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ANALYZING THE INCIDENCE OF CONSUMPTION TAXES

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Abstract: This paper deals with the question of how consumption taxes, especially the value-added tax, affect consumption prices. The analyses are based on data from EU countries for the period 1970-2004. The starting point is a conventional supply-demand analysis of the tax incidence problem. This problem is solved using some simple price mark-up equations, Phillips curves and inflation forecast error equations. All these equations are estimated from panel data from EU countries using different estimators and variable specifications. In addition, an analysis is carried out with Finnish excise taxes using commodity/outlet level micro data for the early 2000s. A general result of all analyses is that more than one half of a tax increase shifts to prices.

Keywords: Value-added tax, tax incidence, consumption taxes

JEL Code: H22

CONTENTS

YHTEENVETO

Tutkimuksessa selvitetään, miten kulutusverot siirtyvät kuluttajahintoihin. Erityisenä tarkoituksena on valottaa suunnitellun ruuan arvonlisäveron alennuksen hintavaikutuksia. Empiirinen osa tutkimuksesta perustuu kahteen erilliseen hinta-aineistoon; Euroopan unionin maita koskevanaan vuosiaineistoon arvonlisäveroista ja kuluttajahinnoista sekä Suomea koskevaan kuukausiaineistoon valmisteveroista ja hyödykekohtaisista kuluttajahinnoista..

Ensin mainitussa osassa tarkastelun kohteena ovat Euroopan Unionin jäsenmaat tarkasteluajanjakson ollessa 1970-2004. Taustalla on tavanomainen verotuksen kohtaaanto-ongelma, jota on kansainvälisessä kirjallisuudessa käsitelty jo puolen vuosisadan ajan. Kysyntä- tarjontatarkastelun tasolla kohtaanto-ongelmaa voidaan tarkastella yksinkertaisen "mark-up" hinnoittelumallin avulla. Empiiristen arviointien tukena käytetään paitsi hinnoittelumallista johdettuja hintamarginaaliyhtälöitä myös Phillipsin käyriä ja ennusvirheyhtälöitä kuluttajahintainflaation suhteen. Kaikki nämä estimoidaan EU maiden paneeliaineistolla käyttäen hyväksi eri estimaattoreita ja muuttujaspesifikaatioita. Analyysien yleinen tulos on se, että kaksi kolmannesta verojen korotuksista siirtyy hintoihin.

Jälkimmäisessä tutkimuksessa selvitetään, missä määrin viime vuosina tapahtuneet valmisteverojen muutokset ovat siirtyneet kuluttajahintoihin. Tarkastelun kohteena ovat alkoholi-, auto-, polttoaine- ja sähköverojen muutokset vuosina 1997–2004. Tarkasteluissa hyödynnetään kuluttajahintaindeksin perusaineistoa, jonka avulla estimoidaan tuotekohtaisista paneeliaineistoista verojen impulssivasteet hintojen suhteen. Tarkasteluissa voidaan huomioida vain välittömät hintavaikutukset, jotka tarjonnevat kuitenkin jonkinlaisen suuntaa-antavan arvion siitä, mikä on verojen kohtaanto yleensä ja miten se poikkeaa hyödykeryhmittäin. Tulokset viittaavat siihen, että hyödykeryhmäkohtaiset erot ovat todella suuria. Jonkinlaisena nyrkkisääntönä voidaan tässäkin tapauksessa pitää sitä, että kaksi kolmasosaa verojen muutoksista siirtyy hintoihin.

Saadut siirtymäarviot ovat samansuuntaisia kuin tilastohavainnot Ruotsista, Norjasta ja Islannista, joissa ruuan arvonlisäveroa on laskettu samalla tavalla kuin, mitä Suomessa aiotaan tehdä. Itse asiassa muissa pohjoismaissa tehdyt arvonlisäveron muutokset ovat alentaneet ruuan rintaa lähes täysimääräisesti siirtymävaikutuksen ollessa noin 90 %. Pohjoismaita koskeva luku on sopusoinnussa tässä tutkimuksessa saatujen estimointitulosten kanssa, kun ottaa huomioon, että kyse on vain ruuasta eikä kaikista kulutushyödykkeistä (kuten palveluksista). Edelleen on pidettävä mielessä, että Suomi on pieni avoin talous, jossa ainakin elintarvikkeiden tuontitarjonta on täysin joustavaa.

1. INTRODUCTION

This study deals with the incidence of consumption taxes. More precisely, the starting point of the analysis is an intention to lower the VAT rate on food in Finland. Currently, the Finnish food VAT rate is one of the highest in the European Union (17 per cent compared with an average rate of 6 per cent[2]) and partly because of this a study group was formed to analyse the consequences of an eventual tax cut.[3] Changing the tax structure is obviously a complicated matter that involves analysis of the demand patterns, income distribution, market structure and so on. In this analysis we disregard all welfare aspects and concentrate solely on the issue of tax incidence: how does an eventual change in the VAT rate on food show up in consumer prices?[4]

In terms of empirical analysis, the usual way to proceed would obviously be to scrutinise previous tax changes. Unfortunately, very few cases exactly match the planned Finnish case, and only the recent tax cuts in Sweden, Norway and Iceland are generally directly applicable to our purposes. Evidence from the Swedish, Norwegian and Icelandic exercises is displayed in Figures 1 to 3. In Sweden, food taxes were lowered from 21 to 12 per cent (9 percentage points), which ought to have led to a 7.4 per cent fall in consumption prices if taxes had completely shifted to prices. The corresponding immediate change in food prices was -6.6 per cent, which came quite close to this figure. In Norway, the corresponding figures were 24 and 12 per cent, with an implied price level of -9.7 per cent. The comparable one-month change in prices turned out to be 8.9 per cent, which again is practically identical to the implied value. Recent tax reform in Iceland included to a lowering of the VAT from 14 (in some cases 24.5) to 7 per cent, which ought to have lowered the consumption prices of food by (more than) 6.1 per cent. New data from Statistics Iceland reveals that the immediate price effect is as high as -7.4 per cent. This, in turn, can be explained by the fact along with the VAT tax cut, excise duties on imported and domestic food, excluding sugar and sweets, were also abolished. Summing up, evidence from these three Nordic countries suggests that consumption taxes almost entirely shift to prices (a general figure would be something like 90 per cent). It is often argued that the price shift effect is not linear (tax cut effects differ from tax hike effects, or the effects depend on the cyclical situation or the industry). Some support for this proposition is provided by Garbonnier (2005). Results from the three Nordic countries do not, of course, tell anything about nonlinearity, but they sug-

[2] Six per cent corresponds to the population weighted average of VAT rates for food and beverages. The unweighted average is 8 per cent. By comparison, the average US sales tax rate is 7.7 per cent. For a more exhaustive comparison of tax structures, see Coenen et al. (2006)
[3] A final report of group has already been published by Holm et al. (2007).
[4] See e.g. Coenen et al. (2006) and Bye et al. (2003) for more analyses of tax reform effects.

gest that the tax cut effects do not completely disappear, as is sometimes argued in the media.

In the case of the Nordic countries, such a result would in fact very surprising. All these countries have small open economies where competition is severe, partly because foreign competitors have relatively easy access to them. Thus, we basically have a standard textbook example of commodity markets where supply is infinitely elastic and demand – by the nature necessities – is almost inelastic (see e.g. Swinton, J. and Thomas, C. (2001) and Jha (1998)). Under such circumstances one might expect that the short-run price effect of the tax is indeed very large.[5]

Unfortunately, these three cases are the only that we are aware of and they do not allow sophisticated econometric analysis. For this purpose we have to use other data sources. In fact, we use two alternative data sets: data on the main VAT rates from the EU15 countries and, secondly, data on Finnish excise taxes. The former data are annual and cover the period from 1970-2004, for which the Finnish data are monthly and cover a large number of individual commodities and selling outlets (the data are derived from the CPI database) for the early 2000s.

