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Does the Value-Added Tax Shift to Consumption Prices?

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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 consumer prices. By contrast, there is less evidence on shifts to producer prices.

Keywords Value-added tax, tax incidence, consumption taxes
JEL classification H22

1. Introduction

This study deals with the incidence of consumption taxes. More precisely, the intention is to measure to what extent taxes shift to consumer prices. A motivating factor for 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% compared with an average rate of 6%).[1] The implicit consumption tax rate is the third highest in the EU27 (27.3% compared with the average 19.9%, cf. Eurostat 2008). Partly because of this a study group was formed to analyse the consequences of an eventual tax cut which is to take place in 2009.[2] 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. For practical reasons we cannot analyze the whole issue of tax incidence but we have to concentrate on question of how do changes in the VAT rate(s) shift to consumer prices.[3]

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

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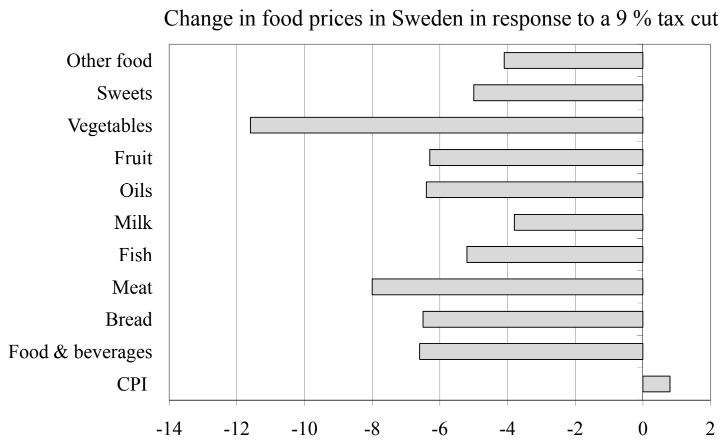
[1] Average 6% corresponds to the population weighted average of VAT rates for food and beverages. The unweighted average is 8%. By comparison, the average US sales tax rate is 7.7%. For a more exhaustive comparison of tax structures, see Eurostat (2008) and Coenen et al. (2008).

[2] A final report of group has already been published by Holm et al. (2007).

[3] See e.g. Coenen et al. (2008) and Bye et al. (2003) for more analyses of tax reform effects.

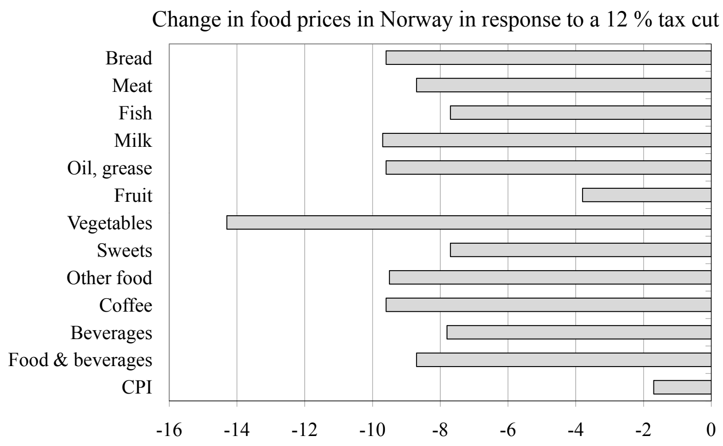
Finnish case, and only the recent tax cuts in Sweden, Norway and Iceland are generally directly applicable to our purposes. Evidence from the Swedish, Norwegian and Icelandic exercises is displayed in Figures 1 to 3.

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



In Sweden, food taxes were lowered in 1996 from 21% to 12% (9%), which ought to have led to a 7.4% fall in consumption prices if taxes had completely shifted to prices. The corresponding immediate change in food prices was -6.6%, which came quite close to this figure.

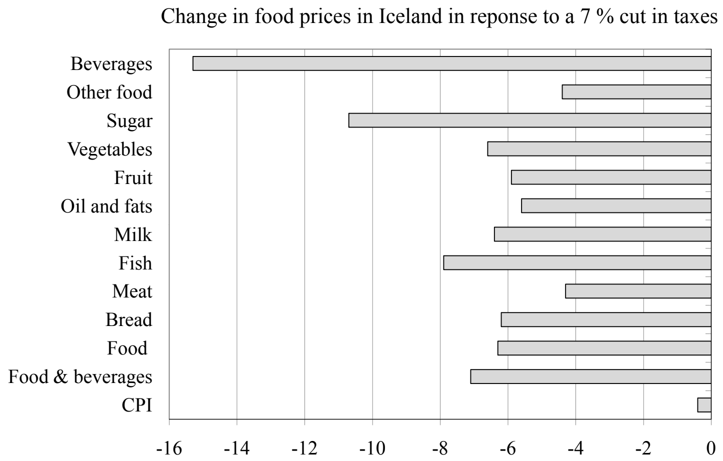
Figure 2. Response of Norwegian consumption prices to a tax cut in 2001



