial correlation tend to show that our data are serially correlated. Given that the data are also heteroskedastic, we use robust standard errors clustered by country to ensure that our estimated standard errors are not unduly low.

We emphasise, then, that we detect heteroskedasticity and serial correlation in our data, but correct for these issues by using robust standard errors clustered by country. This is the case in all models presented here.

Multicollinearity

Multicollinearity occurs when there is a high degree of correlation between the independent variables in a regression. The interpretation of the coefficient on an independent variable in a multiple regression is that it is the effect of a change in the independent variable holding all of the other independent variables constant. If there is a strong correlation between two independent variables, this interpretation does not hold. Taken to its extreme, if two independent variables are exhibit perfect multicollinearity (i.e. the correlation between the two variables is equal to ±1), then coefficient estimates cannot be computed for both variables.

Multicollinearity typically can affect standard errors. In this case, the estimated standard errors are far larger with multicollinearity than they would be without it. One can investigate suspected multicollinearity by examining the correlation among independent variables. Ideally, independent variables would be highly correlated with the dependent variable — meaning that the independent variables can explain changes in the dependent variable — and uncorrelated with one another. High levels of positive or negative correlation between independent variables would suggest the presence of multicollinearity.

Multicollinearity, where it is considerable, is usually addressed by dropping one of the independent variables from the estimation. The idea behind this approach is that if two independent variables are highly correlated, they are likely to contain similar explanatory power in modelling the dependent variable. We find low levels of correlation between the independent variables in our models suggest that multicollinearity is not a concern for the data we use in this study.[64],[65]

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[62] More formally, both heteroskedasticity and serial correlation increase the risk of a "Type I" error when testing the hypothesis that a coefficient is statistically significant.

[63] For more information, see Woolridge, Jeffery M. (2002) *Econometric Analysis of Cross Section and Panel Data*, MIT Press, London, England. In particular, see page 176.

[64] Pairwise correlations among all variables were calculated but not reported. In the majority of cases, the correlation between independent variables was less than 0.40 in absolute value.

[65] In addition to pairwise correlations, we also examined the variance inflation factors (VIFs) for our models. Examining the VIFs is another way to test for multicollinearity. We do not discuss the technicalities of the VIF in any detail, but feel it is appropriate to report the results here. We did not find evidence of multicollinearity, which

Endogeneity

In general, endogeneity means that some of the key causal factors are determined "within the model", and that the model is incorrectly specified. Key types of endogeneity are simultaneity or reverse causation, measurement error, and omitted variables. We cover the latter in the section below, and measurement error is less of an issue for this study as we rely on public statistics and have very little control over the measurement process.

While multicollinearity refers to a strong relationship between independent variables, simultaneity refers to a strong causal relationship running from the dependent variable to the independent variable. This is problematic because standard regression techniques assume precisely the opposite — that the independent variables cause the dependent variable only. Simultaneity can bias coefficient estimates.

The main coefficient in the regression equation proposed in our methodology (i.e. the "Single Market effect") could contain an endogeneity bias to the extent to which there is reverse causality: endogeneity would be present if movements in our explained variables (prices, quality and variety) would influence the existence and/or the timing of the Single Market. In addition, there could be endogeneity problems if there is reverse causality when the explained variables cause changes in the other control variables, such as unit labour costs, interest rates or foreign exchange rates.

A second way to address simultaneity is to use an instrument in an "instrumental variables" regression. An instrument is a variable that is exogenous — that is, determined "outside of the model" — that can explain the suspected endogenous variable. Ideally, an instrument is highly correlated with the endogenous independent variable but has a low correlation with the dependent variable. Criteria for a good instrument are very demanding and it can be difficult to find an appropriate instrument for the research question.

In the case studies presented in this report, we do not suspect that endogeneity is a major concern. In addition, it might not be a simple task to select and collect data on an instrumental variable. Therefore, we do not use an instrumental variable approach in the case studies below. However, we would recommend this approach if the researcher has sufficient data to hand and suspects simultaneity in the data.

Specification of the Single Market dummy variable

Our Single Market dummy takes a value of one from 1993 onwards, or from the first full year after the signing of the Maastricht Treaty in 1992. A shortcoming of this approach is that it fails to recognise that the Single Market has been a continuous project, rather than a discrete event. Although we take theoretical and historical guidance to begin the Single Market dummy in 1993, one might argue that the dummy should begin earlier or later than 1993.

Methods to test for a "structural break" or importance of a key event in data, such as the Chow Test, require that the researcher already knows when the structural break occurred. We wish to test for when a structural break, if it happened, is present in the data, and so methods that require prior knowledge of the date of the structural break are insufficient.

Instead, we run our models using Single Market dummies that begin from 1988 to 1998 and examine whether there has been a material differences in any of the coefficients — and particularly the coefficient on the Single Market dummy — under alternative specifications. The models used for the sensitivity analysis are our preferred models, which for price inflation is the fixed-effects model with full controls on the sample containing the UK and non-European countries and for quality and variety is the fixed-effects model with full controls. By flexing the Single Market dummy in this way, we investigate whether the estimated Single Market effect is sensitive to the specification of the Single Market dummy. If the model is not sensitive to specification, then the estimated Single Market effect should be considered robust to specification of the dummy variable. If the model is sensitive to specification, then this sensitivity is a

would be either a VIF for a particular independent variable greater than 30 or a mean VIF substantially larger than one.

shortcoming of the model and should be recognised when interpreting the magnitude and reliability of the results.

Model specification

Accurate causal and statistical inference requires that the estimated model is correctly specified. If the model is not correctly specified, then estimated relationships between a dependent variable and its explanatory variables may be spurious or, if a genuine causal relationship does exist, the estimated magnitude of the effects of the independent variables on the dependent variable may be inaccurate. The main concerns on model specification are:

- Functional form of the estimate.
- Omitted variables and omitted variable bias.

