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Abstract

This paper examines whether European monetary union has lowered the degree of price dispersion among member countries. The difference-in-differences methodology is applied to four independent data sets containing prices of identical goods. While the results reported in the paper vary somewhat across goods, they provide little overall support of the European Commission's claim that the single currency would significantly deepen market integration among the euro-zone countries. Even though this should be viewed as preliminary evidence, it does suggest that there are other, more important impediments to market integration in the EU.

Keywords

EMU, price convergence, difference-in-differences

JEL Classification

F15, F33, F36

1. Introduction

Does a common currency lead to greater market integration? Certainly European policy-makers seemed to be convinced when they set out on the Maastricht agenda to create the economic and monetary union (EMU). Despite considerable scepticism throughout the first two stages, the third and final stage of monetary union started successfully in 1999, when the exchange rates of the participating countries were permanently fixed against the euro. This paper examines to what extent price differences in the euro-zone narrowed as a result of the introduction of the single currency: has 'one money' really supported the creation of 'one market'?

The empirical analysis is based on four different sets of final goods prices: (i) Big Mac prices; (ii) the cover prices of *The Economist*; (iii) the prices of cars; and (iv) the prices of a range of goods and services from a publication by UBS, a Swiss bank. Estimating the single currency effect on price dispersion suffers from a problem afflicting most studies that attempt to evaluate the effects of economic policies – we do not have an observable counterfactual. A number of methodologies have been suggested in the literature. The estimates of the single-currency effect reported in this paper employ the difference-in-differences (DD) approach.

The results suggest that the common currency has had little impact on price convergence so far. Altogether, the paper reports 178 DD estimates of the single currency effect, which differ in terms of price series, estimator and control group. Even though 41 of them provide statistically significant evidence that the single currency has reduced the degree of price dispersion among the member countries, there are another 40 test results with a statistically significant positive effect on price dispersion. There are some differences across data sets and specifications. While the evidence favours a downward euro effect for 14 of the price series considered in this paper, there are nine others where the evidence shows just the opposite.

Several interpretations are offered. The preferred explanation is that there are many other influences on price dispersion, such as a lack of competition between firms, transaction costs and informational asymmetries. Even if a single currency could lower transaction costs in principle, this effect may be too small or too slow to show up in the estimates, given these other impediments to price convergence.

The structure of the paper is as follows. The next section provides an overview of the issues related to common currencies and market integration, followed by a discussion of the methodology and estimation method. The fourth section describes the four data sets on prices in more detail. The estimates of the single currency effect on price differences are presented in section five. Section six concludes the paper.

2. Common currencies and market integration: the issues

During the past four decades, the member countries of the EU have adopted a range of measures to raise the level of economic integration, culminating in the creation of the European single market in 1993. Nevertheless, prices for identical goods have stubbornly refused to converge between member countries. This has been highlighted repeatedly by the popular press, in academic work and in Commission reports. Table 1 provides evidence on price differences within the EU around the time the single currency was introduced. Even though various sources were used, all entries in the table relate to identical,

branded items and can thus justifiably be used for price comparisons. Some also feature in the analysis of this paper.

The differences are substantial, ranging from 18% (Monopoly game) to 74% (Swatch watch). Although not necessarily representative of all products sold in the EU, the comparisons in Table 1 illustrate that European consumers frequently pay very different prices for identical products. Since the entries in the table mark the extreme values reported in each survey, they do not represent *average* price differences. However, they highlight the extent to which prices *can* differ. Part of the observed price dispersion may be due to variations in national sales taxes, but the percentage differences are much too big for them to play a dominant role. A further interesting feature of the table is that several countries feature in both the 'low' and 'high' price columns. This indicates that domestic relative prices of different goods also frequently differ across countries.

The question taken up in this paper is whether the introduction of the single currency has led to a narrowing of price differences. That a single currency would have such an effect was first argued by the European Commission in its influential *One Market, One Money* (1990) publication:

> Without a completely transparent and sure rule of the law of one price for tradable goods and services, *which only a single currency can provide*, the single market cannot be expected to yield its full benefits – static and dynamic. (p. 19, *italics* added).

According to the Commission, a single currency deepens economic integration in a number of ways. First, the costs of doing business in other member countries would be reduced due to the reduction in exchange rate premia (payable, for instance, on forward contracts). Second, lower uncertainty would make cross-border business more profitable, since lower risks would translate into higher risk-adjusted rates of return. Third, international transactions would become cheaper due to the elimination of currency exchange costs and reduced delays. The direct costs of foreign transactions in the EU were estimated by the Commission at between one-half and one percent of its gross domestic product.

In a background paper to its 1996 single market review the European Commission (1996) added a fourth potential benefit of the single currency. As a result of 'one money'

> ... increased price transparency will enhance competition and whet consumer appetites for foreign goods; price discrimination between different national markets will be reduced ... (p. 74).

And, when the euro was finally introduced in 1999, the European Commission (1999, p. 2) repeated its conviction that it would "squeeze price dispersion in EU markets".[1]

Recent theoretical work has provided some additional insights. A common theme is that currency unions may alter the way firms set prices. Devereux et al. (2002), for instance, argue that, when the euro develops into a vehicle currency for international trade,

[1] Similar views were voiced by European consumer organisations. Jim Murray, director of the BEUC (Bureau Européen des Unions de Consommateurs), for instance, argued that "the euro should help to reduce these price differences", but also conceded that it would "not in itself bring full price convergence" (BEUC 1998).

firms outside the euro area will tend to set common prices for the entire euro area. Friberg (2001) shows that firms that price-discriminate internationally will adopt different pricing strategies under a common currency, compared to a regime of fixed exchange rates. However, greater price convergence as a result of a common currency is not a foregone conclusion. Firms may respond to an exogenous lowering of arbitrage costs – e.g. via a common currency – by endogenously introducing greater arbitrage barriers to raise the degree of market segmentation, e.g. through vertical restraints, bundling with non-tradables or technical differentiation. Friberg and Martensen (2001) show that in this case lower transaction costs could lead to greater price differences.

Empirically, the potential effects of currency unions on economic integration have received a considerable amount of attention following the publication of a study by Andrew Rose (2000). He found that currency unions are associated with a large increase in trade between participating countries, even after controlling for a variety of other characteristics shared between such countries. While a number of subsequent papers (e.g. Persson 2001, Melitz 2001) have questioned his results, in particular the magnitude of the effect, there is little doubt that trade flows tend to be higher for countries in a currency union.[2] This suggests that the widely discussed home-bias in international trade (McCallum 1995, Helliwell 1998) and border effect on prices (Engel and Rogers 1996) could in part be due to the use of different currencies across countries.

There are some other recent studies that shed light on price convergence in the EU and the potential role of the common currency. Several have employed the city price data from the Economist Intelligence Unit. On the basis of this data set, Rogers et al. (2001) and Rogers (2001, 2002) report that price dispersion fell during the 1990s, but that most of this reduction occurred between 1990 and 1995. Parsley and Wei (2001) find a significant reduction in price dispersion due to the introduction of the euro for the EMU member countries in their econometric analysis of the city price data. However, when they simultaneously control for EU membership, the EMU effect is no longer significant.[3] In contrast, Isgut (2002) finds a significant euro effect for the 2001 cross-section of the city price data, even when controlling for EU membership.