In Norway, the corresponding figures for the 2001 reduction were 24% and 12%, with an implied price level of -9.7%. The comparable one-month change in prices turned out to be 8.9%, which again is practically identical to the implied value.

Recent tax reform in Iceland (2001) included to a lowering of the VAT from 14%

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



(in some cases 24.5%) to 7%, which ought to have lowered the consumption prices of food by (more than) 6.1%. New data from Statistics Iceland reveals that the immediate price effect is as high as -7.4%. 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.

If instead the producer prices are scrutinized (using data from Statistics Sweden, Statistics Norway and Statistics Iceland) one arrives at a striking result: the monthly change rates are either zero or negative. Thus, these data does not support the hypothesis that taxes would have shifted immediately to (wholesale merchandisers' and retailers') costs.

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%). It is often argued (e.g. Peltzman 2000) 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 Carbonnier (2005). Results from the three Nordic countries do not, of course, tell anything about nonlinearity, but they suggest 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 (e.g. Swinton and Thomas 2001; Jha 1998). Under such circumstances one might expect that the short-run price effect of the tax is indeed very large.[4]

[4] 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

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 and Metcalf (2002), Besley and Rosen (1999) and Morin (2005). These analyses mainly deal with specific commodity taxes. This largely reflects the nonexistence of the VAT in the United States from where most studies come. As for the structure of the VAT (and food, in particular), Morin (2005) is highly relevant. On the basis of these summaries it seems fair to conclude that, as a rule, more than 50% of taxes are shifted to consumer prices. Here, the analysis of Besley and Rosen (1999) dealing with the effect of sales tax on prices in the United States should perhaps be particularly emphasized. They 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, and sign of the tax change.

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 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.[5] Moreover, let us assume that the corresponding curves are of the form: $D = (P_C/P)^{-d}$

have favoured it.

[5] 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.
Even though micro data are currently available on consumer prices (e.g. Aucremanne and Dhyne 2004), they do not cover sufficiently long time periods for follow-up studies of VAR changes.

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.[6] Assuming now that $D = S$, we can derive the following equation for the price “mark-up”:

$$\log P_C = \log P - \alpha \log(1-\tau), \tag{1}$$

where the coefficient of the tax rate is simply the ratio of the price elasticities, that is: $\alpha = s/(d+s)$.[7] 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, $\log P_C - \log P$. We have, in fact, several price margins reflecting the fact that before consumption goods reach consumers they are handled by primary producers, the industry and wholesale and retail merchandise companies. Thus, we have the producer prices (PP) which reflect the prices of the industry and raw material prices which reflect the prices of primary producers. The difference between consumer prices and producer prices mainly reflects the costs of merchandise and retail companies and their profits, plus taxes, of course. In principle, changes in consumption taxes could show up in all of these items (including consumer prices) but the effects could even show up in the input prices of industry, including the raw material prices.

Irrespective of the way in which the prices margins are measured, it appears that they not stationary. 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 leveled off although Finland, Ireland and Spain represent notable exceptions to this rule (see Viren 2007 for details).

One explanation for the recent behaviour is the introduction of the Euro and the resulting change in the competitive environment.[8]

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

$$\log PC_{it} = a_0 + a_1 \log PP_{it} + (1-a_1)\log PM_{it} + a_2 TAX_{it} + a_3 t + u_{it}, \tag{2}$$

[6] 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%. 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.)

[7] 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 $\log P_C = \log P + \alpha \log(1+\tau)$. A convenient way of interpreting the result would be an analysis of a monopoly-monopsony firm which has the following profit expression: $(1-\tau)p(q(x))q(x) - w(x)x$ where τ denotes the commodity tax, p denotes the selling price, q denotes the output, x the input and w the input price (input could be e.g. an industrial product which is purchased by a retailer). Then the FOC gives the following condition: $p(1-\tau)(1+1/\varepsilon)q'(x) = w(1+1/\theta)$ where ε is the price elasticity of demand and θ the price elasticity of input supply. Clearly, the tax incidence depends on relative price elasticities ε, θ and the curvature of the production/cost function, $q'(x)$.