Modelling a variable with regression implicitly assumes that the relationship between the dependent variable and the independent variables is linear. Addressing non-linear relationships between the dependent variable and independent variables using regression is possible, although limited to some specific functional forms. One can transform the dependent variable or individual independent variables using natural logarithms, the exponential function, squares, etc. However, the core relationship between the dependent variables and the independent variable remains linear.

We suggest attempting to capture non-linear relationships by transforming the dependent variable. In the case studies in Section 6, we calculated what the implied estimated value of the dependent variable would be using our unadjusted specification and under natural logarithm, exponential, squared, and square root specifications of the dependent variable. We then examined whether the different functional forms give the same implied estimated inflation figure as our core models. We note that our key independent variable, the Single Market variable, is a dummy variable with values of either zero or one. Therefore, the usefulness of transforming the independent variable is limited in, for example, squares (one squared is one) or the natural logarithm (the natural logarithm of one is zero).[66]

One can also run a second test for model specification known as the Ramsey Regression Equation Specification Error Test (RESET). The details of the RESET test are outlined below.

It is important to note that, although we test other functional forms of the dependent variable, the mathematical form of our model (as opposed to the independent variables) does not arise from a theoretical framework. In this way, our analysis does not arise from a theoretical framework and which can accommodate a specific mathematical representations of those relationships. Thus, our model has the potential risk of being "misspecified" to some degree from the start. This particular weakness is a disadvantage compared with other theoretically founded approaches, such as macroeconomic simulation.

Omitted variable bias occurs when one or more important explanatory variables are omitted from an estimate, which in turn causes the estimates of the coefficients for other independent variables to be biased upwards or downwards. In the face of limited data and macro-level relationships, omitted variables are likely to be a problem. One way we attempt to counter omitted variable bias is to use fixed-effects, which controls for unobserved country-specific characteristics that do not change over the period of observation. Still, omitted variables may be a problem and can be solved by including them if they are correlated with any of the explanatory variables.

[66] Equally, this problem arises when trying to estimate the value of the coefficient of the Single Market dummy in different functional forms of the dependent variable. For example, under the exponential specification of the inflation rate, the coefficient on the Single Market dummy is negative, indicating that inflation has been lower than the counterfactual during the Single Market period. One could calculate the magnitude of the effect of the dummy on inflation would by taking the natural logarithm of both sides of the equation. However, the natural logarithm of a negative number is undefined, and therefore it is impossible to directly calculate only the Single Market's effect on inflation. By comparing fitted values of our core model against fitted values of alternative functional forms, we implicitly assume that, if the fitted values of the dependent variable are similar under different specifications, then the estimated effects are similar.

Stationarity

Statistical inference requires that the distribution of data and their descriptive statistics (e.g. mean, variance, covariance, etc.) do not change over time. If they do not, a series is said to be "stationary". Otherwise, the series is "non-stationary". Non-stationary time series contain what is called a "unit root".

Unlike heteroskedasticity and serial correlation, the presence of a unit root in data can generate both misleading coefficient estimates and inaccurate standard errors. One common test for the presence of a unit root is the (Augmented) Dickey Fuller test. However a second variant, the Phillips-Perron test, adjusts the errors of the test for serial correlation and heteroskedasticity. This is particularly important in our case, as our data are frequently serially correlated and heteroskedastic.

These two tests are appropriate for time series data, but not for panel data with observations on several different countries over time. Due to limited data availability, the time series for data from different countries begin in different years (though data are generally available consistently thereafter). This is what is called an "unbalanced panel". For an unbalanced panel, the appropriate test for a unit root is the Im-Pesaran-Shin test for a unit root. In this test, the null hypothesis is that all panels — that is, all countries — have a unit root in the variable tested. The strongest statement the alternative hypothesis can make, however, is that *some* of the panels do not contain a unit root. That is, rejecting the null hypothesis in the Im-Pesaran-Shin test for a unit root does not guarantee that all panels are stationary. Despite this shortcoming, we use the test primarily because our panel is unbalanced and many other panel unit root test require a balanced panel.

9.3.2 Technical details of the Ramsey RESET test

One test for regression misspecification in general and potential omitted variable bias in particular is the Ramsey RESET test. The RESET test investigates whether the squared, cubed, or other higher order polynomial of the estimated values of the dependent variable have any explanatory power when used as independent variables themselves. Mathematically, under the RESET test, one estimates the model under investigation:

$$\hat{y} = a + \sum_{i=1}^{n} \beta_i * X_i$$

where $\hat{y}$ is the estimated dependent variable, a is a constant, X_i is independent variable *i*, and β_i is the coefficient on X_i. One then uses the fitted values

Then one the following equation:

$$\widehat{y_{NEW}} = a + \sum_{i=1}^{n} \beta_i * X_i + \gamma\hat{y}^2 + \delta\hat{y}^3 + \theta\hat{y}^4$$

Where γ, δ, and θ are coefficients on the second, third, and fourth powers of the estimated dependent variable[67], respectively, and $\widehat{y_{NEW}}$ is the new value of the estimated dependent variable.[68] The RESET test tests whether γ, δ, and θ are jointly equal to zero. If they are, then higher orders of the estimated dependent variable have no additional explanatory power and the model does not have missing variables. If they are not, then the model is likely to suffer from omitted variable bias.

[67] These values are normalised prior to running the test.

[68] The statistical software package Stata's default for the Ramsey RESET test is to use polynomials up to four in the RESET test. However, one could use only the square or the square and cube of the estimated dependent variable in the test. Unfortunately, the results of the test can be sensitive to the order of the polynomials used in the test. We recommend that researchers examine how sensitive results from the RESET test are before saying definitively that a model suffers from omitted variable bias or is misspecified.