Naturally, we can also make use of previous empirical analyses of tax incidence. Useful summaries of the results are provided for instance by Fullerton & Metcalf (2002), Besley & Rosen (1998) and Morin (2005). On the basis of these summaries it seems fair to conclude that, as a rule, more than 50 per cent of taxes are shifted to prices. Here, the analysis of Besley and Rosen (1998) dealing with the effect of sales tax on prices in the United States should perhaps be particularly emphasized. Besley and Rosen observed that in several cases prices increase more than taxes. Thus, research results are broadly consistent with the recent informal evidence from the Nordic countries. Of course, there are differences between research results depending on factors such as the:

- size of the market
- length of the inspection interval
- nature of commodities
- market structure.
- analytical framework
- sign of the tax change

[5] Because the price elasticity of demand for food is very low, food appears to be a product that should, according to the Ramsey principle, be taxed more heavily than, for instance, services. This in turn may explain why there has been reluctance in lowering the tax rate, even though distributional reasons might have favoured it.

From the point of view of the current analysis these facts are somewhat alarming, because the analysis of aggregate VAT rates in the EU does not exactly correspond to an analysis of Finnish VAT rates for food. Neither does the analysis of Finnish excise taxes exactly correspond to the policy proposal. Finnish petrol, electricity and car markets surely have some special characteristics that have to be kept in mind when interpreting the final results. In particular, the level of competition differs considerably (compare e.g. electricity and petrol pricing).

Nonetheless, these are the best data sets currently available and we have work with them. This study first analyses VAT rates and then Finnish excise taxes. Before these analyses we briefly present the analytical framework and the estimating equations. Finally, some concluding remarks are provided at the end of the paper.

2. ANALYTICAL FRAMEWORK

Let us focus on a single commodity c with demand and supply being equal to D and S.[6] [7] Moreover, let us assume that the corresponding curves are of the form: $D = (P_C/P)^{-d}$ and $S = ((1-\tau)P_C/P)^{s}$, where d and s are price elasticities, P_C the price of commodity c and P the general price (or cost level). τ is the ad valorem tax rate.[8] Assuming now that D = S, we can derive the following equation for the price "mark-up":

$$\log(P_C) = \log(P) - \alpha\log(1-\tau), \qquad (1)$$

where the coefficient of the tax rate is simply the ratio of the price elasticities, that is: $\alpha = (s/(d+s))$.[9] Basically, we can simply estimate (1) to obtain α, assuming that we have data on P, τ and possible control variables. Although the analysis is in principle straightforward, there are several problems. The most obvious of these is related to the nature of the price margins, $\log(P_C) - \log(P)$. Irrespective of the way they are measured, it appears that they not stationary (see Figures 5 and 6). Thus, there is a trend-like change in almost all price margins starting from the beginning of the 1970s and continuing until the end of the 1990s. Since then the margins seem to have levelled off (although Finland, Ireland and Spain represent notable exceptions to this rule).

One explanation for the recent behaviour is the introduction of the Euro and the resulting change in the competitive environment.[10]

Here we can do little to control for the change in the market structure and/or competitive environment. The only thing we can do is to include a time trend as a proxy for the

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[6] Note that in the subsequent analysis we do not always examine individual commodities but sometimes aggregates, or even total consumption. In this case we have to keep in mind that instead of individual prices we have implicit price deflators. Moreover, taxes apply not only to consumption but also to part of investment and public consumption, which aggravates the simultaneity problem. The implicit weights of the tax rate do not exactly match the "weights" of the consumption price deflator.

[7] Even though micro data are currently available on consumer prices (see e.g. Aucremanne, L & Dhyne, E. (2004)), they do not cover sufficiently long time periods for follow-up studies of VAR changes.

[8] Here we do not consider tax incidence in the case of different market structures, although the case of monopolistic competition, for instance, could provide useful insights into the different results of tax shifting. Take, for instance, the case in which tax shifting exceeds 100 per cent. It is hard to explain this kind of result by anything other than a monopoly. (See the classic studies of Musgrave (1959) and Fullerton and Metcalf (2002) for details).

[9] If the tax rate applies to pre-tax prices the supply curve is of the form $S = (P_C/(1+\tau)P)^{S}$, and (1) is of the form $\log(Pc) = \log(P) + \alpha\log(1+\tau)$.

[10] The long-run growth of the price margin may reflect similar tendencies in the functional distribution of income. The results might, however, also reflect some measurement problems. If we compute the price margin in terms of import prices we have to acknowledge that import prices typically only include commodities while consumer prices have a large weight for services.

structural change or to move to first log differences. Thus, we start with the following simple estimating equation:

$$\log(PC_{it}) = a_0 + a_1\log(PP_{it}) + (1-a_1)\log(PM_{it}) + a_2TAX_{it} + a_3t + u_{it} \quad (2)$$

where

PC = consumer prices (private consumption deflator)
PP = producer prices, or alternatively wholesale prices
PM = import prices
TAX = log(1+τ) where τ = the main VAT rate, or alternatively the weighted-average tax rate, WAR that is used by the EU [11]
t = time trend
u = the residual

Above, (2) has been estimated in a level form by introducing the lagged dependent variable as an additional regressor and together with log differences. In practice, only a_0, a_2 and a_3 have been estimated freely, because a_1 has been calibrated to be 2/3.[12] Thus, we actually try to explain the gross price margin. Even so, we do also estimate an even simpler price change equation that takes the following form:

$$\Delta\log(PC_{it}) = a_0 + a_1\Delta TAX_{it} + u_{it}. \quad (2')$$

In the case of aggregate consumer prices, we could obviously make use of the Phillips curve to verify whether, in the context of this curve, we could identify the effect of a tax change. This would requite the introduction of an output gap (or some other proxy for the real marginal costs) to the equation estimating price level changes, which would otherwise in the currently standard New-Keynesian hybrid form be of the following form:

$$\Delta\log(PC_{it}) = b_1\Delta\log(PC_{it-1}) + b_2\Delta\log(PC^e_{it+j}) + b_3\Delta TAX_t + b_4GAP_{it} + e_{it}, \quad (3)$$

where

[11] WAR refers to the weighted average (tax) rate, which is computed as a ratio between VAR receipts and the so-called VAT base. In a sense, it represents a weighted average of different VAT rates and VAT exceptions.
[12] By calibrating the values we have partly circumvented simultaneity problems that are related to unrestricted estimation of (2). Alternatively, we use IV estimation (Table A4).

j = the time horizon of inflation expectations (forecasts), that is either 1, 1½ or 2
$p_{+j} = \Delta\log(PC^e)$ = inflation forecast
GAP = ouput gap[13]

When estimating this equation, we have used the OECD inflation forecasts for expected inflation. This makes estimation somewhat easier (we do not need to impose the rational expectations' orthogonality conditions), and thus instead of GMM we can use least squares or maximum likelihood. In addition to (3), we also estimate a backward-looking Phillips curve where we have import prices as an additional regressor to incorporate open-economy considerations.

Inflation forecasts can also be used in assessing how much unanticipated inflation is a consequence of unanticipated changes in VAT rates. One cannot obviously say how well VAT rate changes are known in advance in the OECD but, fortunately, we have forecasts that go two years ahead of the forecasting period (e.g. forecasts that are made in autumn 2002 for the year 2004).
Forecast errors for different time horizons give us the following testing equation:

$$\Delta\log(PC_{it}) - \Delta\log(PC^e_{it+j}) = c_1\Delta TAX_{it} + c_2 GAP_{it} + v_{it} \qquad (4)$$

where again the time horizon of forecasts is ½, 1 and 2 years.

The parameters of interest in the estimation of (2), (3) and (4) are a2, b_3 and c_1. Although we might not expect that they are exactly the same, we might nevertheless expect that they are of the same magnitude and at least between 0 and 1.

The analysis now turns to Finnish excise taxes.

Here, the basic problem and thus also the analytical framework is the same. However, the frequency of the data is quite different (monthly) and the commodities are genuinely different (commodity brand, weight and selling outlet). Moreover, the number of observations is very large, going up to thousands per commodity. The problem is that we are completely unable to construct a proper price margin, let alone price change expectations. However, because we have monthly data we may safely assume that producer prices (costs) do not change at the same time as taxes. Later on we see that this might not be exactly true, but otherwise we may proceed with this assumption and thus estimate the following very simple price equation (which is comparable to (2')):

$$\log(PC_{ikt}) = a_{0k} + a_{1k}\log(tax_{kt}) + u_{ikt} \qquad (5)$$

[13] Output gaps are here constructed by means of the Hodrick-Presoctt filter with the usual weight parameter 100.