[8] 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.

where PC = consumer prices (private consumption deflator), PP = producer prices, or alternatively wholesale prices in the empirical application, PM = import prices, $TAX = \log(1+\tau)$ where τ = the main VAT rate, or alternatively the weighted-average tax rate, WAR, that is used by the EU,[9] t = time trend and u = the residual.

In equation (2), import prices can reasonably safely be considered exogenous (with the "pricing to market" caveat) but with producer prices the assumption is not completely warranted. Producer prices which basically represent the prices that the industry obtains from its product could also adjust if wholesale or retail merchandise companies have enough market power. With producer prices we can make an experiment by estimating a two equation model where also producer prices are allowed to adjust to changes in consumption taxes. The model which is basically an extension of equation (2) will be reported along with other estimation results in Table A4.

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 $2/3$.[10] 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:

$$\Delta \log PC_{it} = a_0 + a_1 \Delta TAX_{it} + u_{it}$$

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, and whether the effect comes close to that from equation (2). Thus, the subsequent analysis with the Phillips curve (and with unexpected inflation) can be seen as some sort of robustness checks. Estimating a Phillips curve requires 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:

$$\Delta \log PC_{it} = b_1 \Delta \log PC_{it-1}) + b_2 \Delta \log PC^e_{it+j} + b_3 \Delta TAX_t + b_4 GAP_{it} + e_{it}, \qquad (3)$$

where j = the time horizon of inflation expectations (forecasts), that is either 1, 1.5 or 2, $\Delta \log PC^e$ = inflation forecast and GAP = output gap.[11]

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

[9] 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.
[10] By calibrating the values we have partly circumvented simultaneity problems that are related to unrestricted estimation of (2). Estimation results were not overly sensitive for this calibration. Alternatively, we use IV estimation (Table A4).
[11] Output gaps are constructed by means of the Hodrick-Prescott filter with the usual weight parameter 100.

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:

$$\Delta \log PC_{it} - \Delta \log PC^{e}_{it+j} = c_1 \Delta TAX_{it} + c_2 GAP_{it} + v_{it}, \tag{4}$$

where again the time horizon of forecasts is 0.5, 1 and 2 years.

The parameters of interest in the estimation of (2), (3) and (4) are a_2, 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. As pointed out earlier, this analysis is carried out using the micro level Consumer Price Index (CPI) data. Here, the basic problem and thus also the analytical framework is the same as with aggregate consumer prices. However, the frequency of the data is quite different (monthly) and the commodities are genuinely different (commodity brand, weight and selling outlet). The estimation period is (with a few minor exceptions) 2001M1-2004M12. 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:

$$\log PC_{ikt} = a_{0k} + a_{1k} \log TAX_{kt} + u_{ikt} \tag{5}$$

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.

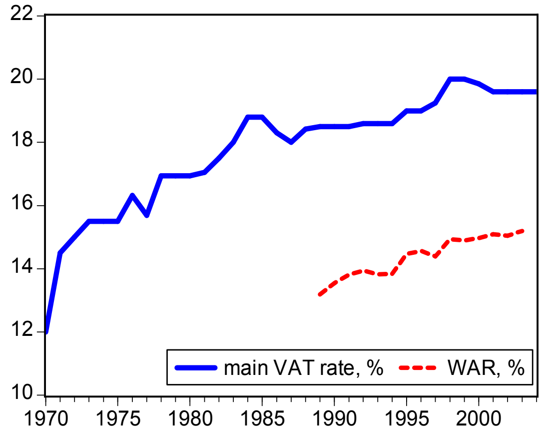
The estimation period is so short that we may assume that other potential control variables constant. For the same reason, no seasonals are included. In most cases, the data include only one change in taxes which obviously diminishes the value of information. In is not uncustomary that the number of events is this small. Take for instance the case of changes in legislation (cf. e.g. MacKinlay 1997). Even so, we have to consider the results as a whole rather than to focus on each individual coefficient estimate.

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.[12] 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.

Figure 4. Median of VAT rates in the EU15



The results are summarised in Table 1, while detailed results are reported in the Appendix (Tables A1–A4). In Table 1, we report only the coefficient estimates of the tax variable and with specifications (3) and (4), we just report the results with the longest time horizon for inflation expectations (to minimize the possibility that advance announcement of tax changes would show up in inflation forecasts). Anyway, a full set of results is reported in the appendixes.

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

[12] The EU allows for two reduced rates: a reduced rate and a special reduced rate. The rates should in principle exceed 5% but some countries have received permission to apply even lower (zero) rate.