9.3.3 Diagnostics for automotives

Specification of the Single Market Dummy

We test the sensitivity of our models and in particular the estimated coefficient on the Single Market dummy by running models with the Single Market dummy beginning between 1988 to 1998. The coefficients change in both value and statistical significance depending on when the Single Market dummy starts, indicating the models are sensitive to how the Single Market dummy is specified. In general, coefficient on the Single Market dummy tends to become more statistically significant the later the Single Market dummy begins.

Table 9.5: Sensitivity analysis of car price inflation models with different SM dummy specifications

Year SM dummy begins		Nominal cars	Real cars using RPI/CPI	Real cars using NGDP
1993	Coefficient	-2.27	-1.51	-3.56*
	Standard Error	1.60	0.81	1.51
1988	Coefficient	-2.78	-1.00	-2.15
	Standard Error	1.53	0.88	1.79
1989	Coefficient	-2.49	-0.99	-1.93
	Standard Error	1.63	0.94	1.91
1990	Coefficient	-2.10	-0.93	-1.97
	Standard Error	1.67	0.95	1.89
1991	Coefficient	-1.74	-0.59	-2.18
	Standard Error	1.62	0.94	1.71
1992	Coefficient	-1.84	-0.92	-2.90
	Standard Error	1.72	0.90	1.62
1994	Coefficient	2.01	-1.53	-3.04*
	Standard Error	1.53	0.80	1.47
1995	Coefficient	-2.19	-1.73*	-2.97*
	Standard Error	1.36	0.78	1.44
1996	Coefficient	-2.18	-1.83*	-3.06*
	Standard Error	1.31	0.78	1.44
1997	Coefficient	-2.80*	-2.56**	-3.34*
	Standard Error	1.14	0.77	1.34
1998	Coefficient	-3.16**	-2.81**	-3.27*
	Standard Error	1.11	0.79	1.33
Coefficient min		-3.16**	-2.81**	-3.56*
Coefficient max		2.01	-0.59	-1.93
Value in preferred model		-2.27	-1.51	-3.56*

Notes: : ***: significant at p < 0.01; **: significant at p < 0.05; *; significant at p < 0.1; errors are robust and clustered by country.
Source: Various national statistics offices; OECD; World Bank; Eurostat; Europe Economics' calculations.

As our initial model of quality and variety growth did not give many statistically significant results and as the adjusted-R^2 were very low, we will not give a full discussion of their sensitivity to the Single Market dummy. Below we present the coefficient minimum and maximum coefficients on our Single Market dummy at

different specifications and the coefficient value in our baseline model. As shown in the table, the coefficient on the Single Market dummy is very sensitive to specification, meaning that our model of the effect of the Single Market on quality and variety depends to a large extent on when the researcher set the Single Market dummy to begin. We emphasise that the Single Market dummy is still not statistically significant in any case and the models are still very poor predictors of quality and variety.

Table 9.6: Coefficient on Single Market dummy in different specifications of quality and variety models for the automotive sector

	Quality	Variety
Coefficient min	0.91	-2.54
Coefficient max	3.48	1.59
Value in preferred specification	3.48	1.59

Notes: Constant calculated but not reported; errors are robust and clustered by country.
Source: Various national statistics offices; OECD; World Bank; Eurostat; Verboven; Europe Economics' calculations.

Specification of the econometric model

We investigate our specification of the dependent variable in two ways. First, we run Ramsey RESET test to determine whether our model suffers from potential omitted variable bias or functional misspecification. Second, we estimate various function forms of the dependent variable to test how sensitive our baseline estimate is to specification.

As mentioned in the methodology section, the Ramsey RESET test is interpreted as a test of omitted variable bias or, at times, a test of functional misspecification more generally.[69] The null hypothesis of the test is that there are no omitted variables and the alternative hypothesis is that there are omitted variables, suggesting potential omitted variable bias. The test is an F-test and if the F-statistic is larger then the critical value, then there are likely to be omitted variables. We present the F-statistics and the p-values for the RESET test for car price inflation, car quality growth, and car variety growth. Where the p-value is less than 0.05, the null hypothesis is rejected and the model suffers from potential omitted variable bias. The model considered is the sample containing only the UK and non-European countries.

Table 9.7: Results of Ramsey RESET test for car-related variables

Model	F-statistic	Prob > F
Nominal cars	314.75	0.00
Real cars using RPI/CPI	31.17	0.00
Real cars using NGDP	3.29	0.14
Car quality growth	1.67	0.3092
Car variety growth	6.24	0.0546

Source: Various national statistics offices; OECD; World Bank; Eurostat; Verboven; Europe Economics' calculations.

Our car price inflation models may suffer from omitted variable bias. The fixed-effects RESET test finds evidence of omitted variables for models of nominal and real (using all-items prices) car price inflation, but not the model of real (using NGDP) car price inflation.