Notice that now index i indicates a single commodity (commodity brand or selling outlet; i.e. in the case of unleaded 95-octane petrol the cross-section of observations corresponds to different petrol stations; with beer we have both different shops and different brands/marks and bottle sizes) while k denotes the commodity group. In some cases (electricity, petrol) we also include a proxy for the producer prices to control for possible simultaneous cost changes.

Although we have estimated equations (1) – (4) for single countries, here all reported analyses make use of cross-country panel data. For practical reasons, we restrict the coefficients of the explanatory variables to be the same so that we have a representative number for the tax shift parameter.

3. VAT RATE CHANGES IN EU COUNTRIES

The analyses have been carried out with annual panel data from 15 EU countries for the period 1970-2004. In practice, the data include 393 data points when we use the main VAT rate as the tax variable[14]. We do also introduce the two reduced rates as explanatory variables but only the ordinary reduced rate (typically for food) turns out to have explanatory power. When instead we use the WAR data the number of data points goes down to 176 (see Figure 4 for the tax data). Annual data are obviously not ideal for our purposes because in principle the tax rate change can in principle take place at any time of year and the time path of prices can differ quite a lot between countries and years. It seems, however, that almost all tax changes have taken place at the beginning of the year, which makes the results somewhat comparable across countries.

The results are summarised in Table 1, while detailed results are reported in the Appendix (Tables A1-A4).

In assessing and interpreting the results we have several problems. First we need to consider whether the partial adjustment type of model is appropriate to capture the long-term effects of tax changes. The nature of the data (i.e. annual frequency) already makes the distinction between short- and long-run effects quite subtle. In the case the Phillips curve and forecast errors model, we cannot in a similar way measure the long-run effects. Only if we consider the forecasts to be exogenous (with respect to tax changes) we can technically compute the long-run values in the same way as in the case of equation (2). Whether that can be done depends crucially on the economic rationalization of the lagged term.

Interpretation of the Philips curve is rather complicated because in "free" estimation the sum of lag and lead inflation terms exceeds unity. However, the problem does not appear to be particularly severe and similar problems have been encountered in almost all empirical applications of Phillips curves.[15]

One might argue that the Phillips curve is not best way to identify tax effects, because if tax changes are known in advance they obviously show in expected inflation. Only if we use a sufficiently long time horizon for expected (forecasted) inflation could we perhaps circumvent this problem. Results with an unanticipated inflation model seem indeed to corroborate this projection. Thus, the longer is the time horizon in making inflation forecasts, the higher is the tax rate coefficient. In the case of a two-year horizon, the

[14] The EU allows for two reduced rates: a reduced rate and a special reduced rate. The rates should in principle exceed 5 per cent but some countries have received permission to apply even lower (zero) rate.
[15] Compare e.g. to the results of Paloviita & Viren (2005) and Tillman (2005).

coefficient is of the magnitude of 0.75, which makes sense according to other empirical analyses and also informal evidence from the Nordic countries.

The empirical results can perhaps be summarized by saying that in general the coefficients of the tax variable fall within the range of 0.4 to 0.8. The coefficients are practically always positive and equally regularly below 1. Moreover, one may safely reject the hypothesis that the coefficient is just zero. Thus, taxes shift to prices: if not completely, more than half of the effect shows in prices.

Here, it should be kept in mind that the results are not directly applicable to any specific tax rate change in any specific country. Changes in the main VAT rates apply to all kinds of goods with a wide variety of demand and supply elasticities. Thus, for instance, they include services where demand elasticities might well be larger than supply elasticities. This, in turn, would show in lower values of the tax-shifting parameter.

Table 1 **Summary of results from EU data**

Specification; estimator	data	tax rate co-efficient
Price margin equation (2)		**a_2**
Level form; short run; GLS	PPI	.200 (1.38)
Level form: long run; GLS	PPI	.753
Level form; short run; GLS	VAT1&2 ,PPI	.163*
Level form; long run, GLS	VAT1&2 ,PPI	.898*
Level form; short run; GLS	WPI	.099 (0.92)
Level form; long run; GLS	WPI	.414
Level form; short run; GLS	VAT1&2, WPI	.118*
Level form; long run; GLS	VAT1&2, WPI	.494*
Difference form ; GLS	PPI	.942 (3.69)
Difference form ; GLS, FE	PPI	.428 (1.88)
Difference form ; GLS	WPI	1.017 (4.85)
Difference form ; GLS, FE	WPI	.579 (3.28)
Level form, no lags	PPI	.442 (2.18)
Level form; no lags, IV$)	PPI	8.17 (48.72)
Level form, lags, long-run, IV$)	PPI	.875
Arellano-Bond GMM, long run	PPI	.717
Phillips curve equation (3)		**b_3**
S3; OLS		.443 (2.77)
S3, GLS		.360 (3.66)
S3, SUR		.449 (18.53)
S3; OLS		.537 (2.86)
S3, GLS		.401 (3.43)
S3, SUR		.409 (4.90)
K2, OLS		.182 (2.76)
K2, GLS		.304 (3.84)
K2, SUR		.259 (5.69)
S2, OLS		.189 (2.76)
S2, GLS		.202 (4.64)
S2, SUR		.189 (5.57)
Unanticipated inflation equation (4)		**c_3**
S3, OLS		.746 (2.22)
S3; GLS		.433 (2.14)
S3, SUR		.721 (17.17)
K2; OLS		.413 (2.59)
K2; GLS		.441 (3.37)

K2, SUR		.408 (6.31)
S2; OLS		.083 (0.51)
S2; GLS		.044 (0.38)
S2; SUR		-.001 (0.01)
S3; OLS	WAR	.629 (1.20)
S3, GLS	WAR	.442 (1.93)
K2, OLS	WAR	.373 (1.09)
K2, GLS	WAR	.389 (2.02)
S2, OLS	WAR	.628 (1.23)
S2, GLS	WAR	.442 (1.93)

See the appendix for details. The levels from equations include a time trend, while the first difference models include only constant terms (fixed effects) or nothing. Numbers inside parentheses are White-corrected t-ratios. S3 refers OECD forecasts that are made in the autumn for the year t+2. In the same way, K2 refers to OECD forecasts that are made during the spring for period next year. With Phillips curves we have not computed any long-run effects, although with the "hybrid" specification we might consider doing that. * denotes the sum of VAT rate coefficients. $) the Dependent variable is log(PC), no the price margin. The main VAT rate (VAT1) used as the tax rate if not otherwise indicated.

Between-country differences should also be considered. For small open economies, it is quite clear that the supply of goods is almost perfectly (price)elastic, while in large countries this assumption is not equally warranted. Thus, the tax incidence parameters would also differ accordingly, being probably larger in small countries.[16] But again we have a caveat: retail trade appears more concentrated in small countries, which might also imply a lower level of competition (DG Competition (1999)). It is not, however, clear whether concentration indexes (measured as market shares of companies) are equivalent to indices of competition. This doubt arises when scrutinizing the development of concentration indices: they tend to generally steadily increase in the EU15, but this does not seem to show in price margins or in other indicators of competition.

[16] A relatively well-documented case is that of oil prices. The supply of oil is essentially perfectly elastic with respect to small countries or market areas, while for the world supply elasticity is much lower. Thus, it makes a considerable difference whether individual countries or all countries impose taxes on oil consumption. See Chouinard and Perloff (2006) for US evidence.

4. FINNISH EXCISE TAXES

This analysis deals with the following commodity groups: alcohol, cars (new and used), petrol (95 and 98 octane) diesel, beer, long drink, cider and electricity.[17] The empirical results are presented in Table 2. Moreover, the tax changes are illustrated in Figure 7. The prices changes of old and new cars are illustrated in Figure 8. Finally, the development of Finnish pre-tax car prices (in relation to German prices) is illustrated in Figure 9.

On the basis of the figures and estimation results one may readily conclude that (a) the magnitude by which taxes shift to prices varies considerably between products/branches and (b) the short-run tax parameter falls short of one, being roughly of the magnitude of two thirds.