Other studies have used the monetary union between Belgium and Luxembourg as a case study to inform on the likely euro effects. Lutz (2002) examines price differences in the European car market during 1993-98 and reports that price differences between Luxembourg and Belgium were significantly smaller than for other country pairs, even after controlling for a variety of additional determinants of economic integration. Mathä (2003) examines differences in individual product prices between Luxembourg and four surrounding regions in Belgium, France and Germany in 2001/02. He also finds that price differences for Luxembourg-Belgium comparisons were significantly lower than those for other bilateral comparisons.

[2] There are many studies related to Andrew Rose's work, including his own subsequent work. A useful list can be found on Rose's homepage under http://faculty.haas.berkeley.edu/arose/RecRes.htm.

[3] Note that their study uses the standard deviation of the common currency price differential across different goods for each bilateral country comparison. This is a measure of the dispersion of relative rather than absolute prices. The current study, in contrast, looks at the standard deviation of prices for a given good across countries. These two measures could give different results, since the dispersion of relative prices can be low even if prices for individual goods differ substantially across countries.

3. Methodology and estimation strategy

The issue addressed in this paper is a classic policy evaluation question. There is a substantial literature on the evaluation of economic policies, particularly in labour economics (e.g. Angrist and Krueger 1999), which provides the basis for the empirical strategy employed here. This section follows Frondel and Schmidt (2001) who discuss the application of these tools to the evaluation of environmental policies. The discussion of the different estimators will be kept in general terms, referring to 'policy' or 'treatment' to denote the introduction of the single currency. Accordingly, the term 'treatment group' refers to the euro-zone countries. Of course, since the observations in this study are at a national level, potential data sets tend to be much smaller than those commonly used in labour studies where they relate to individuals or households.

Let the variable of interest that may be affected by the policy (in our case the degree of price dispersion among a group of countries) be denoted by X_r^j where $j \in (Y, N)$ and $r \in (T, T')$. Y identifies the group undergoing the treatment (here the 11 original EMU countries), N the group(s) not affected by the treatment; T denotes the treatment period (here the EMU period, i.e. 1999 and after) and T' non-treatment periods. We want to estimate the effect of a policy, i.e. the 'treatment effect', and this is denoted by Δ. Ideally this would be estimated as the difference between the outcome for the treatment group after receiving the treatment (i.e. price dispersion among EMU member countries after the introduction of the euro), $X_T^Y + \Delta$, and the outcome the same group would have experienced had it not undergone the treatment, X_T^Y,

$$S^* = (X_T^Y + \Delta) - X_T^Y \tag{1}$$

Thus S^* is the ideal estimator of the treatment effect. The fundamental difficulty is that we cannot observe the counterfactual X_T^Y with non-experimental data. It needs to be replaced by an observable variable that serves as proxy (instrument). Two simple possibilities are the *before-after approach*,

$$S_1 = (X_T^Y + \Delta) - X_{T'}^Y \tag{2}$$

where the unobservable X_T^Y in (1) is replaced by $X_{T'}^Y$, the outcome for the treatment group before the treatment period, and the *cross-section approach*,

$$S_2 = (X_T^Y + \Delta) - X_T^N \tag{3}$$

where X_T^Y is proxied by X_T^N, the outcome for a control group not undergoing the treatment.

However, S_1 and S_2 only yield unbiased estimates under certain assumptions. The before-after approach requires the identifying assumption $E(X_T^Y) = E(X_{T'}^Y)$, which implies in our case that price dispersion would not have changed over time had these countries not joined EMU. The cross-section approach requires that $E(X_T^Y) = E(X_T^N)$ and will

therefore only be unbiased if selection into the treatment is independent of the outcome without the treatment.[4]

Both sets of requirements are unlikely to hold in our context. There are other factors which may have changed the degree of price dispersion over time irrespective of currency union – one only needs to think of improvements in transport and transaction technologies such as the internet. In this case the before-after estimate S_1 would overstate the EMU effect. The cross-section approach requires that EMU and non-EMU countries are completely alike apart from participation in the monetary union. This, too, is an unrealistic assumption since, as the theory of optimal currency areas explains, the incentive to form a currency union is stronger the greater the prior degree of economic integration. Countries forming a currency union are thus likely to be more integrated to start off with. In this case, the cross-section approach will also overstate the impact of monetary union on lower price dispersion.

The estimator employed to test the EMU effect in this study is based on the difference-in-differences (DD) approach, which can be viewed as a combination of the before-after and cross-section approaches. This estimator is denoted by S_3 and given by

$$S_3 = \left[\left(X_T^Y + \Delta\right) - X_{T'}^Y\right] - \left(X_T^N - X_{T'}^N\right) \tag{4}$$

By comparing the changes in outcomes for treatment and control groups, S_3 avoids the drawbacks of i) the cross-sectional approach by netting out fundamental differences between the two groups and ii) the before-after approach by netting out changes in the outcome variable affecting all groups. The assumption necessary to identify the treatment effect this way is $E(X_T^Y - X_{T'}^Y) = E(X_T^N - X_{T'}^N)$. This requires that there are no other factors during the treatment period which affect the treatment and control groups differently. An interesting application of the DD approach in a macroeconomic context can be found in Slaughter (2001).[5]

The DD approach will be implemented in a linear regression framework,

$$s_{rt}^i = \alpha_1 + \alpha_2 D_T + \alpha_3 D^Y + \alpha_4 D_T^Y + \sum_{k=1}^{K} \beta_k Z_{krt}^j + \varepsilon_{rt}^j \tag{5}$$

where the dependent variable is the estimated standard deviation of the logarithm of common-currency prices for a given group, and i) D_T, ii) D^Y and iii) D_T^Y are dummy variables equal to one when i) $r = T$, ii) $j = Y$ and iii) $r = T$ and $j = Y$ simultaneously, zero otherwise. The residual ε_{rt}^j is assumed to have the usual desirable characteristics.

The dummy variables capture influences that are not directly measured but specific to the treatment and control groups and/or specific to periods before and during the treatment. Empirical studies on the determinants of economic integration, for instance, often control for geographical factors such as distance and common borders, or whether

[4] In other words, there should be no fundamental differences between treatment group and control group which simultaneously affect i) the likelihood of undergoing the treatment and ii) the outcome without the treatment.

[5] A fourth method discussed in Frondel and Schmidt (2001) is the matching approach. This entails finding for each entity (individual, household, etc.) undergoing treatment a 'similar' or 'matching' entity (in terms of their general characteristics) not undergoing treatment to identify the treatment effect. This approach cannot be applied here due to the large data requirements.

countries share a common language. If there are differences in average distances, language patterns or other time-invariant characteristics across groups, their influence will be captured by α_3 in the DD regression equation (5).[6] In addition, changes in general influences that are likely to affect all groups (such as lower transportation costs etc.), will be captured by α_2. Thus, all terms in (5) can be given a distinct interpretation, since there is a direct mapping between the dummy effects and the terms used in the DD estimator in eq. (4):

$$\alpha_1 \rightarrow X_{T'}^N$$

$$\alpha_1 + \alpha_2 \rightarrow X_T^N$$

$$\alpha_1 + \alpha_3 \rightarrow X_{T'}^Y$$

$$\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 \rightarrow X_T^Y + \Delta$$

Most importantly, the DD effect in (4) thus corresponds to the estimate of α_4 and its statistical significance is easily tested by considering the corresponding t-statistic. However, α_4 only identifies the treatment effect if all factors with a differential effect on treatment and control groups during the treatment period are controlled for. Thus the Z_{krt}^j (k = 1, 2, ... K) terms in eq. (5) are additional control variables that are thought to influence price dispersion and vary over time and across groups.