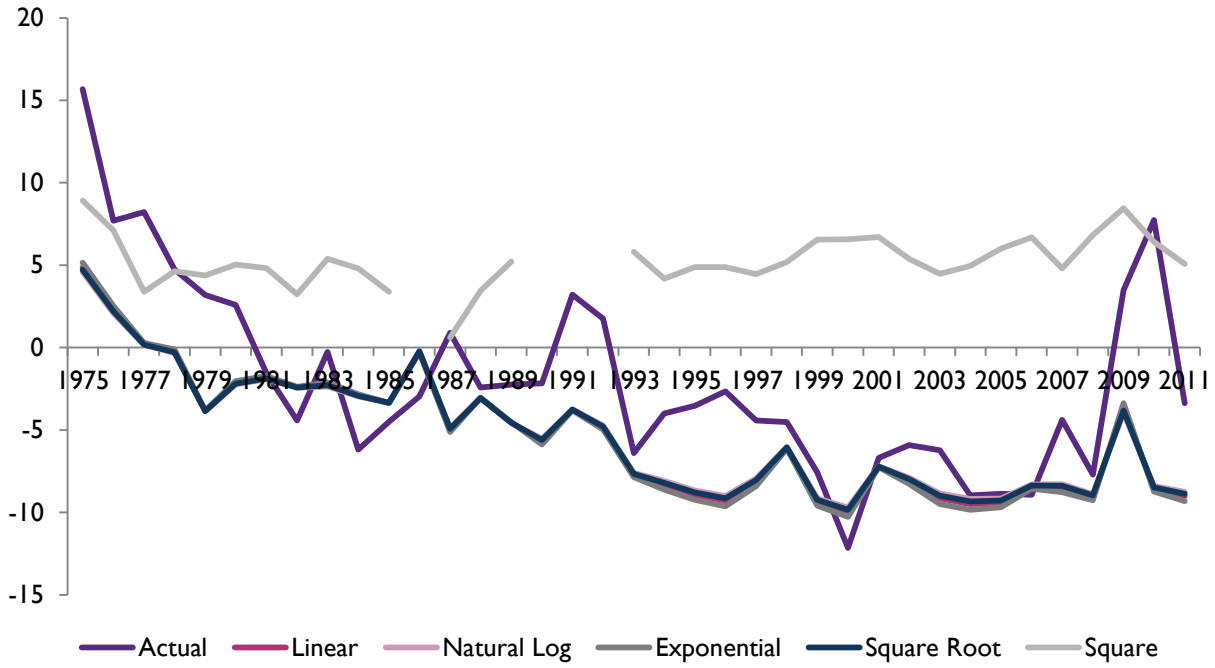
The RESET test for car quality growth finds that the model does not suffer from omitted variable bias, but the RESET test for car variety growth indicates potential omitted variable bias. Nonetheless, the poor explanatory power of these models and the lack of statistically significant coefficients suggest that, even if correctly specified, neither of these models are good predictors of quality or variety.

As a cross-check on the functional form of our model, we transformed the dependent variable using the exponential function, natural log, square, and square root. We conducted this exercise for all specifications of car price inflation, but we present the specification for real (using NGDP) car price inflation as an

[69] See Harvey, Andrew (1990) *The Econometric Analysis of Time Series*, Phillip Allan, London, p. 159.

illustration. Figure 9.1 shows actual and fitted values of the modelled real car price inflation under different functional specification. The exponential, natural log, and square root transformations of the dependent variable are not substantially different from our baseline linear model. The squared model is considerably different, but also tracks the actual data less well than other models.

Figure 9.1: Actual and fitted inflation in real (using NGDP) car prices under various functional forms



Source: Various national statistics offices; OECD; World Bank; Europe Economics' calculations.

We do not report the full plots for quality and variety, as these models do not have much predictive power. Nonetheless, we ran a similar cross-check on quality and variety estimations using different functional forms and the results are similar to the car price inflation results: other functional forms do not differ dramatically from the baseline linear estimate other than the squared model of the dependent variable, but this model fits the data less well than all of the other models.

Stationarity in series

We test for stationary in the variables used in this study, both for car prices and for car quality and car variety. We use the Im-Pesaran-Shin (IPS) test for a unit root in panel data, which investigates whether at least some panels are stationary. We also conducted Phillips-Perron test for unit roots in UK data only, to see if variables in the UK portion of the panel are stationary. Given the number of tests conducted for a variety of variables, we do not report full test results here. Instead, we comment on the most salient results.

In both the IPS test for stationarity in the full panel and the Phillips-Perron test in time series data, all of the variables in nominal and real models except the nominal interest rate are stationary or trend stationary, both with and without lags.[70] The first difference of the nominal interest rate is stationary, and thus we use the first difference of the nominal interest rate in our model of nominal inflation.[71]

9.3.4 Diagnostics for insurance

Specification of the Single Market Dummy

[70] Most are stationary at the 95 per cent confidence level, but some are stationary only at the 90 per cent level.
[71] These results are also generally true for the data used in the quality and variety variables.

As in the case of cars, we run a sensitivity analysis of our model by adjusting the date at which the Single Market dummy variable begins taking a value of one. In our baseline model, the Single Market dummy takes a value of one from 1993 onwards. In our sensitivity analysis, we vary the starting year from 1988 to 1998.

Table 9.8 contains the results of our sensitivity test for the various models of home insurance price inflation. As with the car price inflation models, the insurance models are sensitive to when the Single Market dummy begins. Where the Single Market dummy begins between 1989 and 1996, the coefficients on the dummy are statistically significant. When the dummy begins before 1988 or after 1996, the coefficients are much smaller and not significant. Again, this indicates that these models are sensitive to how the Single Market dummy is specified.

Table 9.8: Sensitivity analysis of home insurance price inflation model with different SM dummy specifications

Year SM dummy begins		Nominal insurance	Real insurance using RPI/CPI	Real insurance using NGDP
1993	Coefficient	-2.29**	-2.46*	-4.25**
	Standard Error	0.73	0.96	1.16
1988	Coefficient	1.01	0.35	-0.23
	Standard Error	0.82	0.43	0.44
1989	Coefficient	-1.02	-1.58	-1.66**
	Standard Error	0.81	1.15	0.47
1990	Coefficient	-3.73**	-3.87	-4.29**
	Standard Error	1.25	1.92	1.29
1991	Coefficient	-2.57**	-2.76*	-4.02**
	Standard Error	0.85	1.24	1.08
1992	Coefficient	-2.54**	-2.64*	-4.41**
	Standard Error	0.87	1.08	1.25
1994	Coefficient	-2.36**	-2.44*	-3.69**
	Standard Error	0.65	1.02	1.02
1995	Coefficient	-1.72**	-1.99*	-2.84**
	Standard Error	0.52	0.92	0.84
1996	Coefficient	-0.93*	-1.31	-2.06**
	Standard Error	0.44	0.74	0.67
1997	Coefficient	0.51	0.25	-0.18
	Standard Error	0.51	0.57	0.51
1998	Coefficient	0.82	0.61	0.53
	Standard Error	0.53	0.55	0.56
Coefficient min		-3.73**	-3.87	-4.41**
Coefficient max		1.01	0.61	0.53
Value in preferred model		-2.29**	-2.46*	-4.25**

Notes: : ***: significant at p < 0.01; **: significant at p < 0.05; *; significant at p < 0.1; errors are robust and clustered by country.
Source: Various national statistics offices; OECD; World Bank; Eurostat; Europe Economics' calculations.