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.[13]

Table 1. Summary of results from EU data

Specification	Estimator	Tax rate	Tax rate coefficient
Price margin equation (2)			$\hat{a}_2$
Level form; short run	GLS, FE	VAT1	0.200
Level form: long run	GLS, FE	VAT1	0.753
Level form; short run	GLS, FE	VAT1&2	0.163*
Level form; long run	GLS, FE	VAT1&2	0.898*
Level form; short run	GLS, FE	VAT1	0.099
Level form; long run	GLS, FE	VAT1	0.414
Level form; short run	GLS, FE	VAT1&2	0.118*
Level form; long run	GLS, FE	VAT1&2	0.494*
Difference form	GLS	VAT1	0.942
Difference form	GLS, FE	VAT1	0.428
Difference form	GLS	VAT1	1.017
Difference form	GLS, FE	VAT1	0.579
Level form, no lags	0LS	VAT1	0.442
Level form; no lags	IV	VAT1	0.817
Level form, lags, long-run	IV	VAT1	0.875
Arellano-Bond GMM, long run	GMM	VAT1	0.717
Phillips curve equation (3)			$\hat{b}_3$
unrestricted estimates	OLS	VAT1	0.443
unrestricted estimates	GLS	VAT1	0.360
unrestricted estimates	SUR	VAT1	0.449
$b_1 + b_2 = 1$	OLS	VAT1	0.537
$b_1 + b_2 = 1$	GLS	VAT1	0.401
$b_1 + b_2 = 1$	SUR	VAT1	0.409
Unanticipated inflation equation (4)			$\hat{c}_3$
	OLS	VAT1	0.746
	GLS	VAT1	0.433
	SUR	VAT1	0.721

Notes: See the Appendix for details. All level from equations include a time trend, while the first difference models include only a constant term (fixed effects, FE) or nothing. With inflation expectations, the forecast horizon for $\Delta \log PC^e_{it+j}$ is in all cases S3 which means that the forecasts are made in December (year t) for the year $t+2$.
* denotes the sum of the coefficients of the main VAT rate and the reduced rate. In the IV estimation, the dependent variable is $\log PC$, not the price margin. The data represent the EU15 countries.

[13] Compare e.g. to the results of Paloviita and Viren (2005) and Tillmann (2008).

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 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 system estimation results (reported in Table A4) give some idea of the nature of tax incidence in general. It seems that taxes have a very strong impact on consumer prices (the long run effect is even slightly above one) while the effect on producer prices is quite weak (and statistically) insignificant although it is of correct sign. Thus, the casual observations which were mention in section 1 for the Nordic countries' experiences with a lower VAT for food seem to be consistent with more general empirical evidence. In other words, the VAT seems to shift mainly to consumer prices, not producer (and presumably not to raw material) prices.

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 which should be kept in mind when considering policy proposals which intend to improve employment, for instance.

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.[14] 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.

[14] 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 (2004) for US evidence.