Modelling the euro effect as a structural break in form of a simple shift in the standard deviation, as in eq. (5), is the most straightforward way to implement the DD approach. However, we do not have any a priori knowledge of the shape the potential narrowing of price dispersion could take. Thus, in addition to the specification shown in (5), results will also be presented for a specification where the dummies are interacted with time trends to allow for group- and period-specific changes in price dispersion over time, and one where both the dummies and differential time trends are included. These two additional specifications are given by

$$s_{rt}^i = \alpha_1 + \beta_1 t + \beta_2 t D_T + \beta_3 t D^Y + \beta_4 t D_T^Y + \sum_{k=1}^{K} \beta_k Z_{krt}^j + \varepsilon_{rt}^j \qquad (6)$$

where the DD estimate is given by β_4, and

$$\begin{aligned} s_{rt}^i = {} & \alpha_1 + \alpha_2 D_T + \alpha_3 D^Y + \alpha_4 D_T^Y \\ & + \beta_1 t + \beta_2 t D_T + \beta_3 t D^Y + \beta_4 t D_T^Y + \sum_{k=1}^{K} \beta_k Z_{krt}^j + \varepsilon_{rt}^j \end{aligned} \qquad (7)$$

which contains both a DD shift (α_4) and a DD change in trend (β_4) estimate. To examine the sensitivity of results, all versions are estimated with and without additional control variables.

[6] This will also include measurement issues, such as differences in group size.

4. Data description

The analysis uses four different data sets on final goods prices:

- the prices of Big Macs that are published annually in *The Economist*;
- the cover prices of *The Economist*;
- pre-tax car prices from *Car Prices in the European Union*, a survey of car prices regularly released by the European Commission;
- data on the costs of various goods and services from *Prices and Earnings around the Globe*, a publication by the Swiss bank UBS.

All four data sets have in one form or another been used in previous work, usually to study issues related to the law of one price and market integration. Big Mac prices, for instance, were used in Cumby (1996), Ong (1996) and Pakko and Pollard (1996). *The Economist* cover prices were employed, amongst others, in studies by Ghosh and Wolf (1994), Knetter (1997) and Knetter and Slaughter (1999). Lutz (1999), Gaulier and Haller (2000) and Goldberg and Verboven (2001) have utilised the European Commission's data on car prices and Lutz (2001) the UBS data set.

Table 2 describes the basic characteristics of the four data sets. They differ in various respects, such as the frequency which ranges from monthly (Economist) to three-year intervals (UBS data). They also cover different time spans and, as a result of the particular countries included, vary with respect to the composition of treatment and control groups. Moreover, the UBS data refer to specific cities while the other three data sets apply at the national level. Lastly, the car price data is unique here in being available before tax.

Ideally, the treatment group should contain all eleven starting EMU member countries. The most natural control group would then contain the four remaining EU countries. Alternatively, one might consider a broader control group including both the remaining EU members and other OECD countries. One would then like to cover the 1995-2001 period, since Austria, Finland and Sweden were not formal EU members before then. In practice, however, several concessions have to be made due to specific limitations in each of the four data sets. As a result, in most cases either the selection of group members or time periods deviates in some dimension from the 'ideal' data set.

The following selection criteria were used to set up the data. First, there had to be a sufficient number of observations over time. For Big Mac prices and UBS data this meant going further back than 1995 (in both cases the entire available period was used). Second, only countries are included where observations on prices are available without gaps, since changes in the composition of groups might otherwise bias the results. For Big Macs, the treatment group thus only consists of four countries; for the UBS data, the treatment group omits Ireland (since Dublin featured only intermittently) and Germany (since there is no German city with data throughout all surveys). The analysis of car prices omits Denmark, Finland and Greece, since the European Commission reports did not include them prior to 1999.

The UBS and car price data sets are somewhat different since each contains more than one good or model. To make the tests strictly comparable across goods/models, only those are included where data is available for the entire set of countries in treatment and control groups. In addition, there had to be a sufficient number of consecutive observations over time (at least ten for each car model and nine in the case of the UBS data). As

a result, of more than 90 models covered at one point or another in the car price reports, only 17 had sufficient data.[7] Similarly, of more than 30 individual price series featured at some point in the UBS price reports, only 13 had a sufficient number of observations to be included.[8]

The resulting observations are plotted in Figure 1. The four diagrams show the standard deviations of the logarithm of prices for both treatment and control groups in each data set, and for the periods selected for this study. The diagrams for the car and UBS price series depict the means across models/series. Looking at the treatment group – i.e. the EMU countries – there is little visual evidence that price dispersion decreased after 1999 except for the prices of the Economist. However, in this case the prices for the control groups appear to have converged too. The diagrams also reveal that, during the sample periods covered here, price dispersion was often considerably lower for the treatment group compared to the two control groups. There are some exceptions to this, such as the earlier observations of the UBS and car price data, and Big Mac prices during the later periods where price dispersion in the euro zone and EU control group were very similar.

Table 3 reports before-after and cross-section comparisons of standard deviations. Each entry in the table shows the ratio of two standard deviations, either for different periods or for different country groups. A lower degree of price dispersion during the EMU period compared to previous periods, or for the treatment group relative to a control group, is indicated by a ratio smaller than one. Due to the multitude of car price and UBS series, the table also reports the median relative standard deviation as a summary measure for these two data sets. Entries marked by an asterisk (*) indicate that a standard *F*-test, given by $s_1 / s_2 \sim F(n_1 - 1, n_2 - 1)$, results in a statistically significant difference (at a 10% level or lower) between the two respective variances.

The relative standard deviations in the table confirm the visual impression from Figure 1. Looking at the standard deviation of log prices before and after the introduction of the euro, there is little indication of a downward shift. This is irrespective of whether one compares the entire first three EMU years (1999-2001) to the three years before (1996-98), or whether one takes a longer view by comparing the third euro year (2001) to the third year before its introduction (1996). As already noted, the prices of the Economist are the exception here, and the reduction in price dispersion is also statistically significant in this case.

There are some cars with lower price dispersion after 1999 (e.g. the Audi A4, the Mercedes S-Class and the Ford models), but this has to be offset against several where price dispersion rose (e.g. three of the Opel models). The overall evidence for cars, as summarised by the median, reveals little overall trend, since it is either just below or a

[7] These are: Audi A4, Ford Fiesta/Focus/Mondeo, Mercedes S-Class, Opel Corsa/Astra/Vectra/Omega, Peugeot 307, Renault Laguna, Seat Ibiza/Toledo, Toyota Avensis, VW Golf/Passat and Volvo S40.