Specification of the econometric model

As with cars, we tested the specification of our econometric model using the Ramsey RESET test and estimating other functional forms of the dependent variable.

Table 9.9 contains the results of the Ramsey RESET test for insurance price inflation models.[72] According to the RESET tests, the nominal and real (using all-items) insurance price inflation models suffer from omitted variable bias, but the real (using NGDP) insurance price inflation model does not suffer from omitted variable bias.[73] This is the same pattern we saw in the tests of our car price models.

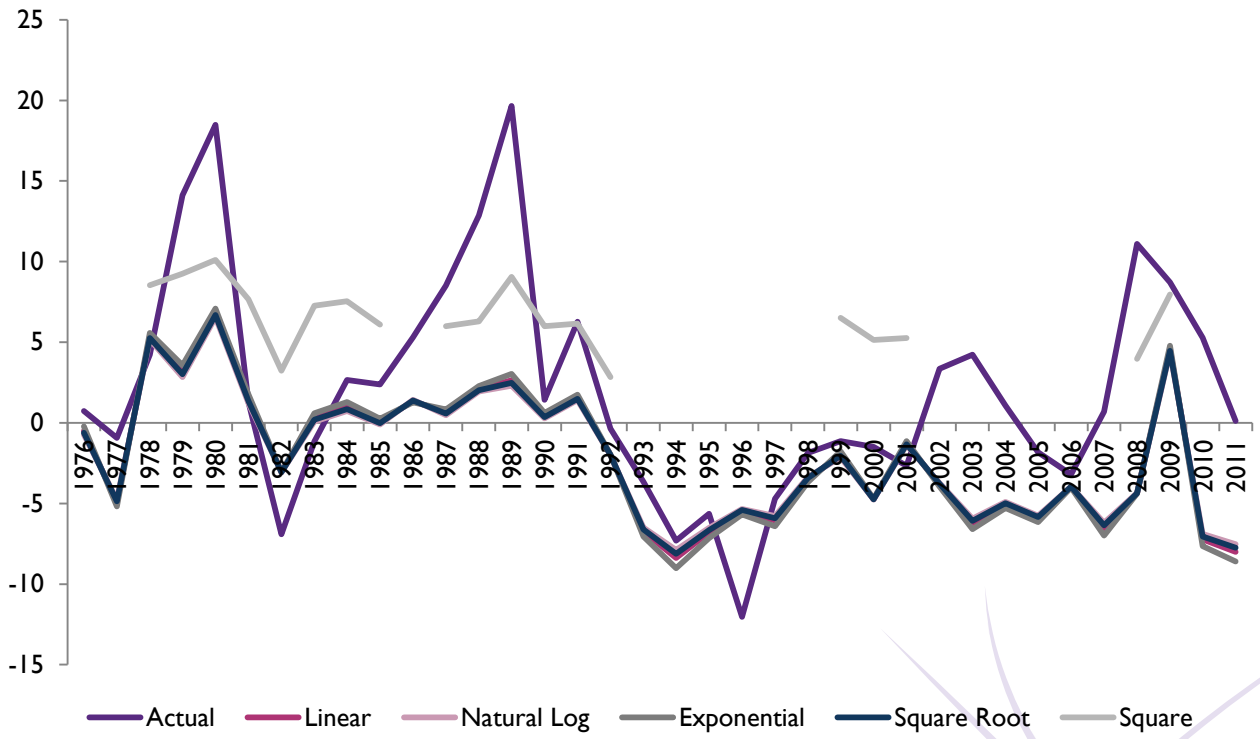
Table 9.9: Results of Ramsey RESET test for insurance price inflation models

Model	F-statistic	Prob > F
Nominal insurance	5.59	0.06
Real insurance using RPI/CPI	41.81	0.00
Real insurance using NGDP	2.63	0.19

Source: Various national statistics offices; OECD; World Bank; Europe Economics' calculations.

Figure 9.2 shows the actual home insurance price inflation and estimated real (using NGDP) home insurance price inflation in various functional forms. As with cars, the exponential, natural log, and square root transformations all give similar fitted inflation estimates as the baseline linear model. The only model that is considerably different is the square model. However, the square model fits the actual data less well than the linear model and other functions forms. Therefore, we conclude that our baseline linear estimate for home insurance price inflation is not substantially dependent on the functional form of the dependent variable.

Figure 9.2: Actual and fitted real (using NGDP) price inflation in home insurance various functional forms



Source: Various national statistics offices; OECD; World Bank; Eurostat; Europe Economics' calculations.

Stationarity in series

[72] As with cars, the tests use the second, third, and fourth powers of the estimated dependent variables in the tests.
[73] Assuming the test is for the 95 per cent confidence level.

We test for stationary in the variables used in the analysis of car price inflation with the IPS test for stationarity in panel data and the Phillips-Perron test for stationarity in the UK time series. As with cars, we do not report all results, but only comment on the key results.