These results are not, of course, in any way surprising given the differences in market structure and competition between branches. Moreover, we have to keep in mind that with items such as electricity, long-term contracts hide the price effects for several months. By contrast, in the case of alcohol, all retails sales take place in the Finnish state monopoly, the Alko Company, which in practice means that taxes shift almost exactly to prices.[18]

The change in car taxation in 2003 represents an interesting episode in the incidence of consumption taxes. It appears that car taxes have only marginally shifted to prices. This is especially true with used cars (see Figure 5). Closer scrutiny of car prices reveals some interesting insights into car pricing. In the past, when Finnish car taxes were extremely high (more than 100 per cent of the pre-tax price), car producers and import firms tried to keep the import prices as low as possible. Thus, the pre-tax car prices were among the lowest in Europe and much lower than, for instance, in Germany. Along with the lowering of car taxation, import prices started to increase. In other words, earlier car producers, importers and sellers paid part of the tax but lower taxes also allowed them to obtain a better price. Scrutinizing the profitability of cars to importers/sellers suggests that, after all, profits slightly

[17] Here we have omitted tobacco which is a bit complicated because of different tax rates for different tax products. Moreover, pricing is highly regulated which produces almost an almost trivial result (Figure 11). Thus, in monthly data, only the tax changes show up.

[18] The state monopoly applies only to retail sales to consumers; pricing of hotel/restaurant alcohol is not considered in this study.

Table 2 Results with Finnish CPI data

	TAX	Brent/TH	R2/SEE	N	pre-tax rate	Ad valorem
alcohol	1.022		1.000	12	200	.999
	(1290)		0.000			
cars (new)	.700		0.990	720	7500	.873
	(20.11)		0.040			
cars (used)	.183		0.856	12	7500	.224
	(8.03)		0.003			
petrol 95E	.662		0.460	1224	34	.402
	(10.23)		0.036			
petrol 95E	.313	.161	0.538	1224	34	.190
	(4.82)	(13.77)	0.033			
petrol 98E	.738		0.562	1224	36	.459
	(12.76)		0.035			
petrol 98E	.344	.154	0.540	1224	36	.253
	(5.17)	(13.20)	0.033			
diesel	2.422		0.360	1200	32	1.988
	(17.41)		0.060			
diesel	.420	.499	0.680	1200	32	.345
	(3.64)	(33.16)	0.042			
beer	.829		0.991	467	45	.748
	(48.12)		0.023			
long drink	.685		0.696	874	90	.824
	(21.24)		0.048			
cider	.691		0.856	1063	83	.661
	(42.16)		0.029			
electricity	1.799		0.940	12	5850	2.154
	(12.56)		0.0002			
electricity	.894	.615	0.915	12	5850	1.074
	(4.18)	(7.36)	0.003			

The pre-tax price is expressed in cents, with cars in euros. Koskenkorva spirits is used as the benchmark product for alcohol. The average price of imported cars is slightly above 9000 euros. “Brent” refers to the Brent oil price and TH to the producer price, which has been used in constructing the price margin. N denotes the number of data points and numbers inside parentheses the White-corrected t-ratios. The tax rate is expressed in the log(1+(tax/pre-tax price)) form. The corresponding ad valorem tax rate effects are presented in the last column of the table. Computing the tax rates has been

somewhat cumbersome because no time series of the tax rates are available and taxes are in legislation expressed in either Finnish marks or in Euros/cents. See Martikainen and Viren (2006) for more details of the computation of these tax rates.

Increased in 2003 despite marked decreases in retail prices.[19] The government also benefited from the tax cut, as receipts from car taxes increased by 18 per cent in 2003 (for more details, see Martikainen and Viren (2006)).

The Finnish car tax reform clearly illustrates the errors that are induced when using tax receipts (in relation to some scale variable such as the GDP) as an indicator of the severity of taxation. If taxes are simply too high, preventing sales, one may misleadingly interpret this as an indication of the lightness of taxation, even if the opposite is true.

Considering all taxes, we may we conclude that, in accordance with the results for consumption prices in the EU, excise taxes shift to prices in a way that justifies using the range from 60% to 100% as the confidence interval and 80% as a representative estimate (see Figure 10 for a justification of the estimate).

[19] If taxes are set on import prices, producers can have a strong incentive to set up a sister company to import cars. The sister company can then have higher profit margins, which are nevertheless taxed at a lower rate then imported cars. This pricing strategy explains at least part of the change in pre-tax car price differentials over time.

5. CONCLUDING REMARKS

Consumption taxes shift to prices. This finding is corroborated by all analyses that we have made[20]. Although our analyses all pointed in the same direction and indicated that tax shifting is of the same magnitude as in most previous analyses, we must acknowledge several caveats that complicate more affirmative conclusions.

First of all, in the European data we cannot control such important elements as excise taxes, various tax deductions and reliefs. Neither do we have data for market structures or competitiveness (such as Herfindahl indices). The frequency of the data also prevents proper analysis of immediate, medium-term and long-term effects. Nevertheless, we can argue that evidence from tax incidence is sufficiently compelling to nullify arguments that taxes do not show up in consumer prices or that the tax shifting effect is negligible. In considering estimates of the tax rate coefficient from the point of view of Finnish food prices, one has to keep in mind that Finland is a small open country and in this respect deviates somewhat from, say, Germany and France. The level of competition is otherwise difficult to compare, but casual evidence does not seem to suggest that the Finnish markets work less perfectly then elsewhere in Europe.

Whether this is enough to justify changes in certain specific (here food) tax rates is unclear, because the decision ultimately depends on estimates of the welfare and income distribution effects. To some extent these effects have been evaluated, but even then some balancing ~~i~~of pros and cons is still needed.

[20] An unweighted average of all (long-run) estimates tabulated in this paper is 0.64. The corresponding median is 0.60.

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APPENDIX

Table A1 **Estimation results from the price margin equation (2)**

Equation	TAX1	TAX2	Time tre-nd	Lagged dependent variable	R^2/SEE	DW
Level, PP, FE	.442		.013		0.996	0.42
	(2.18)		(26.91)		0.050	
Level, PP, FE	.200		.003	.735	0.999	1.33
	(1.38)		(5.42)	(20.82)	0.028	
Level, PP, FE	.163	.075	.003	.735	0.999	1.34
	(1.10)	(1.44)	(5.32)	(20.62)	0.028	
Level, WP, FE	.099		.003	.761	0.996	1.38
	(0.92)		(5.29)	(20.92)	0.025	
Level, WP, FE	.074	.044	.003	.761	0.971	1.39
	(0.67)	(0.76)	(5.14)	(20.84)	0.025	
Dif, FE	.753				0.132	0.31
	(2.79)				0.041	
Dif, FE	.110			.871	0.816	1.66
	(1.02)			(35.49)	0.020	
Dif, PP	.942				..	1.22
	(3.69)				0.032	
Dif, PP, FE	.428				0.056	1.46
	(1.88)				0.030	
Dif, WP	1.017				..	1.19
	(4.84)				0.029	
Dif, WP, FE	.579				0.049	1.50
	(3.26)				0.026	

The price (m) marginal is derived as: $m = \log(P_C) - 0.67*\log(P_B) - 0.33 \log(P_M)$. TAX = log(1+tax). Level refers to the level from the equation and Dif to the first difference specification. In equations 4 and 5 (see the corresponding lines), log differences of the consumer prices (not price margins) are first used. All estimates are cross-section GLS estimates. TAX1 denotes the main VAR rate and TAX2 the reduced rate.