[8] Only those price series are included that have appeared in at least nine consecutive surveys. These are: cost of a weighted basket of goods and services (1976-2000; 1976 value excl. rent); cost of a food basket (1970-2000); costs of a set of men's and a set of women's clothing (1970-2000); rent for a 4room furnished apartment (1973-2000); cost of purchasing a set of household appliances (1970-2000); price of a one-way ride on public transport (bus, streetcar or subway) of about 10 km (6 miles) or at least 10 stops (1973-2000); price of a taxi ride, 5km (3miles) during daytime within city limits (1973-2000); average labour costs (not including price of spare parts and oil change) for a 15000 km car service (1976-2000); price of a dinner for one (1970-2000); cost of a double room with bath and breakfast for two, incl. service, in a first class hotel (1970-2000); cost of a basket of services (1970-2000); price of a medium-sized automobile (1970-2000; models vary).

little above one, depending on whether three-year periods or just 2001 and 1996 are compared. This mixed picture on car prices does not change when one considers only those differences that are statistically significant. There are five that are significantly smaller but also five that are significantly larger. A similar picture emerges across the various UBS price series. For some, price dispersion declined during 2000, but this depends on whether one draws a comparison with 1997 or 1994. The median is again close to one, slightly above for the 2000/1997 comparison and slightly below for the 2000/1994 comparison.

The cross-section comparisons of relative standard deviations in Table 3 send out a clearer message. For the periods examined, the entries in the table show that, with few exceptions, price dispersion was in general lower among euro-zone countries than among either of the two control groups. This applies to all data sets, including Big Mac prices, where the difference to the OECD control group is statistically significant when three-year periods are used for comparison. The evidence on large differences between treatment and control groups is particularly strong for the Economist and across the various car models. The median estimates for cars are now 0.61 and 0.46, and most ratios are significantly different from one. The median relative standard deviations across the UBS price series are now also clearly below one, as are most of those that are statistically significant.

Altogether, these comparisons provide a mixed picture. The before-after comparisons, on the one hand, indicate that price dispersion did not fall during the first three years of the euro. The cross-section comparisons, on the other hand, reveal that price dispersion during 1999-2001 was considerably lower among euro-zone countries than among either of the two control groups. While these comparisons are useful descriptions of the basic properties of the data, they have their limitations, since they cannot be used to isolate the effect of the introduction of the euro on price dispersion (see section 3). In the next section the DD approach is used to test the euro hypothesis per se.

5. Difference-in-differences estimates of the single currency effect

The results of the DD estimates of the single currency effect are presented in Tables 4-6. As discussed in section 3, the DD approach controls for both additional influences during the treatment period and differences between treatment and control groups. Tables 4 and 5 (Big Mac, Economist and cars) contain estimates for all three DD specifications: the first relates to DD estimates of the differences in the level of price dispersion (denoted by 'shift' in the column header) and based on eq. (5), the second to differences in the trend in price dispersion (denoted by 'change in trend' in the column header) and based on eq. (6), and the third allows for both simultaneously as in eq. (7). The corresponding *t*-ratios are shown in parentheses. Estimates that are statistically significant at the 10% level or below are marked by an asterisk (*). To save space, only the estimates of the single currency effect are reported in the tables, i.e. the estimates of α_4 and β_4. All regressions were estimated individually by ordinary least squares.[9] Due to the inherent limitation of the car price (only EU countries) and UBS data sets (only one EMU observation), Table

[9] System estimation such as seemingly unrelated regression, which might be considered for the car and UBS price series, would not lead to efficiency gains here, since each regression contains identical right-hand side variables.

5 only features the EU control group and Table 6 only includes specification (5). Each specification was estimated with and without the following additional control variables:

- the standard deviation of inflation rates to capture i) differences in the extent of local-currency pricing across groups and ii) the extent to which monetary conditions (i.e. relative movements in money supply and demand) are similar;
- the standard deviation of the growth rates of the nominal dollar exchange rate to allow for different price movements as a result of import price changes and the degree to which incomplete exchange rate pass-through matters;
- the standard deviation of output growth rates to capture the degree to which business cycle movements are correlated.

The data on exchange rates, growth and inflation were taken from the August 2002 CD-ROM edition of the International Monetary Fund's *International Financial Statistics*.[10] The three variables vary between groups and over time, thus not only capturing exogenous influences specific to treatment and control groups, but also specific to each period. The dispersion of exchange rate movements, for instance, is zero for EMU countries from 1999 onwards, but not for the other groups and periods. Similarly, including the dispersion of inflation rates helps to control for the fact that monetary policies were already becoming increasingly harmonised across prospective euro zone members in the run up to the introduction of the euro, but not necessarily for other countries.

First consider Table 4 which contains the estimates for Big Mac and Economist prices. Almost all DD estimates for Big Mac prices are positive, irrespective of control group and whether the other control variables are included or not. The two estimates that are negative – the 'change in trend' coefficient in specification 3 with the other EU countries as control group – are statistically insignificant. In contrast, all those that are significant are positive. Big Mac prices, therefore, do not provide any evidence in favour of the price-equalising effects of the euro. On the contrary, the results in this case suggest that, if anything, price dispersion rose as a result of the introduction of the euro.

The estimates for the prices of the Economist are a lot more supportive of the European Commission's euro hypothesis. The majority of estimates are negative, in particular when the additional control variables are included. The exception are the estimates of specification 2 without additional controls, where both estimates are positive and significant. However, this result does not extend to the corresponding estimate of specification 3 where both level shift and trend change are allowed for. In those cases where the additional controls are added the evidence is unambiguous: the majority are significant, and all of those are negative. Thus, in contrast to Big Mac prices, the evidence based on the cover prices of the Economist is more supportive of significant euro effects on lower price dispersion between member countries.

Moving to the car price data, there are now seventeen further 'goods' to consider. Consider first the point estimates in Table 5. While the majority of 'shift' estimates are negative (26 out of 34 with and without additional controls), the opposite is the case in specifications 2 and 3 (15 out of 32 and 22 out of 64, respectively). Hence the point esti-

[10] The data used in the estimation were as precisely as possible matched to the respective periods of observation and sample intervals of each data set. Inflation rates are based on the consumer price index (code ..64..ZF..). The exchange rate data are end-of-period observations (code ..AE.ZF..). Output growth is based on real gross domestic product (code ..99BV..), except for Greece (manufacturing production up to 2000), Ireland (industrial production) and Luxembourg (industrial production up to 2000:6).

mates themselves do not lend any clear-cut evidence either way. Looking only at those estimates that are statistically significant provides similarly mixed evidence. Whenever trends are allowed for – as in specifications 2 and 3 – the evidence is more supportive of a rise than a fall in price dispersion after the introduction of the euro. The inclusion of additional control variables does not alter the results by much. The point estimates are fairly similar, as indicated by the median point estimates (shown in the last two rows of the table), except for specification 2 where there is a slight increase when controls are added. In terms of significance, there are 27 estimates without controls versus 24 with controls that are significantly different from zero.