In both the IPS test for stationarity in the full panel and the Phillips-Perron test in time series data, all of the variables except the real interest rate are stationary or trend stationary. Again, the nominal interest rate is not stationary, but the variable's first difference is. Therefore we use the first difference of the nominal interest rate in our nominal price inflation models.

10 Appendix 3: Possible Extensions to Other Sectors

The methodology presented above could be applied to a large number of sectors relevant from a household expenditure perspective. These include:

Goods:

- Food and (non-alcoholic) drink.
- Clothing and footwear.
- White goods.
- Small electronics (TV, computer, cameras, mobile phones).

Services:

- Transport.
- Recreation and culture.
- Energy, Fuel, Utilities.
- Telecommunications.
- Travel and hospitality (hotels and restaurants).

The suitability of each of these sectors for the analysis will depend on the availability of the data required for the analysis. Table 10.1 below presents some potential sources of data for these sectors. These data sources might also be used to identify sectors that satisfy the minimum requirements of our methodology.

The survey identifies some sectors where sufficient data may exist over a long enough time period (such as electronics), but it is clear that further investigation will be required for many sectors to identify whether national agencies or other sources have suitable data. Eurostat would in principle be an ideal source of comparable data for this research, but unfortunately its data generally only extends back to 1996 for most sectors, proving of limited use for our purposes.

Table 10.1: Preliminary assessment of data availability in selected areas of household expenditure

Cost Item	Indicator	Data Sources	Period	Countries	Comments
Food and Drink	Price	World Bank	1980-2013	Worldwide	Price data is available as an index
	Price	Eurostat	1996-2013	EU Countries	
	Price	FAO Food price Index	2000-2013	United Nations Countries	Contains both producer and consumer price Indices
	Price	VAM World Food Programme	2004-2013	Developing Countries	Disaggregated data containing information such as monthly/quarterly and yearly wholesale prices for key staple food commodities at national and sub-national levels
	Quality	Wold Bank	1980-2013	Worldwide	Data on water quality,
	Quality	World Bank	2014-2013	Worldwide	Data on food exports and imports that would allow to compute a trade based index of quality
	Quality	Defra	2001-2013	UK also available broken down into various geographical areas and regions of UK	Data is collected for a sample of households in the United Kingdom using self-reported diaries supported by till receipts of all purchases, including food eaten out
	Quality	International Food Security Index	2010-2014	Worldwide	Aggregate index only
	Variety	Food and Agriculture Organisation of the United Nations	1991-2014	Worldwide	Data on production, prices, trade, food supply,food balance sheet, resources, investment, forestry, emmissions agriculture
Clothing and Footwear	Price	Eurostat	1996-2014	EU Countries	
	Price	World Bank	1995-2007	Worldwide	Survey data on expenditure on clothing and footwear
	Price	emergingtextiles .com	2002-2014	US Based but also some EU data	Daily data available
	Quality	Comtrade	1996-2014	Worldwide	
	Quality	UK fashion and Textile Association	2009-2014	UK and EU	Data is available for members only
	Quality	CBI Market Intelligence	2005-2014	Worldwide	High level data
	Quality	http://www.statista.com/topics/965/apparel-market-in-the-us/	2010-2014	US	Subscription only
	Quality	ILO study of the International garment industry	1997-2014	Worldwide	The website contains a number of reports about the garment industry around the world. The reports offer summarised data on specific issues in the industry
	Quality	US Economic Sensus	2008-2004	US	2012 NAICS: 315 - Apparel manufacturing

Cost Item	Indicator	Data Sources	Period	Countries	Comments
White Goods	Variety	Comtrade	1996-2014	Worldwide	
	Price	Eurostat	1996-2014	EU Countries	
	Price	Euromonitor - Consumer Appliances Industry Market Research	1990-2014	Worldwide	Access by subscription (about £600 per database)
	Quality	The greening of white goods report	1993-2009	Australia	Qualitative research on the development of the quality of white goods
	Quality	Comtrade	1996-2014	Worldwide	
	Variety	Monopolies and Mergers Commission report on domestic electrical goods	2008 and 2012	UK	Review of the Restriction on Agreements and Conduct (Specified Domestic Electrical Goods) Order 1998 and Associated Undertakings
Electronics	Price	National Websites/ONS	1980-2014	UK	Long time series available
	Price	Xiaoling Xing Fang-Fang and Zhenlin Yang dataset in their paper "Pricing dynamics in the online Consumer electronics market"	2000-2001	US	Data on price dispersion in consumer electronics
	Price	Euromonitor International Passport	1988-2014	Worldwide	Available to purchase (Cost: £39,000)
	Price	Feenstra database	1980-2012	US focused but includes also other countries	Collected from various sources
	Quality	Comtrade	1996-2014	Worldwide	
	Quality	Baye, Morgan and Scholten (2001) database	2000-2002	US	
Transport	Price	Eurostat	1996-2013	EU Countries	The price data available for transport include price indices for: purchase of vehicles, fuels and lubricants for personal transport equipment, maintenance and repair of personal transport equipment
	Price	OVID	1968-2012	Worldwide	Access by subscription
	Price	Department for transport Research	2003-2014	UK	Covers all the means of transport in UK
	Price	National Transit Database	1991-2014	US	Highly disaggregated data
	Quality	UN Services Database	1996-2014	Worldwide	
	Quality	National Public Transport Data Repository	2004-2011	UK	Data on public transport journeys in Great Britain for a selected week in October each year.