Table A2 **Estimation of the Phillips curve (3)**

Equation, time horizon	p_{+i}^e	p_{-1}	ΔTAX	GAP	p_m	R^2/SEE	DW
OLS, S3	.545	.531	.443	.098		0.911	2.35
	(5.36)	(8.11)	(2.77)	(2.88)		0.899	
GLS, S3	.534	.521	.360	.092		0.909	2.13
	(12.17)	(16.12)	(3.66)	(4.63)		0.933	
SUR, S3	.551	.522	.449	.097		0.911	1.96
	(36.21)	(66.40)	(18.93)	(11.78)		0.942	
OLS, S3	.339	.661	.537	.125		0.915	2.03
		(15.09)	(2.86)	(3.91)		0.906	
GLS, S3	.412	.588	.401	.120		0.909	2.07
		(19.02)	(3.43)	(6.20)		0.886	
SUR, S3	.423	.577	.409	.133		0.967	2.03
		(16.74)	(4.90)	(8.15)		1.425	
OLS, K2	.596	.431	.252	.103		0.912	2.21
	(7.48)	(6.79)	(1.55)	(3.43)		0.953	
GLS, K2	.613	.411	.304	.102		0.911	0.95
	(13.04)	(11.69)	(3.84)	(4.55)		0.950	
SUR, K2	.582	.435	.258	.117		0.911	2.17
	(19.32)	(19.80)	(5.69)	(8.23)		0.959	
OLS, S2	.760	.312	.198	.050		0.932	2.17
	(16.35)	(8.13)	(2.76)	(1.56)		1.175	
GLS, S2	.730	.326	.202	0.33		0.931	2.14
	(18.67)	(10.85)	(4.64)	(1.38)		1.167	
SUR, S2	.715	.342	.189	.056		0.932	2.15
	(25.17)	(16.20)	(5.57)	(3.16)		0.943	
OLS		.775	.169	.242	.200	0.895	2.09
		(38.70)	(1.44)	(7.39)	(12.53)	1.471	
GLS		.791	.086	.223	.165	0.892	2.13
		(54.04)	(1.50)	(9.32	(12.89)	0.943	
SUR		.799	.085	.269	.178	0.894	2.03
		(62.94)	(1.11)	(9.44)	(12.92)	1.456	

OLS denotes the least squares estimator, GLS the cross-section generalized least squares estimator and SUR the comparable, seemingly unrelated regression estimator. $\Delta TAX = \Delta\log(1+tax)$, $p_{+i} = \Delta\log(PC^e_{t+i})$, $p_{-1} = \Delta\log(PC_{t-i})$ and $pm = \Delta\log(PM_t)$.

Table A3 **Estimation results from the forecast error model (4)**

Estimator, time horizon	ΔTAX	GAP	R^2/SEE	DW
OLS, S3	.746	.239	0.157	1.32
	(2.22)	(4.59)	1.321	
GLS, S3	.433	.224	0.146	1.41
	(2.14)	(7.72)	1.304	
SUR, S3	.721	.215	0.156	1.92
	(17.17)	(12.89)	0.936	
OLS, K2	.413	.153	0.086	1.57
	(2.56)	(3.94)	1.264	
GLS. K2	.441	.143	0.086	1.77
	(3.37)	(4.84)	1.263	
SUR K2	.408	.122	0.083	1.80
	(6.31)	(7.30)	0.955	
OLS, S2	.082	.209	0.039	1.51
	(0.51)	(4.52)	1.768	
GLS, S2	044	.169	0.036	1.55
	(0.38)	(5.13)	1.554	
SUR, S2	-.001	.150	0.031	1.87
	(0.01)	(6.38)	0.952	
OLS, S3, WAR	.628	.234	0.157	1.59
	(1.23)	(6.05)	1.175	
GLS, S3, WAR	.442	.205	0.152	1.39
	(1.93)	(8.17)	1.168	
OLS, K2, WAR	.373	.164	0.171	1.52
	(1.09)	(5.54)	0.816	
GLS, K2, WAR	.389	.151	0.170	1.65
	(2.02)	(6.52)	0.815	
PNS, S2, WAR	.317	.087	0.069	1.56
	(1.23)	(3.28)	0.761	
GLS, S2, WAR	.259	.065	0.065	1.69
	(1.47)	(2.93)	0.758	

ΔTAX = Δlog(1+tax) where both the main VAT rate (VAT1) and the weighted average rate (WAR) are used .

Table A4 **IV and GMM estimates**

IV estimates of the level form equation

$\log(PC) = 1.014\log(PP) + .817\log(1+tax)$
(48.9211) (4.12)
$R^2 = 0.991$, SEE = 0.032, DW = 0.46

$\log(PC) = .082\log(PP) + .819\log(PC_{-1}) + .125\log(1+tax)$
(2.92) (34.28) (1.66)
$R^2 = 0.998$, SEE = 0.014, DW = 0.75

The set of instruments include gap, log(pp-1) and $\log(wpi_{US})$

Arellano-Bond GMM estimates for the price margin equation

$\log(m) = .601\log(m_{-1}) + .286\log(1+tax) + .005t$
(98.98) (10.32) (35.01)
$R^2 = .885$, SEE = 0.028, J(11) = 9.30

The set of instruments include, in addition to lagged variables, m_{-2}, gap, $\log(pm_{US})$ and $\log(wp_{-})$. Time series have been transformed by using orthogonal deviations.