As an alternative to a summary by test specification, one can also evaluate the evidence by model. For instance, consider those DD estimates that are statistically significant and then examine whether, for a given model, they point in the same direction. On the basis of this approach there are seven models (Audi A4, Ford Fiesta, Ford Focus, Opel Corsa, Opel Vectra, Opel Omega and Renault Laguna) where there is some statistically significant evidence of a downward movement in price dispersion due to EMU but none against. Yet, there are also five models (Seat Ibiza, Seat Toledo, VW Golf, VW Passat and Volvo S40[11]) where the evidence points in the opposite direction: for each of these five models, there is at least one statistically significant DD estimate with a positive sign and none with a negative sign. For the remaining models, the DD tests are either all insignificant (Ford Mondeo, Mercedes S-Class, Opel Astra and Toyota Avensis) or provide contradictory evidence (Peugeot 307).

The results for the UBS price series are presented in Table 6. As indicated earlier, they relate to specification 1 ('shift') only. The majority of point estimates carry a negative sign (31 versus 21). This also applies to the majority of those DD estimates that are statistically significant (15 versus 6). The inclusion of the three additional control variables weakens the evidence somewhat in comparison to the tests without – the median point estimate is larger and fewer of the estimates are significant. However, it makes little difference whether the EU or OECD control groups are employed. Considering the individual price series, seven (food, rent, automobile, automobile service, restaurant meal, hotel stay and basket of goods and services) provide evidence of a statistically significant narrowing of price dispersion in one or more cases (and no evidence against), while three show the opposite (women's clothing, men's clothing and taxi ride).

A summary of the results across data sets and test specifications is provided in Table 7. This last table lists for each data set and DD specification i) the overall number of single currency estimates, ii) how many are negative and statistically significant, iii) how many are positive and significant and iv) what is called the 'net %' and defined as the difference between ii) and iii) as a percentage of i). This last measure can theoretically range from 100% in the case where all estimates are significant and indicative of a downward single currency effect on price dispersion, and -100% when all estimates are significant but point exactly the other way. While the 'net %' number does not constitute a statistical test, it is a useful way to represent the overall balance of DD results.

[11] In specification 3 the two DD estimates for the Volvo S40 point in opposite directions. Since a change in trend will always dominate a shift over a sufficiently long time interval, the 'change in trend' estimate is considered to dominate in this case and thus the results for specification 3 are taken as evidence of a positive effect on price dispersion.

In total, there are 178 DD tests of the single currency effect, differing in terms of price series, data set, specification and control group.[12] Of these, 41 provide statistically significant evidence that the single currency has reduced the degree of price dispersion among EMU countries. However, there are also 40 tests where the results are statistically significant but point in the opposite direction, i.e. an upward effect on price dispersion due to the single currency. If one weighs up the statistically negative and positive estimates against each other, the net effect across all DD tests is practically zero. Considering the aggregate results across specifications, the DD approach thus lends no support to the European Commission's claims.[13]

There are some differences across data sets. The evidence based on Big Mac prices, for instance, provides no support for the European Commission's claims. The results on car price and Economist cover prices are somewhat sensitive to the inclusion of additional controls. Considered across all tests, car prices do not support a single currency effect in either direction. The strongest evidence of a downward single currency effect on price differences comes from the cover prices of the Economist. Some support of the Commission's claims can also be found among the UBS price series.

Alternatively, the DD test results can be summarised by price series. There are 14 price series (seven each in the car and UBS data sets) where the evidence points at a significant negative euro effect on price dispersion, and nine price series (Big Macs, five car models, three UBS series) where the evidence points in the other direction. While this perspective lends a little more support to the claim that the European single currency would reduce the degree of price dispersion, it is also far from overwhelming.

6. Conclusion

The results in this paper suggest that EMU has not led to a widespread narrowing of price differences during the first three years, at least for the goods prices studied here. Taken at face value, this suggests that the use of different currencies has not exerted a significant influence on the degree of market segmentation across the European Union. This may not only come as a surprise given the statements made by the European Commission and other commentators in the run-up to EMU, but also when one considers the recent evidence on the effect of common currencies on trade. It is therefore natural to ask whether the evidence provided in this paper is truly indicative of a general pattern. Could it be unrepresentative – possibly even biased – as a result of the particular data and method employed?

The first question that arises relates to the goods covered in this study. Is the small selection of goods covered in this paper indicative of more general price trends? A thorough answer could be provided by considering a larger set of goods, but there is currently only a very limited number of data sets on prices of individual goods. As reported earlier, the study by Parsley and Wei (2001) uses a larger set of goods but also fails to find a sig-

[12] Note that, as explained in footnote 11, estimates of the third specification (eq. 7) are counted as a single test here. In cases where both α_4 and β_4 are statistically significant but of opposite sign, the β_4 estimate is used for Table 7.

[13] These results also demonstrate that the lower euro zone price dispersion found in cross-section comparisons is not related to the single currency, but merely reflects the fact that euro countries were already more integrated than others before they joined the single currency.

nificant euro effect once EU membership is controlled for. At least, the evidence provided in this study is based on four independent data sets and a fairly wide range of goods and services. There is no a priori reason to suspect that the results presented here are inherently biased against finding a significant single market effect.

A second potential limitation may be that only the first three years of EMU are covered here. It may that the integrating effects of the euro take longer to materialise. However, while the relatively low convergence speeds – half-life estimates of three to five years – typically estimated in research on purchasing-power parity may be a 'puzzle' (Rogoff 1996), there is some evidence of faster convergence in Taylor (2001) and recent research with disaggregated and micro-level price data comes up with half-life estimates of less than two years, some even below one year.[14] It thus appears that prices do converge rapidly enough to expect some evidence of lower price dispersion in our three-year period, *if* the single currency really has such an effect.

A third question is whether one should draw a distinction between the first three years of EMU and the period from 2002 onwards. Could it matter whether people have actual notes and coins in their pockets? The standard answer is no, if agents are rational and therefore capable of telling the difference between nominal (i.e. prices in different currencies) and real variables (i.e. relative prices between countries). If not, we would be dealing with some form of money illusion. The evidence in Fehr and Tyran (2001) suggests that money illusion may be a realistic phenomenon.[15] There is also strong evidence of 'framing effects' in the experimental literature and perhaps a particular currency serves as a reference frame to agents.

It will therefore be interesting to see whether the introduction of actual euro notes and coins has a separate effect on price convergence, but systematic evidence on this will only be available in a few years' time. The casual evidence is mixed. A survey reported in *The Times* (5 September 2002), for instance, indicated that price differences in the euro zone were still substantial in 2002. In contrast, *The Economist* started charging a common price in euro countries (except for Greece) in 2002. Two recent studies that examine price differences before and after the euro changeover in January 2002 provide more systematic, though still preliminary, evidence. Mathä (2003), comparing prices in Luxembourg and surrounding regions in Belgium, France and Germany, reports no reduction in price differences between October 2001 and April 2002. Baye et al. (2002) compare online prices for a range of goods between October 2001 and May 2002 and report no convergence after the changeover.

Altogether, the results of these studies and those presented in this paper suggest that the use of different currencies was probably not the major barrier to further economic integration in the EU it was often made out to be. Instead, the focus should shift to other influences on the degree of product market integration in the EU. Clearly, some goods and services are non-tradable by nature. Others, however, are rendered non-tradable in practice due to lack of competition between producers and/or distributors, transport and transaction costs, and informational asymmetries between local and foreign consumers about local prices. It is also possible that, precisely because of these additional constraints on market integration, the single currency has so far had such a negligible effect on price dispersion in the EMU.