Cost Item	Indicator	Data Sources	Period	Countries	Comments
	Quality	Maritime Transport Research Database		EU Countries	Qualitative data
	Quality	United Nations Economic Commission for Europe	1993-2014	EU Countries	
	Quality	ETIS Plus - European Transport Policy Database	2005-2014	Worldwide but focus on EU Countries	Some data are available to all users while other are only available by subscription
	Variety	UN Services Database	1996-2014	Worldwide	Trade data
	Variety	International Transport Forum	2010-2014	Worldwide	More qualitative than quantitative data
	Variety	EU Transport in Figures - European Commission	1995-2012	EU Countries	High level data
Recreation	Price	Eurostat	1996-2013	EU Countries	The closest level of disaggregation is the HICP for recreation and culture
	Price	United Nations Statistics division - tourism statistics	2008-2014	Worldwide	Derives a lot of the data from the Comtrade database
	Quality	European Environment Agency	2000-2014	EU Countries	Bathing quality data
	Quality	Community Surveys on ICT	2011-2013	EU Countries	Survey data
	Quality	Cultural Statistics in Europe by Eurostat	2008-2014	EU Countries	High level data such as number of enterprises involved in the cultural sector, household cultural expenditure, concentration in the publishing sector and imports and exports of works of art/ antiques etc.
	Variety	SBS	1996-2010	EU Countries	Data on businesses providing tourism services, such as hotels and catering
	Variety	Sports and Recreations Alliance	2009-2013	UK	Access to underlying data needs to be requested
Energy	Price	oilprice.net		China	weekly prices available
	Price	Eurostat	1996-2013	EU Countries	Time series is not long enough
	Price	http://energy.publicdata.eu/ee/vis.html	1997-2008	Worldwide	Data on CO2 emission per capita, renewable energy share, primary energy production and net imports
	Price	European Environmental Agency	2006-2014	EU Countries	Complete coverage of all EU countries

Cost Item	Indicator	Data Sources	Period	Countries	Comments
	Price	European Commission energy prices dataset	2004-2014	EU Countries	Index
	Quality	www.energy.eu	2014	EU Countries	Can subscribe to receive daily data on fuel prices
	Quality	European Environmental Agency	2006-2014	EU Countries	Complete coverage of all EU countries
	Quality	The BPIE data hub for energy performance of buildings	1946-2010	EU Countries	Disaggregated data which allows to compute a quality index rather easily but data is given in decades rather than yearly
	Quality	energy efficiency potentials EU database	2000-2014	EU Countries	Data broken down by household, tertiary, transport and industry
	Quality	ETS data set	2008-2014	EU Countries	Provides aggregated data by country, by sector and by year on the verified emissions, allowances and surrendered units of the more than 12 000 installations covered by the EU emission trading scheme
	Variety	World Bank	1980-2013	Worldwide	A significant number of missing observations
	Variety	odyssee-mure.eu	1990-2011	EU Countries	Detailed data on the energy consumption drivers by end-use and, on the other hand, energy efficiency and CO2 related indicators. Available on a subscription basis
Telecommunications	Price	Eurostat	1996-2013	EU Countries	The closest level of disaggregation is splitting the data between local calls (10 mins), national long distance calls (10 mins) and international calls to USA (10 mins)
	Price	WTO Statistics	1980-2014	Worldwide	Prices can be computed from International import and export values and volumes
	Quality	UN Services Trade Database	1996-2014	Worldwide	
	Quality	European Union Open Data Portal	2009-2013	EU Countries	Data at a comprehensive disaggregated level for the EU telecommunications sector
	Quality	International Telecommunications Union	2006-2013	Worldwide	Mostly indicators
	Variety	UN Services Trade Database	1996-2014	Worldwide	

Cost Item	Indicator	Data Sources	Period	Countries	Comments
	Variety	US Patent Office data as used in Entry and Competitive Dynamics in the Mobile Telecommunications Market (2006) by Lim et al.	1970-2014	US. World Data can be found at WIPO	Methodology is easy to replicate
	Variety	Article: the diffusion of mobile telecommunication service in the European Union by F. Verboven (2001)	1998-2006	EU Countries	Indicators are computed in the paper. The data used in the paper come from Mobile Communications for the period 1992-1997 and from International telecommunications Union (World Telecommunications Indicators) for the period 1984)
Travel and Hospitality	Price	Eurostat	1996-2013	EU Countries	
	Price	Statista.com	2002-2014	Worldwide	Data available upon subscription
	Quality	UN Service Trade Data	1996-2014	Worldwide	Can compute a trade based quality index- see Feenstra and Romalis "International prices and endogenous quality" 2012
	Quality	DCMS Data set	1995-2014	UK	Disaggregated data at country level
	Variety	https://www.hotstats.com/		Worldwide	Data available upon subscription. Provides in excess of 100 performance metric comparisons covering 70 areas of hotel revenue, cost, profit and statistics providing far deeper insight into the hotel operation than any other tool. The HotStats database currently totals 1,650 properties representing 360,000 rooms from 100 different brands

11 Appendix 5: Literature on the Effects of the Single Market

Table 11.1 presents a short review of previous studies that have attempted to estimate the effect of the Single Market on various economic variables.

Table 11.1: Literature on the effects of the Single Market

Authors	Period analysed	Object of analysis	Methods	Results
Cecchini et al (1988)[74]	1988-1994	Single Market as a whole (removal of frontier delays and costs, the opening of public markets to competition, the liberalisation and integration of financial markets)	Cost estimation Efficient scale estimation Macroeconomic simulation of GDP, output and employment	Single Market would add output equivalent to 5 per cent of GDP Direct costs of frontier costs are estimated to be 1.8 per cent of the value of goods traded Economies of scale: community size market optimal for efficiency gains Decrease of 6 per cent in prices Increase in employment Total economic gains for the Community: 4.25-6.5 per cent of GDP
Campos and others (2014)	1980-2005	How poorer/rich nations benefit EU membership	Synthetic Counterfactuals Method Cost and Benefit Analysis	Without European integration, per capita incomes would have been, on average, approximately 10 percent lower today The only country that was negatively affected by EU membership is Greece
Leach (2000)[75]	1960-2000	The aggregate impact of the EU Budget, CAP, Customs Union, Single Market, EU Social Welfare Model and EU related Foreign Direct Investment is negative for the UK economy	Cost and Benefit analysis	In the future, if the UK were to join the euro and engage in simultaneous monetary and fiscal policy harmonisation, tax harmonisation alone could double the net cost, even before the effects of lost output attributable to an inappropriate monetary policy
Hindley and Howe		Assessing the economic costs and benefits of EU	Cost and Benefit analysis (net budget	The major quantifiable cost of EU membership is adherence to the

[74] Cecchini, P. et al (1988) "The European Challenge - 1992: The benefits of a Single Market" Wildwood House Publishing. An official summary can be found at http://aei.pitt.edu/3813/1/3813.pdf.