Figure 1 Response of Swedish consumption prices to a tax cut in 1995/1996

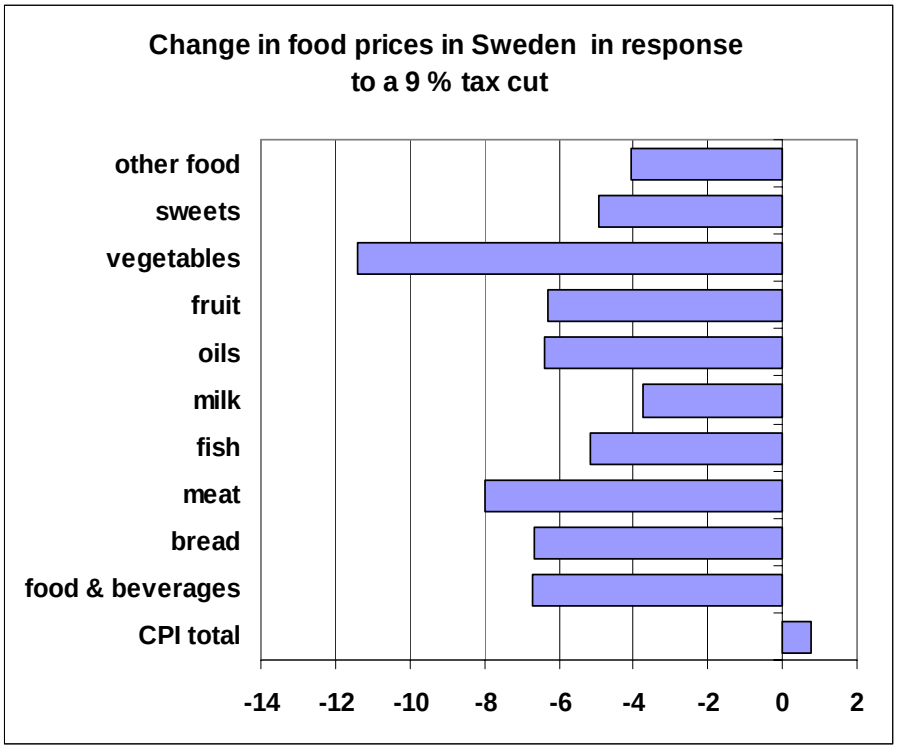


Figure 2 Response of Norwegian consumption prices to a tax cut in 2001

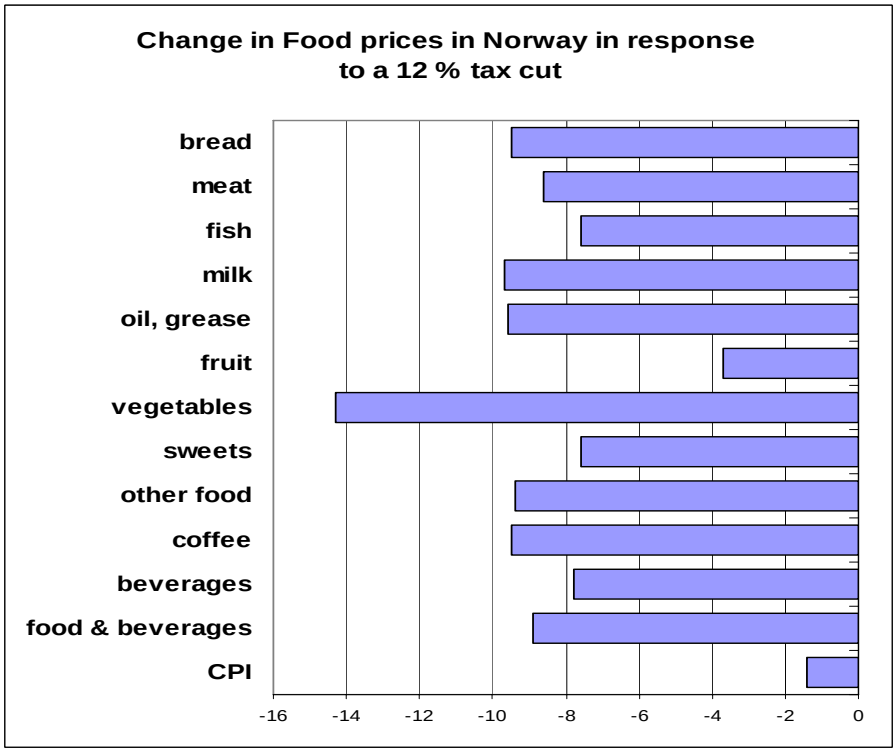


Figure 3 Response of Icelandic consumption prices to a tax cut in 2007

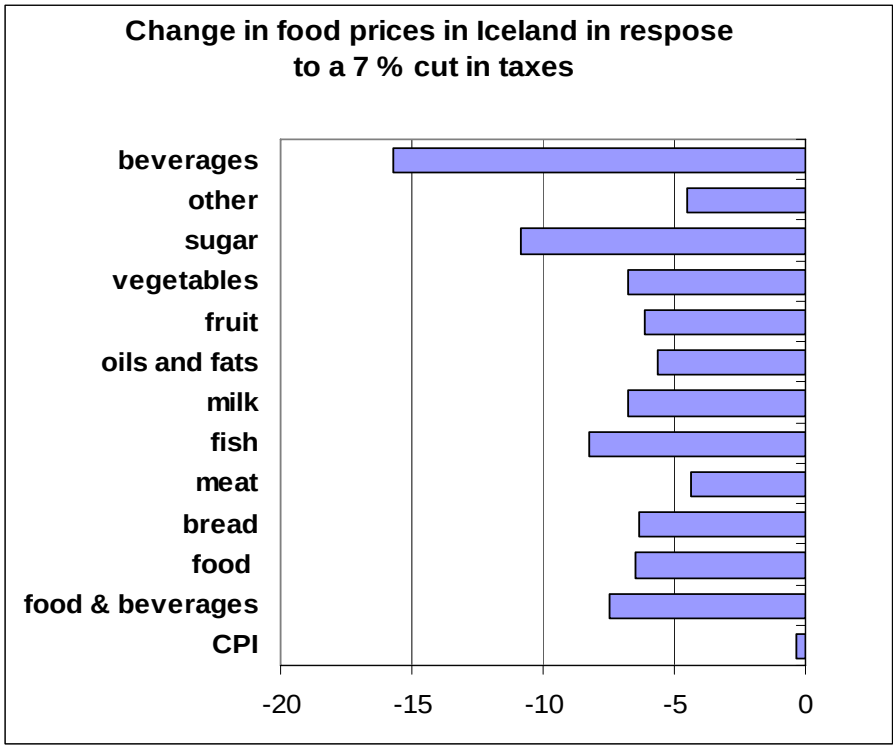


Figure 4 **Median of VAT rates in the EU15**