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[14] See, for instance, Cumby (1996), Lutz (2001, 2002) and Goldberg and Verboven (2001).

[15] However, their experimental setup - where 'money illusion' is driven by strategic complementarities between price-setters - may not be strictly applicable to the single currency issue.

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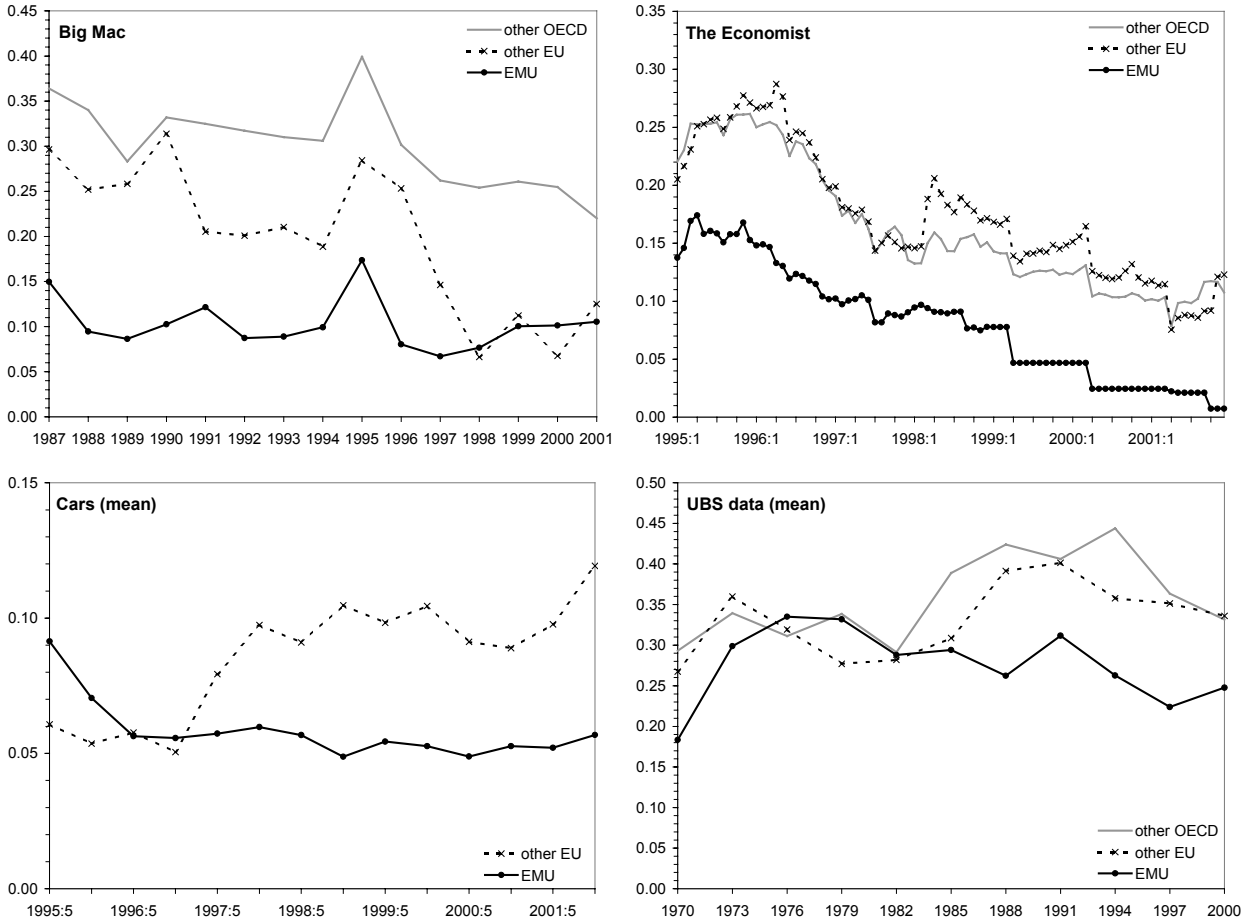

Figure 1. Standard Deviations Over Time

Notes: The panel containing the car price data shows the mean standard deviation across 17 models and that for the UBS data the mean standard deviation across 13 series.

Item	*Price difference*	*Low*	*High*	*Date*
The Economist	58%	Greece	Denmark	Dec. 1998
Big Mac	41%	Spain	Denmark	Apr. 1998
Canon Prima Super 135 (camera)	73%	Germany	UK	Jun. 1998
Lacoste polo shirt	27%	Spain	Austria	Jun. 1998
Swatch "The Classics"	74%	Italy	UK	Jun. 1998
Chanel No 5 (perfume)	59%	Belgium	UK	Jun. 1998
Levi's 501 (jeans)	34%	Italy	Germany	Jun. 1998
Kellog's cornflakes	28%	UK	Germany	Nov. 1999
Top 5 DVD	29%	Germany	France	Nov. 1999
Duracell batteries, 4pack	36%	France	UK	Nov. 1999
Monopoly (game)	18%	France	Germany	Nov. 1999
Sega Dreamcast	25%	Germany	UK	Nov. 1999
Ford Mondeo	54%	Spain	Portugal	Nov. 1998
VW Golf	30%	Luxembourg	Ireland	Nov. 1998
Peugeot 406	28%	Luxembourg	Portugal	Nov. 1998
BMW 3-series	41%	Sweden	Ireland	Nov. 1998
Fiat Punto	33%	France	Ireland	Nov. 1998

Table 1. Price Differences in the European Union, Some Examples

Notes: The cover prices of *The Economist* and Big Macs are taken from the 19 December 1998 and 6 April 1998 issues, respectively. Data for items 3-7 comes from 'A Single Price for a Single Currency?', a BEUC Press Release dated 21 December 1998. This reports prices from a survey covering major cities in 10 EU countries, which was undertaken in June 1998. Data for items 8-12 are taken from 'A Report into International Price Comparisons', prepared for the UK Department of Trade and Industry by ACNielsen and released on 13 February 2000. The report covers prices in France, Germany, UK and US surveyed in November and December 1999. The car price data (items 13-17) comes from *Car Prices in the European Union on 1 November 1998* (European Commission) which covers 12 EU countries.

	Big Mac[a]	The Economist[a]	Cars[c]	UBS[c]
Source	The Economist Newspapers Limited	The Economist Newspapers Limited	European Commission	UBS
Period	1987-2001	1995-2001	1995-2001	1970-2000
Frequency	annual (usually April)	monthly (last issue each month)	bi-annual (1 May; 1 November)	every three years (usually second quarter)
Number of series	1	1	17	13
EMU countries	France, Germany, Italy, Spain	Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain	Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain	Austria (Vienna), Belgium (Brussels), Finland (Helsinki), France (Paris), Italy (Milan), Luxembourg (Luxembourg), Netherlands (Amsterdam), Portugal (Lisbon), Spain (Madrid)
Other EU countries	Denmark, Sweden, UK	Denmark, Greece, Sweden, UK	Sweden, UK	Denmark (Copenhagen), Greece (Athens), Sweden (Stockholm), UK (London)
Other OECD countries	Australia, Canada, Japan, USA	Iceland, Norway, Switzerland, USA		Australia (Sydney), Canada (Montreal), Japan (Tokyo), Norway (Oslo), Switzerland (Zurich), USA (New York)

Table 2. Description of the Four Data Sets

Sources: *The Economist*, European edition (for Big Mac and Economist cover prices); *Car Prices in the European Union* (European Commission); *Prices and Earnings around the Globe* (UBS).