4. Finnish excise taxes

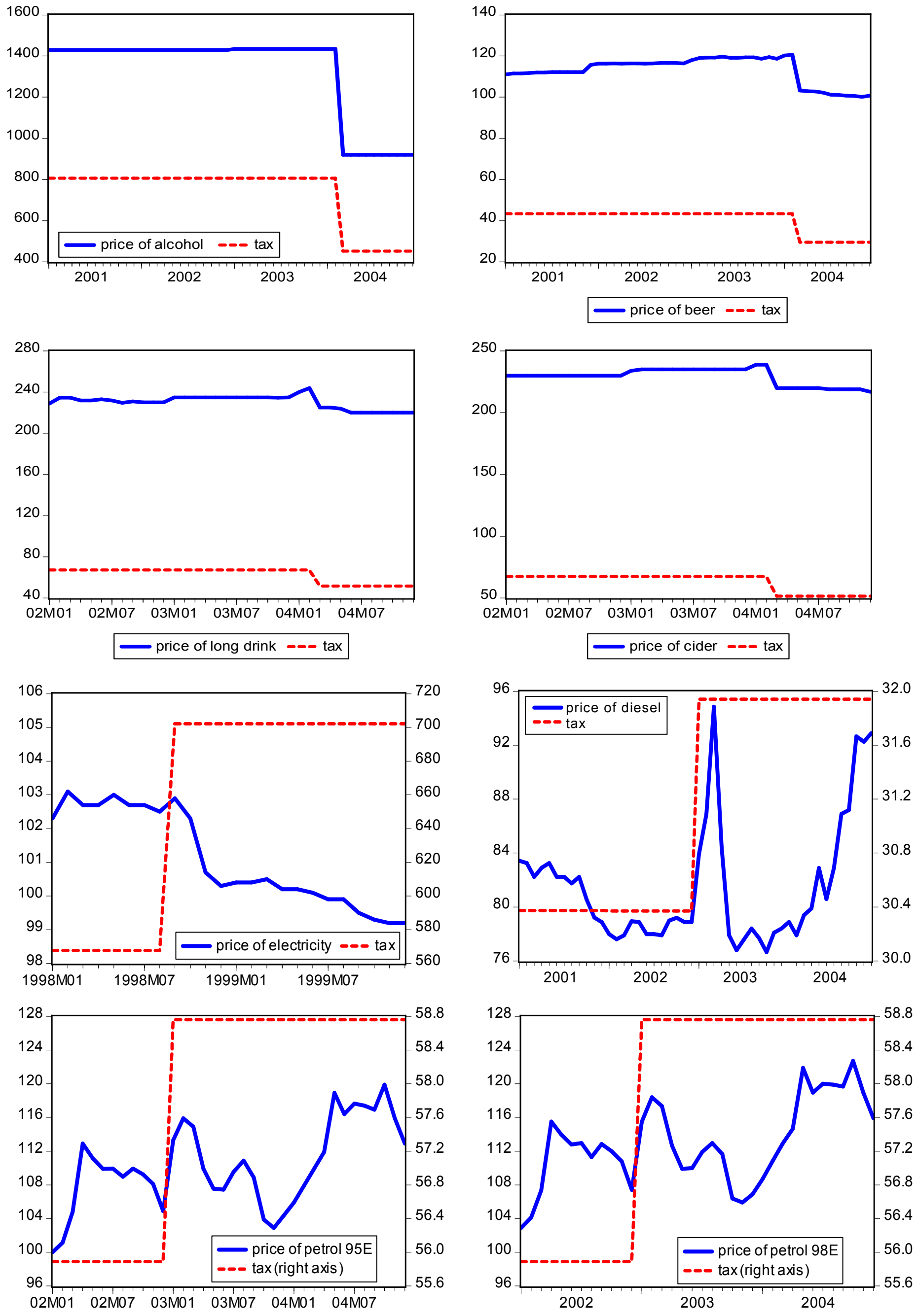
The structure of the Finnish commodity tax system is the following: The main tax is the Value-Added-Tax with the general rate 22%. The reduced rate for food is 17% and the special reduced rate for books, drugs and transportation is 8%. Subscriptions for newspapers are tax except. In addition to the VAT, there are excise taxes for the following commodity groups: tobacco, alcohol, electricity, gasoline and cars. The corresponding tax rates are also relatively high. The exact rates cannot be quoted here because most of these taxes are combined ad valorem and unit taxes (see Martikainen and Viren 2006 for more details).

Table 2. Results with Finnish CPI data

	TAX	Brent/TH	R^2/SEE	*N*	Pre-tax rate rate	Ad valorem
Alcohol	1.022		1.000	12	200	0.999
	(1290)		0.000			
Cars (new)	0.700		0.990	720	7500	0.873
	(20.11)		0.040			
Cars (used)	0.183		0.856	12	7500	0.224
	(8.03)		0.003			
Petrol 95E	0.662		0.460	1224	34	0.402
	(10.23)		0.036			
Petrol 95E	0.313	0.161	0.538	1224	34	0.190
	(4.82)	(13.77)	0.033			
Petrol 98E	0.738		0.562	1224	36	0.459
	(12.76)		0.035			
Petrol 98E	0.344	0.154	0.540	1224	36	0.253
	(5.17)	(13.20)	0.033			
Diesel	2.422		0.360	1200	32	1.988
	(17.41)		0.060			
Diesel	0.420	0.499	0.680	1200	32	0.345
	(3.64)	(33.16)	0.042			
Beer	0.829		0.991	467	45	0.748
	(48.12)		0.023			
Long drink	0.685		0.696	874	90	0.824
	(21.24)		0.048			
Cider	0.691		0.856	1063	83	0.661
	(42.16)		0.029			
Electricity	1.799		0.940	12	5850	2.154
	(12.56)		0.000			
Electricity	0.894	0.615	0.915	12	5850	1.074
	(4.18)	(7.36)	0.003			