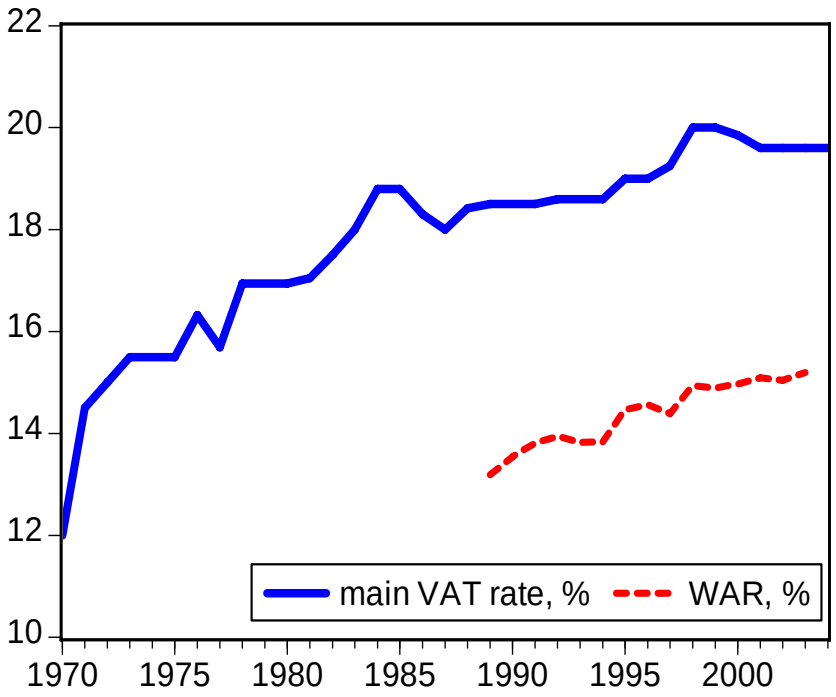


Figure 5: Price margins in terms of producer and import prices

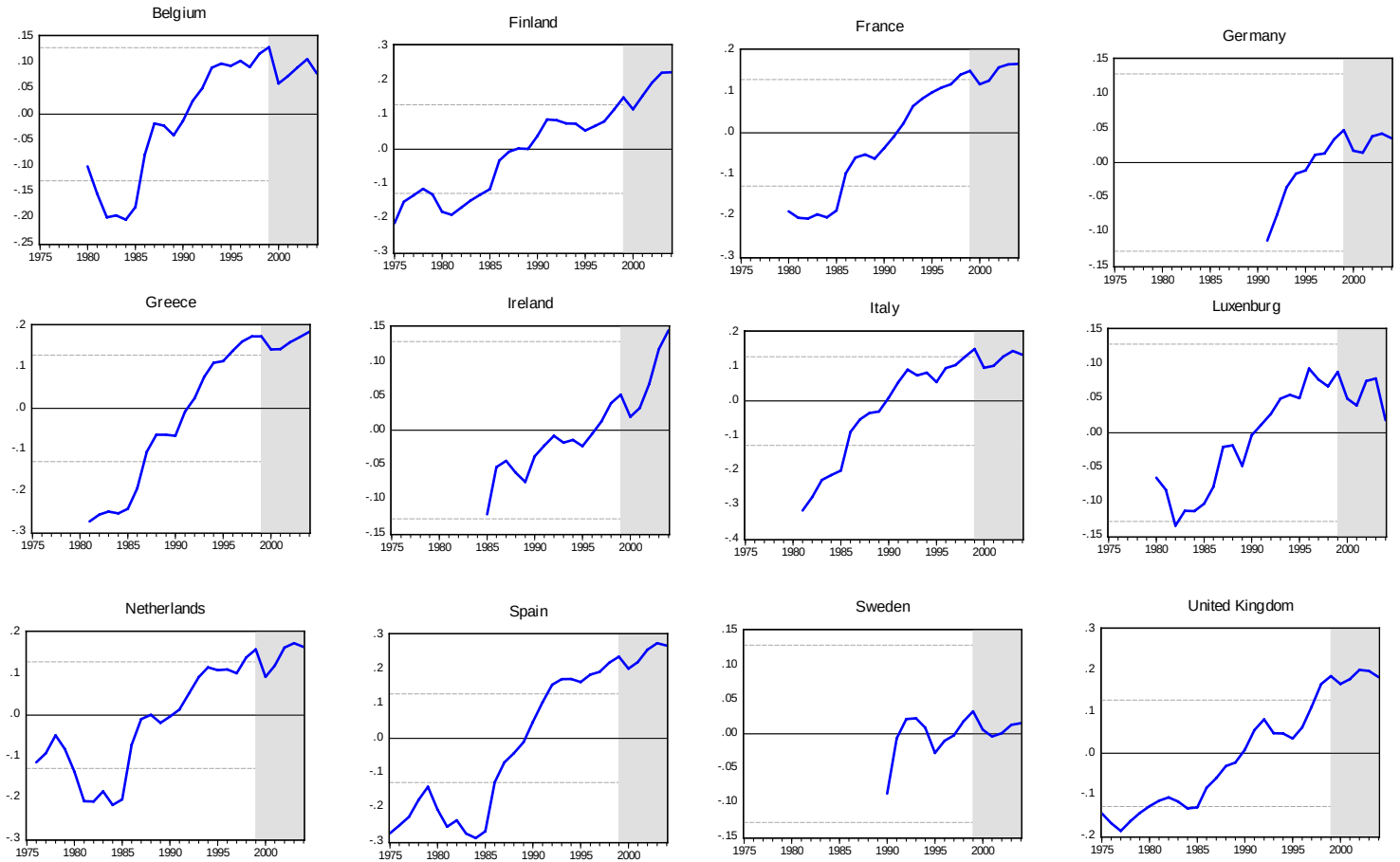


Figure 6: Price margins in terms of wholesale and import prices

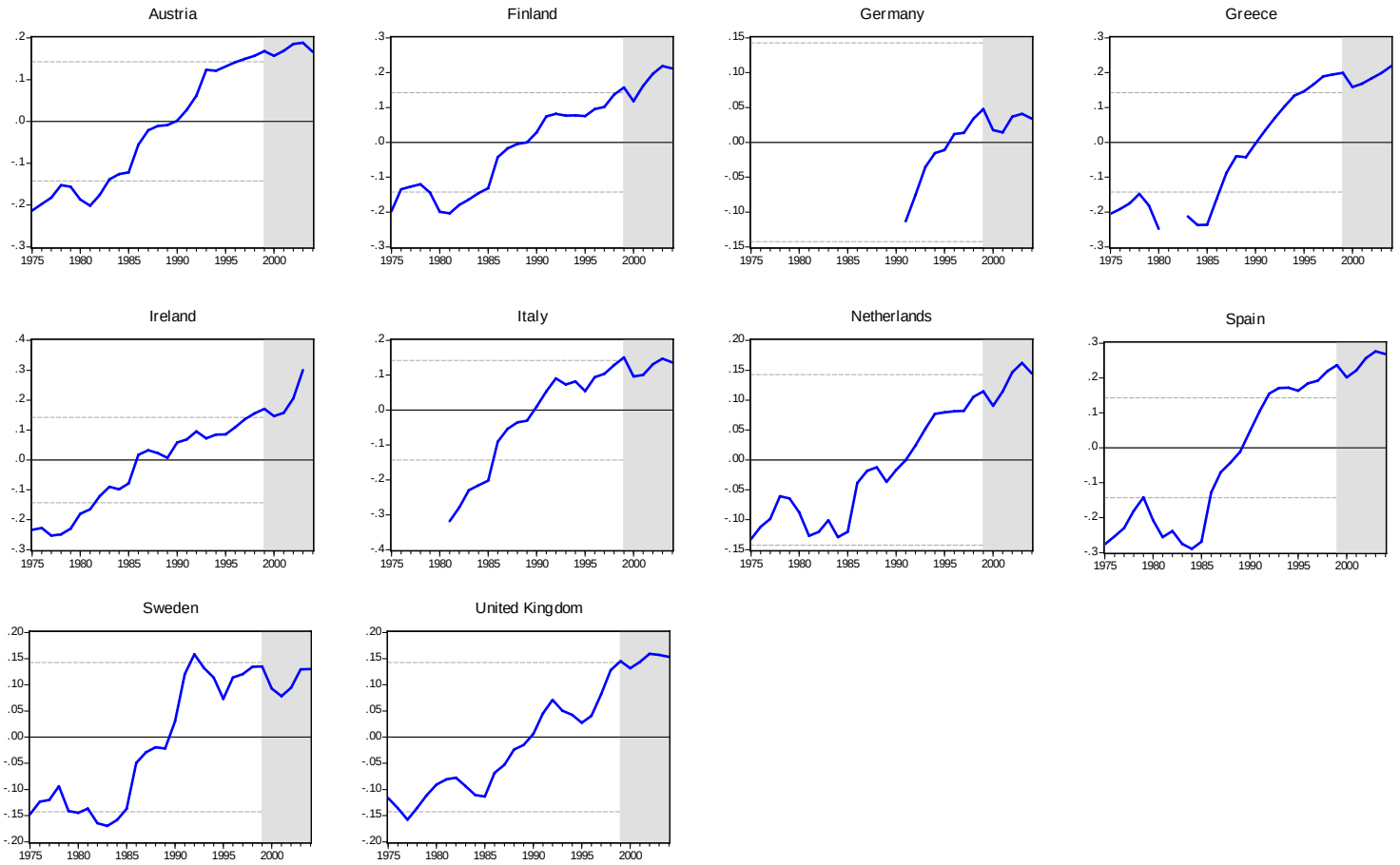
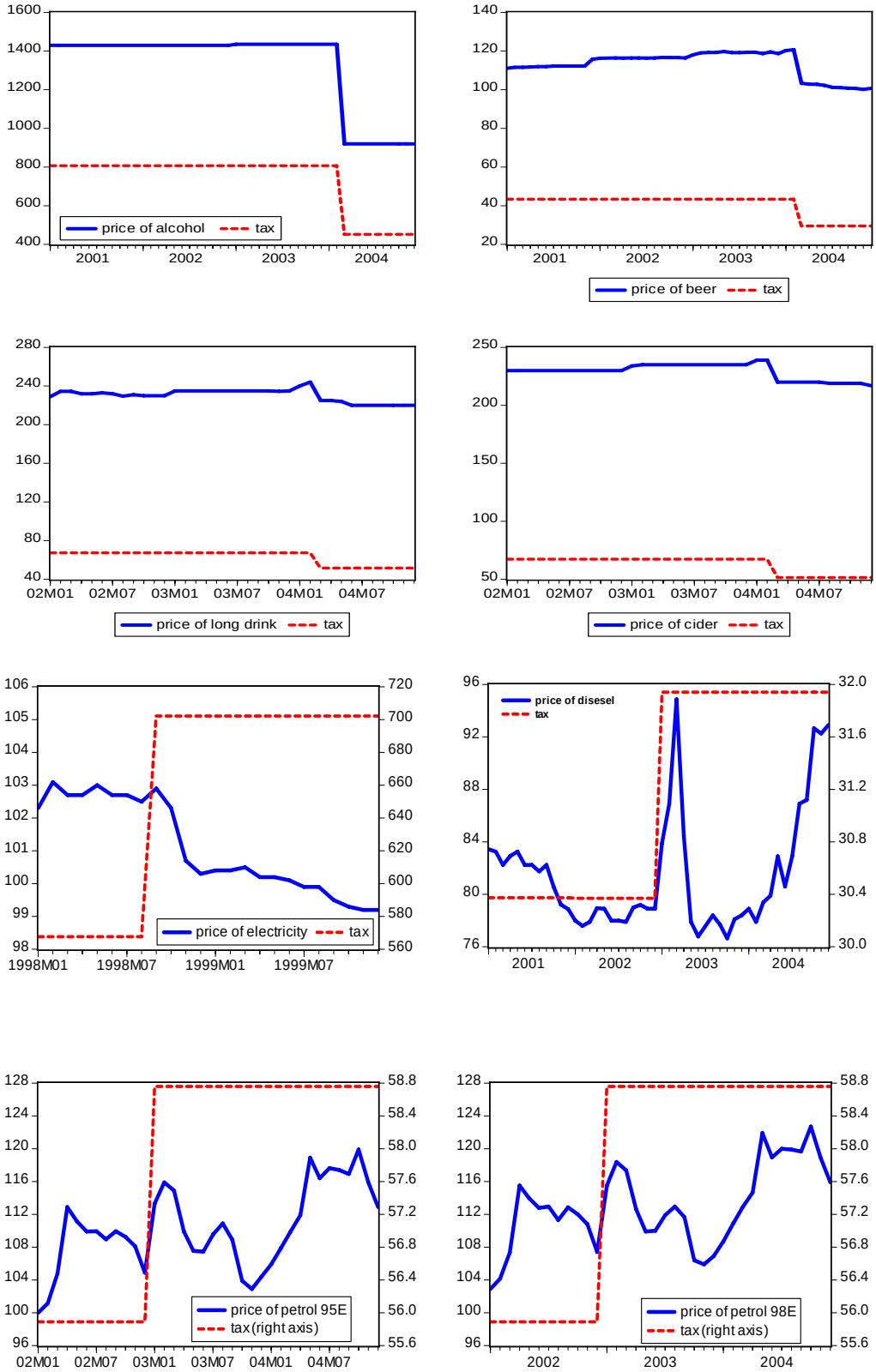


Figure 7 Effect of excise taxes on consumer prices



All prices are expressed as cents per unit of measurement.