[a] Since the first two Big Mac price surveys were in September 1986 and January data for 1987, these were merged by using 1996 observations for 1997 where the latter were missing. Survey dates: 17/1/1987 (or 1/9/1986), 28/3/1988, 11/4/1989, 30/4/1990, 9/4/1991, 10/4/1992, 13/4/1993, 5/4/1994, 7/4/1995, 22/4/1996, 7/4/1997, 6/4/1998, 30/3/1999, 25/4/2000, 17/4/2001.

[b] Economist prices for December in the UK and US are based on the issue preceding the higher-priced Christmas issue. Local currency prices were converted into US dollars using end-of-period exchange rates (code ..AE.ZF) from the IMF's *International Financial Statistics* database.

[c] Pre-tax prices. Data up to the 1998 surveys were converted into ecus and those from 1999 onward into euros using the exchange rates given in each volume.

[c] Data collection periods: July 1970, July/Aug 1973, May/June 1976, June/July 1979, March/April 1982, spring 1988 and 1991, and the second quarter in 1994, 1997 and 2000.

	Before-after		*Cross-section*			
Period:	*1999-01*	*2001*	*1999-01*	*2001*	*1999-01*	*2001*
Relative to:	*1996-98*	*1996*	*EU*	*EU*	*OECD*	*OECD*
Big Mac	1.37	1.31	1.01	0.84	0.42*	0.48
The Economist	0.31*	0.17*	0.27*	0.24*	0.28*	0.21*
Audi A4	0.77*	0.65	0.24*	0.17*		
Ford Fiesta	0.71*	0.74	0.64*	0.40*		
Ford Focus	0.77*	0.84	0.48*	0.46*		
Ford Mondeo	0.96	0.87	0.68	0.46*		
Mercedes S-Class	0.51*	0.34*	0.29*	0.15*		
Opel Corsa	1.30*	1.66*	0.84	1.02		
Opel Astra	1.40*	1.42	0.50*	0.52*		
Opel Vectra	1.34*	1.32	1.13	1.27		
Opel Omega	0.84	0.89	0.33*	0.38*		
Peugeot 307	0.98	1.16	0.27*	0.23*		
Renault Laguna	1.00	1.05	0.34*	0.23*		
Seat Ibiza	1.19	1.35	1.20	1.18		
Seat Toledo	0.93	1.07	0.33*	0.38*		
Toyota Avensis	1.05	1.25	0.75	0.66		
VW Golf	1.36*	1.32	0.61*	0.65		
VW Passat	1.09	0.87	0.90	1.31		
Volvo S40	0.90	0.86	0.90	2.70		
Median (cars)	*0.98*	*1.05*	*0.61*	*0.46*		
Period:	*2000*	*2000*		*2000*		*2000*
Relative to:	*1997*	*1994*		*EU*		*OECD*
Food	0.97	0.95		0.50*		0.48*
Women's clothing	0.97	0.86		0.63		0.42*
Men's clothing	1.50	0.97		1.23		0.85
Rent	1.08	0.64		2.59*		0.76
Household appliances	1.33	0.86		0.31*		0.33*
Automobile	0.60*	0.70		0.99		0.97
Public transport	0.91	0.94		0.63		0.96
Taxi ride	1.10	1.22		0.91		1.05
Automobile service	1.16	0.86		0.85		1.01
Restaurant meal	1.22	1.09		1.05		0.71
Hotel stay	1.34	0.97		0.66		0.64
Basket of services	1.08	1.12		0.83		0.90
Basket of goods and services	1.45	1.12		0.58*		0.80
Median (UBS)	*1.10*	*0.95*		*0.83*		*0.80*

Table 3. Before-After and Cross-Section Comparisons of Standard Deviations

Notes: Each entry in the table is the ratio of the two standard deviations indicated in the column header. The Economist cover price data refer to July and the car price data to November of each year. For the UBS series the number of comparisons is restricted by the low sampling frequency. The standard deviations across multiple time periods (1999-01; 1996-98) were calculated using period-specific means. An asterisk (*) denotes that an *F*-test for the equality of the two variances is statistically significant at the 10% significance level or lower.

				1		2		3	
	n	*Control group*	Z^j_{krt}	*Shift*	*Change in Trend*	*Shift*	*Change in Trend*		
Big Mac	30	EU	no	0.121*	(4.32)	0.068*	(2.37)	0.073	(0.95)	-0.014	(0.47)
		OECD	no	0.071*	(3.62)	0.091*	(4.79)	0.012	(0.33)	0.020*	(2.22)
		EU	yes	0.122*	(3.86)	0.071*	(2.65)	0.074	(0.98)	-0.010	(0.33)
		OECD	yes	0.084*	(3.95)	0.101*	(3.40)	0.012	(0.36)	0.026*	(2.43)
The Economist	168	EU	no	0.001	(0.15)	0.001*	(4.71)	-0.016	(1.53)	0.000	(0.10)
		OECD	no	0.003	(0.31)	0.001*	(3.26)	-0.010	(1.24)	-0.002*	(4.36)
		EU	yes	-0.082*	(9.61)	-0.001	(1.51)	-0.042*	(4.39)	0.000	(0.71)
		OECD	yes	-0.031*	(3.07)	0.000	(0.30)	-0.030*	(3.80)	-0.001*	(3.70)

Table 4. Difference-in-Differences Estimates: Big Mac and Economist Prices

Notes: The estimates are based on equations (5) - (7) in the text. Robust *t*-ratios are shown in parentheses. In column '1' the DD estimate relates to differences in the level of price dispersion, in column '2' to differences in its trend, and column '3' allows for both. Only the estimates of the single currency effect are reported in the table. The Z^j_{krt} column indicates whether the additional control variables are included or not. Significant estimates (at the 10% significance level or lower) are marked with an asterisk (*).