[75] Leach, Graeme (2000) "EU Membership — What's The Bottom Line?" IoD Policy Paper.

Authors	Period analysed	Object of analysis	Methods	Results
(2001)[76]		membership for UK Focuses on the impact of having a "federalist" agenda	contributions and cost of tariffs)	Common Agricultural Policy (CAP). Escape from the CAP would represent a clear gain to Britain. There would be some loss because of the imposition of tariff barriers on UK exports to the EU but, allowing for switching of exports to non-EU countries and other adjustments, it would be small
Milne (2004)[77]	1993-2003	Estimate the cost and benefits to the UK arising from the Single Market	Cost and Benefit analysis Gains from trade Establishing an opportunity cost for being part of the single Market	The current recurring annual direct net cost to the UK of EU membership is estimated to range between approximately three and five per cent of GDP
Ilzkovitz et al (2007)[78]	1992-2006	Analyse the effects of the implementation of the Internal Market Programme on the EU economy. Estimates what has been achieved so far in terms of European Economic Integration	Gains from trade estimation Cost of regulatory compliance Survey article putting together existing studies to draw conclusions on a different question	The estimated 'gains' from the Internal Market amount to 2.2% of EU value added and 1.4% of total EU employment (or 2.75 million jobs). Moreover, these gains could be doubled with the removal of most of the remaining Internal Market barriers.
Booth and Howarth (2012)[79]	2000-2010	Is EU membership still the best option for UK trade?	Gains from trade Macroeconomic Simulation	Membership of the EU customs union, and the free movement of goods with the absence of tariffs and rules of origin, remains a benefit to UK firms exporting to the EU. The UK has been instrumental in developing the Single Market in goods and promoting EU enlargement, which has helped to generate new markets, increased competition and reduced costs
Nick Crafts	2000-2006	Car Price Differentials in Europe and the Effects of	Cost and Benefit	Car price differentials in the early 2000s were large.

[76] Hindley, Brian and Martin Howe (2001) "Better Off Out? The benefits or costs of EU membership".

[77] Milne, Ian (2004) "A Cost Too Far? An analysis of the net economic costs and benefits for the UK of EU membership", Civitas: Institute for the Study of Civil Society, London.

[78] Ilzkovitz, F., A. Dierx, V. Kavocs and N. Sousa (2007) "Steps towards a deeper economic integration: the Internal Market in the 21st Century – a contribution to the Single Market Review" Directorate-General for Economic and Financial Affairs, Economic Papers No. 271.

[79] Booth, Stephen and Christopher Howarth (2012) "Trading Places: Is EU membership still the best option for UK trade?".

Authors	Period analysed	Object of analysis	Methods	Results
(2007)		European Regulation The regulation analysed is the ban on EU vertical price constraints and its subsequent revision to allow manufacturers to impose either selective or exclusive dealerships, but not both.	Analysis Cost of regulation compliance	UK prices were significantly higher than other EU countries. In less than six years, many of the differentials have been eliminated, and the UK prices became in line with the other countries. Regulation is the major contributing factor
Congdon (2012)[80]	2005-2011	Costs of the UK of participating in the Single Market	Survey: costs of regulation compliance and of resource misallocation.	The UK is roughly 10% of GDP – about £150 billion – worse-off every year because it is a member of the EU. It should instead be an independent sovereign nation, like Norway
London Economics / PwC (2013)[81]	2003-2007	Identify the sectors with the largest potential of gain from the Single Market	Construction of measures of labour productivity, innovation, market integration, sustainability and consumer welfare indicators	Substantial progress in manufacturing sectors, the cost of non-Europe is still significant for many service sectors
Europe Economics (2013)[82]	1992-2013	Consider the broad issues and main debates underlying the Internal Market as a whole, in particular exploring the level of market integration thought to be necessary for an effective Internal Market, and the mechanisms (such as harmonisation or mutual recognition) for achieving it	Cost - Benefit analysis Cost of regulation International benchmarking	There is evidence of increased integration — in particular in the form of wage convergence in the 1970s and 1980s and labour productivity convergence in the 2000s. Integration, measured on outputs, is not a one-way process. Integration can reach a plateau (as with wage dispersion from the 1990s onwards) or even, in some cases, be reversed (as with pharmaceuticals price dispersion and interest rate dispersion during the 2000s).
Capital Economics (2014)[83]	1980-2014	Assessing the economic impact for Netherlands of leaving the European Union.	Cost of regulation compliance Macroeconomic Simulation Cost and Benefit Analysis	Outside the European Union, Dutch authorities could: reduce the costs of doing business in the Netherlands by a minimum of €20 billion annually

[80] Congdon, Tim (2012) "How much does the EU cost Britain?".
[81] London Economics/PwC (2013) "Study on 'The cost of non-Europe: the untapped potential of the European Single Market'".
[82] Europe Economics (2013) "Optimal Integration in the Single Market: A Synoptic Review", prepared for BIS.
[83] Capital Economics (2014) "NExit: Assessing the economic impact of the Netherlands leaving the European Union".