Figure 8 Car prices and the change in car taxes in 2003

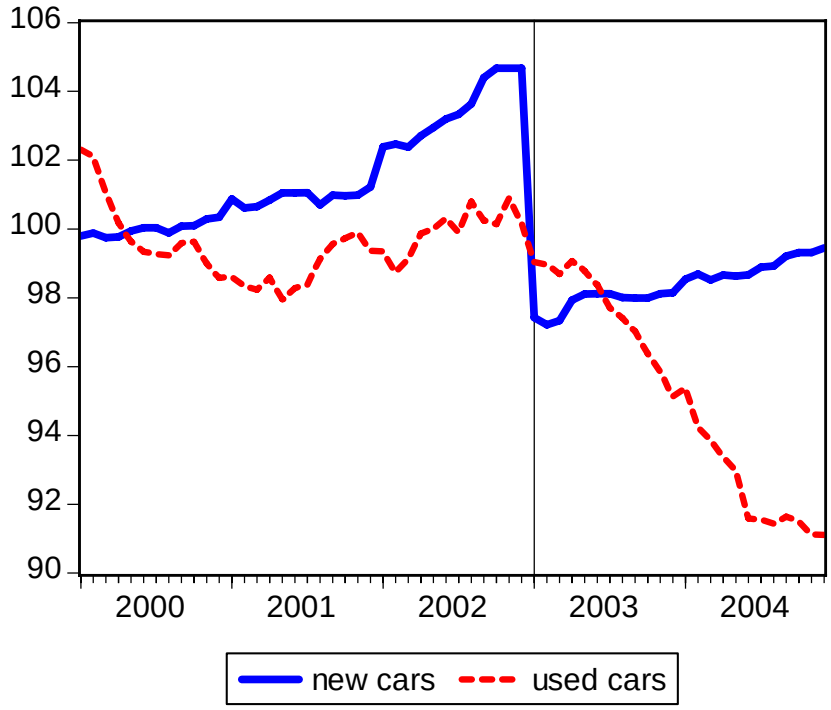


Figure 9 Pre-tax prices of new cars Germany/Finland 1999–2005

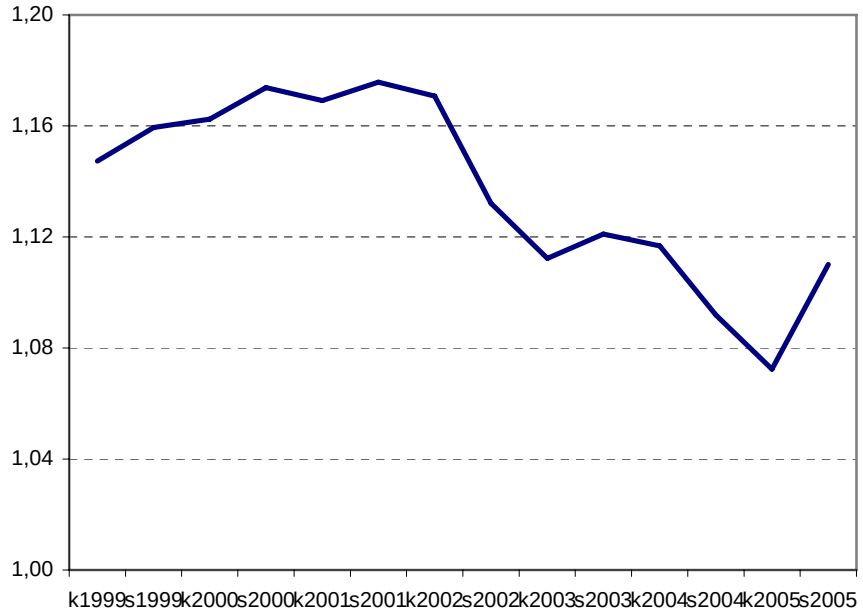
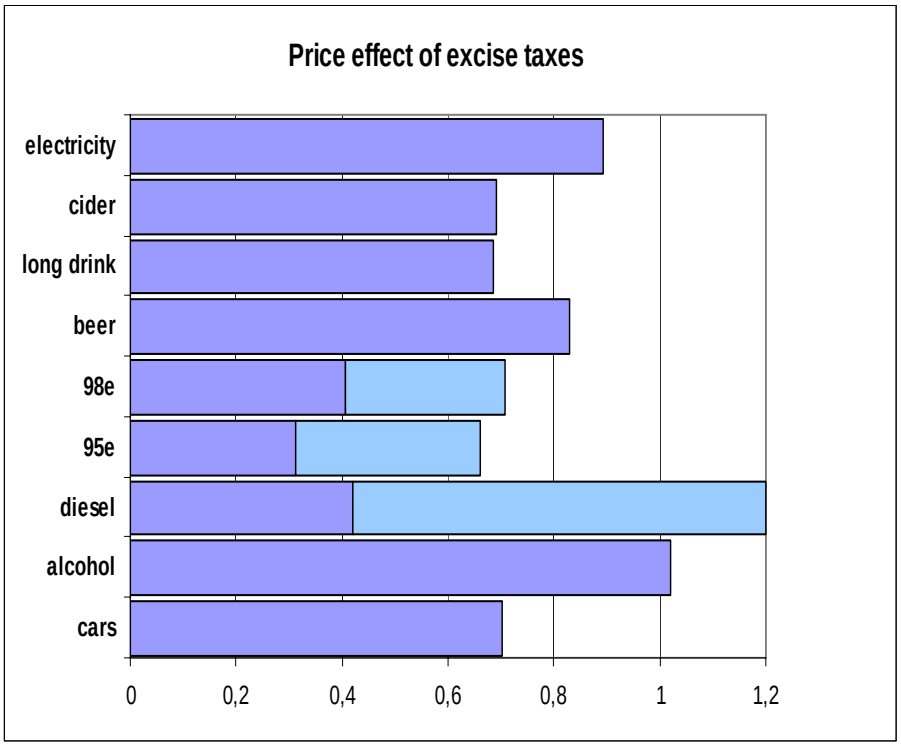
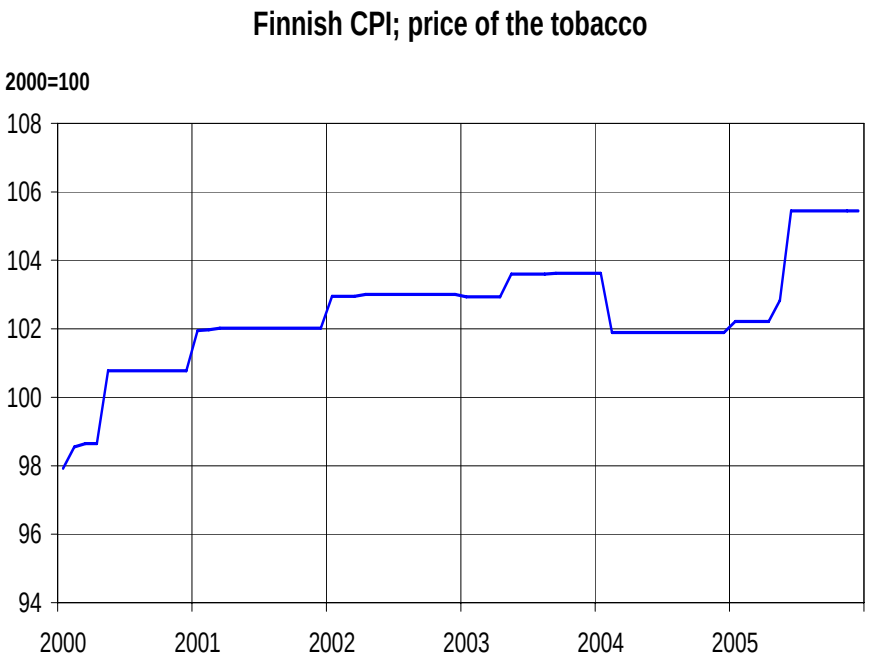


Figure 10 Summary of price effects of excise tax changes



With petrol and diesel prices there is some uncertainty in coefficient values depending on the way in which producer/import prices are taken into account.

Figure 11 Price of Tobacco



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