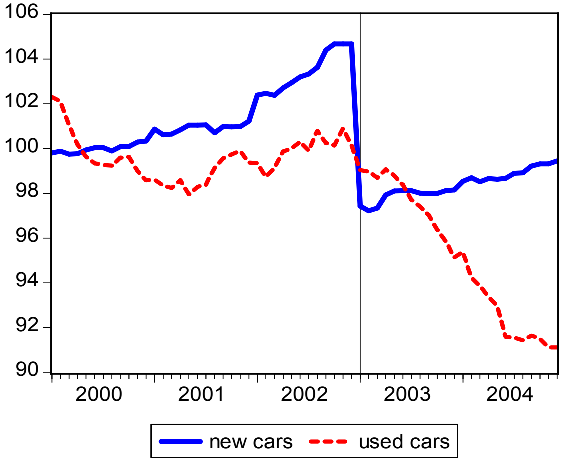
Notes: The pre-tax price is expressed in cents, with cars in euros. Koskenkorva spirits is used as the benchmark product for alcohol. The average price of imported cars is slightly above 9000 euros. ”Brent” refers to the Brent oil price and TH to the electricity producer price, which has been used in 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 in legislation taxes are expressed in either Finnish markkas or in Euros/cents (sometimes in percentage terms). See Martikainen and Viren (2006) for more details of the computation of these tax rates.

Figure 5. Effect of excise taxes on consumer prices



This analysis deals with the following CPI commodity groups: alcohol, cars (new and used), petrol (95 and 98 octane), diesel, beer, long drink, cider and electricity.[15] The empirical results for estimating equation (5) are presented in Table 2. Moreover, the tax changes are illustrated in Figure 5. The prices changes of old and new cars are illustrated in Figure 6.

Figure 6. Car prices and the change in car taxes in 2003



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.[16]

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 6). 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% 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

[15] 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 an almost trivial result (Viren 2007). Thus, in monthly data, only the tax changes show up.

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

(cf. Viren 2007). 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 increased in 2003 despite marked decreases in retail prices.[17] The government also benefited from the tax cut, as receipts from car taxes increased by 18% 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 low level of tax receipts 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.

5. Concluding remarks

Most of consumption taxes seem to shift to consumer prices. This finding is corroborated by all analyses that we have made.[18] 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 exceptions. 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 effects. To some extent these effects have been evaluated, but even then more analysis and public debate are still needed.

[17] 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. For the data, see European Commission (2005).

[18] 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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References

Bye, B., Strøm, B. and Åvitsland, T. (2003). Welfare Effects of VAT Reforms: A General Equilibrium Analysis. Oslo, Research Department of Statistics Norway, Discussion Paper No. 343.

Aucremanne, L. and Dhyne, E. (2004). How Frequently Do Prices Change? Evidence Based on the Micro Data underlying the Belgian CPI. Frankfurt am Main, European Central Bank, Working Paper No. 331.

Besley, T. and Rosen, H. (1999). Sales Taxes and Prices: An Empirical Analysis. *National Tax Journal*, 52(2), 157–178.

Carbonnier, C. (2005). Is Tax Shifting Asymmetric? Paris, Paris School of Economics, Working paper No. 34.

Chouinarnd, H. and Perloff, J. (2004). Incidence of Federal and State Gasoline Taxes. *Economics Letters*, 83, 55–60.

Coenen, G., McAdam, P. and Straub, R. (2008). Tax Reform and Labour Market Performance in the Euro Area: A Simulation based analysis using New Area-Wide Model. *Journal of Economic Dynamics and Control*, 32(8), 2543–2583.

DG Competition (1999). Buyer Power and Its Impact on Competition in the Food Retail Distribution Sector in the European Union. A report prepared by Dobson Consulting. Available at http://ec.europa.eu/comm/competition/publications/studies/bpifrs/.

European Commission (2005). Competition: Convergence of Car Prices in the Euro Zone. Available at http://europa.eu.int/comm/competition/car_sector/price_diffs/.

Eurostat (2008). *Taxation Trends in the European Union*. Brussels, Eurostat.

Fullerton, D. and Metcalf, G. (2002). Tax Incidence. In Auerbach, A. and Feldstein, M. (eds.), *Handbook of Public Economics 4*. Amsterdam, Elsevier, 1787–1872.

Holm, P., Kiander, J., Rauhanen, T. and Viren, M. (2007). *The Effects of Lowering the VAT Rate for Food* (in Finnish, the Finnish title “Elintarvikkeiden arvonlisäkannan alentamisen vaikutukset”). PTT Reports 200.

Jha, R. (1998). *Modern Public Economics*. London, Rutledge.