			1	2	3	
	n	Z_{krt}^{j}	*Shift*	*Change in Trend*	*Shift*	*Change in Trend*
Audi A4	28	no	-0.085* (4.51)	-0.019* (4.64)	0.013 (0.50)	-0.007 (0.92)
		yes	-0.095* (4.44)	-0.009 (1.34)	0.002 (0.07)	-0.009 (1.14)
Ford Fiesta	28	no	-0.067* (3.75)	-0.020* (3.70)	-0.014 (0.34)	-0.007 (0.76)
		yes	-0.074* (3.88)	-0.010 (1.16)	-0.022 (0.52)	-0.009 (0.89)
Ford Focus	28	no	-0.058* (3.01)	-0.011 (1.69)	-0.024 (0.51)	0.000 (0.02)
		yes	-0.062* (2.48)	0.000 (0.03)	-0.014 (0.23)	0.002 (0.13)
Ford Mondeo	28	no	-0.028 (1.06)	-0.001 (0.09)	-0.001 (0.02)	0.016 (0.97)
		yes	-0.026 (0.88)	0.017 (1.35)	-0.002 (0.05)	0.016 (1.01)
Mercedes S-Class	28	no	-0.012 (0.79)	-0.001 (0.11)	0.010 (0.44)	-0.007 (0.80)
		yes	-0.007 (0.35)	-0.007 (0.70)	0.004 (0.17)	-0.007 (0.92)
Opel Corsa	28	no	-0.006 (0.19)	-0.010 (1.31)	0.032 (0.81)	-0.029* (2.14)
		yes	0.006 (0.15)	-0.028* (2.28)	0.025 (0.70)	-0.029* (2.10)
Opel Astra	28	no	-0.002 (0.16)	0.004 (0.95)	0.010 (0.30)	-0.011 (1.44)
		yes	0.010 (0.64)	-0.008 (1.30)	0.019 (0.56)	-0.009 (1.07)
Opel Vectra	28	no	-0.046* (3.94)	-0.013* (2.56)	-0.029 (1.41)	0.007 (1.33)
		yes	-0.048* (3.47)	0.004 (0.61)	-0.028 (1.26)	0.007 (1.28)
Opel Omega	28	no	-0.108* (6.43)	-0.017* (2.72)	-0.048 (1.25)	0.012 (1.29)
		yes	-0.126* (7.57)	0.006 (0.68)	-0.056 (1.58)	0.010 (1.14)
Peugeot 307	28	no	-0.099* (3.16)	-0.013 (1.68)	0.056 (1.60)	0.008 (0.76)
		yes	-0.125* (3.70)	0.011 (0.96)	0.049* (1.77)	0.006 (0.66)
Renault Laguna	22	no	-0.082* (2.51)	-0.018* (2.48)	0.065 (1.31)	0.010 (0.76)
		yes	-0.069 (1.63)	0.017 (0.97)	0.056 (1.12)	0.009 (0.68)
Seat Ibiza	24	no	0.089* (3.03)	0.025* (2.58)	0.158* (3.29)	0.030* (2.56)
		yes	0.080* (2.04)	0.040* (1.82)	0.151* (3.29)	0.030* (3.01)
Seat Toledo	24	no	-0.043 (1.21)	0.001 (0.12)	0.091* (3.19)	0.037* (4.39)
		yes	-0.036 (0.76)	0.049* (3.23)	0.092* (3.09)	0.037* (4.22)
Toyota Avensis	28	no	0.016 (0.74)	0.010 (1.48)	0.016 (0.36)	0.010 (0.94)
		yes	0.011 (0.51)	0.010 (1.08)	0.010 (0.23)	0.009 (0.82)
VW Golf	28	no	0.005 (0.14)	0.022* (2.88)	0.053* (1.87)	0.049* (4.92)
		yes	-0.021 (0.58)	0.052* (4.80)	0.049* (1.88)	0.048* (4.71)
VW Passat	28	no	0.008 (0.28)	0.019* (3.21)	0.016 (0.70)	0.048* (5.85)
		yes	-0.009 (0.29)	0.049* (6.78)	0.013 (0.60)	0.048* (5.56)
Volvo S40	28	no	-0.016 (0.50)	0.013* (1.91)	-0.113* (2.52)	0.038* (3.23)
		yes	-0.018 (0.51)	0.030* (2.39)	-0.119* (2.56)	0.038* (3.26)
Median		no	*-0.028*	*-0.001*	*0.013*	*0.010*
		yes	*-0.026*	*0.010*	*0.010*	*0.009*

Table 5. Difference-in-Differences Estimates: Car Prices

Notes: The results in this table only feature the EU control group. See Table 4 for further details.

		versus EU		versus OECD	
	n	*without* Z_{krt}^{j}	*with* Z_{krt}^{j}	*without* Z_{krt}^{j}	*with* Z_{krt}^{j}
Food	22	-0.015 (0.51)	-0.071* (2.17)	-0.034 (0.97)	-0.071* (1.80)
Women's clothing	22	0.081* (2.97)	0.004 (0.12)	0.048 (1.71)	0.023 (0.48)
Men's clothing	22	0.125* (3.68)	-0.010 (0.31)	0.115* (3.19)	-0.003 (0.05)
Rent	20	-0.376* (6.16)	-0.011 (0.25)	-0.361* (5.29)	-0.001 (0.01)
Household appliances	22	0.031 (1.15)	0.017 (0.71)	0.003 (0.12)	-0.002 (0.07)
Automobile	22	-0.140* (2.86)	0.074 (1.50)	-0.164* (3.17)	0.065 (1.01)
Public transport	20	0.157 (1.58)	0.068 (1.10)	0.139 (1.45)	0.076 (1.20)
Taxi ride	20	0.172* (3.47)	0.072 (1.68)	0.155* (2.51)	0.080* (1.84)
Automobile service	18	-0.207* (2.51)	0.036 (0.46)	-0.185 (1.69)	-0.030 (0.33)
Restaurant meal	22	-0.077 (1.61)	0.017 (0.39)	-0.133* (2.98)	-0.027 (0.48)
Hotel stay	22	-0.106* (2.56)	-0.164* (5.09)	-0.142* (3.56)	-0.161* (6.11)
Basket of services	20	-0.003 (0.09)	-0.001 (0.02)	-0.048 (1.68)	-0.029 (1.18)
Basket of goods and services	18	-0.103* (3.79)	-0.060* (2.27)	-0.133* (6.17)	-0.061 (1.58)
Median		*-0.015*	*0.004*	*-0.048*	*-0.003*

Table 6. Difference-in-Differences Estimates: UBS Price Series

Notes: The estimates are all based on the 'shift' specification shown in DD equation (5). See Table 4 for further explanations.

		versus EU		versus OECD		
		without Z^j_{krt}	with Z^j_{krt}	without Z^j_{krt}	with Z^j_{krt}	Total
Big Mac	*Total*	3	3	3	3	12
	signif. <	0	0	0	0	0
	signif. >	2	2	3	3	10
	net %	-66.7%	-66.7%	-100.0%	-100.0%	-83.3%
The Economist	*Total*	3	3	3	3	12
	signif. <	0	2	1	2	5
	signif. >	1	0	1	0	2
	net %	-33.3%	66.7%	0.0%	66.7%	25.0%
Cars	*Total*	51	51			102
	signif. <	13	8			21
	signif. >	10	12			22
	net %	5.9%	-7.8%			-1.0%
UBS	*Total*	13	13	13	13	52
	signif. <	5	5	3	2	15
	signif. >	3	2	0	1	6
	net %	15.4%	23.1%	23.1%	7.7%	17.3%
Total	*Total*	70	70	19	19	178
	signif. <	18	15	4	4	41
	signif. >	16	16	4	4	40
	net %	2.9%	-1.4%	0.0%	0.0%	0.6%

Table 7. Summary of Difference-in-Differences Results

Notes: The first three rows for each data set report (i) the total number of tests, (ii) the number of tests resulting in a significantly smaller degree of price dispersion and (iii) the number of tests resulting in a significantly larger degree of price dispersion (at a ten percent significance level). The row labelled 'net %' is the difference between (ii) and (iii) expressed as a percentage of (i), for each test category and data set.