MacKinlay, J. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature*, 35, 13–39.

Martikainen, E. and Viren, M. (2006). The Shift of Excise Taxes to Consumption Prices in Finland in 1997–2004 (in Finnish, the Finnish title “Valmisteverojen välittyminen kuluttajahintoihin Suomessa 1997–2004”). Helsinki, Government Institute for Economic Research, Discussion Paper No. 397.

Morin, M. (2005). Economic Effects of Budget-Neutral changes in the VAT structure (in Swedish: Samhällekonomiska effekter vid genomförandet av ed budgetneutral förändring av momsstrukturen – metoder och utgångspunkter). In SOU2005:57, Bilaga 5.

Musgrave, R. (1959). *The Theory of Public Finance*. New York, McGraw-Hill.

Paloviita, M. and Viren, M. (2005). The Role of Expectations in the Inflation Process in the Euro Area. Helsinki, Bank of Finland, Discussion Paper No. 5.

Peltzman, S. (2000). Prices Rise Faster than They Fall. *Journal of Political Economy*, 108(3), 466–502.

Swinton, J. and Thomas, C. (2001). Using Empirical Point Elasticities to Teach Tax Incidence. *Journal of Economic Education*, 32(4), 356–368.

Tillmann, P. (2008). The New Keynesian Phillips Curve in Europe: Does It Fit or Does It Fail? *Empirical Economics*, DOI 10.1007/s00181-008-0241-y.

Viren, M. (2007). Analyzing the Incidence of Consumption Taxes. Helsinki, Pellervo Research Institute, Working Paper No. 97.

Appendix

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

Equation	TAX1	TAX2	Time trend	Lagged dependent variable	R^2/SEE	DW
Level, PP, FE	0.442		0.013		0.996	0.42
	(2.18)		(26.91)		0.050	
Level, PP, FE	0.200		0.003	0.735	0.999	1.33
	(1.38)		(5.42)	(20.82)	0.028	
Level, PP, FE	0.163	0.075	0.003	0.735	0.999	1.34
	(1.10)	(1.44)	(5.32)	(20.62)	0.028	
Level, WP, FE	0.099		0.003	0.761	0.996	1.38
	(0.92)		(5.29)	(20.92)	0.025	
Level, WP, FE	0.074	0.044	0.003	0.761	0.971	1.39
	(0.67)	(0.76)	(5.14)	(20.84)	0.025	
Dif, FE	0.753				0.132	0.31
	(2.79)				0.041	
Dif, FE	0.110			0.871	0.816	1.66
	(1.02)			(35.49)	0.020	
Dif, PP	0.942					1.22
	(3.69)				0.032	
Dif, PP, FE	0.428				0.056	1.46
	(1.88)				0.030	
Dif, WP	1.017					1.19
	(4.84)				0.029	
Dif, WP, FE	0.579				0.049	1.50
	(3.26)				0.026	

Notes: 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. PP denotes producer prices and WP wholesale prices that used as the right-hand-side variable.

Table A2. Estimation of the Phillips curve (3)

Equation, time horizon	p^e_{+i}	p_{-1}	ΔTAX	GAP	p_m	R^2/SEE	DW
OLS, S3	0.545	0.531	0.443	0.098		0.911	2.35
	(5.36)	(8.11)	(2.77)	(2.88)		0.899	
GLS, S3	0.534	0.521	0.360	0.092		0.909	2.13
	(12.17)	(16.12)	(3.66)	(4.63)		0.933	
SUR, S3	0.551	0.522	0.449	0.097		0.911	1.96
	(36.21)	(66.40)	(18.93)	(11.78)		0.942	
OLS, S3	0.339	0.661	0.537	0.125		0.915	2.03
		(15.09)	(2.86)	(3.91)		0.906	
GLS, S3	0.412	0.588	0.401	0.120		0.909	2.07
		(19.02)	(3.43)	(6.20)		0.886	
SUR, S3	0.423	0.577	0.409	0.133		0.967	2.03
		(16.74)	(4.90)	(8.15)		1.425	
OLS, K2	0.596	0.431	0.252	0.103		0.912	2.21
	(7.48)	(6.79)	(1.55)	(3.43)		0.953	
GLS, K2	0.613	0.411	0.304	0.102		0.911	0.95
	(13.04)	(11.69)	(3.84)	(4.55)		0.950	
SUR, K2	0.582	0.435	0.258	0.117		0.911	2.17
	(19.32)	(19.80)	(5.69)	(8.23)		0.959	
OLS, S2	0.760	0.312	0.198	0.050		0.932	2.17
	(16.35)	(8.13)	(2.76)	(1.56)		1.175	
GLS, S2	0.730	0.326	0.202	0.33		0.931	2.14
	(18.67)	(10.85)	(4.64)	(1.38)		1.167	
SUR, S2	0.715	0.342	0.189	0.056		0.932	2.15
	(25.17)	(16.20)	(5.57)	(3.16)		0.943	
OLS		0.775	0.169	0.242	0.200	0.895	2.09
		(38.70)	(1.44)	(7.39)	(12.53)	1.471	
GLS		0.791	0.086	0.223	0.165	0.892	2.13
		(54.04)	(1.50)	(9.32)	(12.89)	0.943	
SUR		0.799	0.085	0.269	0.178	0.894	2.03
		(62.94)	(1.11)	(9.44)	(12.92)	1.456	

Notes: 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 $p_m = \Delta\log PM_t$ where PM denotes import prices. K2, S2 and S3 denote OECD's inflation forecasts. S2 denotes the December forecast for the next year and S3 the corresponding forecast for the following year. Analogously, K2 denotes the June forecast for the next year.

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

Estimator, time horizon	ΔTAX	GAP	R^2/SEE	DW
OLS, S3	0.746	0.239	0.157	1.32
	(2.22)	(4.59)	1.321	
GLS, S3	0.433	0.224	0.146	1.41
	(2.14)	(7.72)	1.304	
SUR, S3	0.721	0.215	0.156	1.92
	(17.17)	(12.89)	0.936	
OLS, K2	0.413	0.153	0.086	1.57
	(2.56)	(3.94)	1.264	
GLS. K2	0.441	0.143	0.086	1.77
	(3.37)	(4.84)	1.263	
SUR K2	0.408	0.122	0.083	1.80
	(6.31)	(7.30)	0.955	
OLS, S2	0.082	0.209	0.039	1.51
	(0.51)	(4.52)	1.768	
GLS, S2	44	0.169	0.036	1.55
	(0.38)	(5.13)	1.554	
SUR, S2	-.001	0.150	0.031	1.87
	(0.01)	(6.38)	0.952	
OLS, S3, WAR	0.628	0.234	0.157	1.59
	(1.23)	(6.05)	1.175	
GLS, S3, WAR	0.442	0.205	0.152	1.39
	(1.93)	(8.17)	1.168	
OLS, K2, WAR	0.373	0.164	0.171	1.52
	(1.09)	(5.54)	0.816	
GLS, K2, WAR	0.389	0.151	0.170	1.65
	(2.02)	(6.52)	0.815	
OLS, S2, WAR	0.317	0.087	0.069	1.56
	(1.23)	(3.28)	0.761	
GLS, S2, WAR	0.259	0.065	0.065	1.69
	(1.47)	(2.93)	0.758	

Notes: $\Delta TAX = \Delta \log(1 + tax)$ where both the main VAT rate (VAT1) and the weighted average rate (WAR) are used.

Table A4. IV, GMM and system estimates

IV estimates of the level form equation

$\log PC = 1.014 \log PP + 0.817 \log(1+tax)$
(48.92) (4.12)
$R^2 = 0.991$ SEE = 0.032 DW = 0.46

$\log PC = 0.082 \log PP + 0.819 \log PC_{-1} + 0.125 \log(1+tax)$
(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 $\log WP_{iUS}$.

Arellano-Bond GMM estimates for the price margin (m) equation

$\log m = 0.601 \log m_{-1} + 0.286 \log(1+tax) + 0.005t$
(98.98) (10.32) (35.01)
$R^2 = 0.885$ 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 ortho- gonal deviations. J denotes the J test for overidentifying restrictions.

System estimates with the two-equation model

$\Delta \log PC = 0.004 + 0.135 \Delta \log PM + 0.700 \Delta \log PC_{-1} + 0.037 \Delta \log PP_{-1} + 0.447 \Delta \log(1+tax)$
(4.20) (9.19) (24.98) (1.71) (3.76)
$R^2 = 0.886$ SEE = 0.011 DW = 1.67

$\Delta \log PP = 0.003 + 0.533 \Delta \log PM + 0.158 \Delta \log PC_{-1} + 0.247 \Delta \log PP_{-1} - 0.031 \Delta \log(1+tax)$
(1.51) (18.78) (2.76) (5.55) (0.13)
$R^2 = 0.723$ SEE = 0.021 DW = 1.89

Estimates are SUR estimates with 552 observations.