CPB Netherlands Bureau for Economic Policy Analysis

CPB Discussion Paper | 297

Robust estimation of the VAT pass-through in the Netherlands

Hendrik Vrijburg
Martin Mellens
Jonneke Dijkstra

Robust estimation of the VAT pass-through in the Netherlands

Hendrik Vrijburg* Martin C. Mellens† Jonneke Dijkstra

Erasmus University Rotterdam CPB Erasmus University Rotterdam

December, 2014

Abstract

This paper introduces the Common Correlated Effects Estimator into the study of Value-Added-Tax pass-through and compares this method to various other methodologies used in the literature. To this end, we study two Value-Added-Tax increases in the Netherlands, in January 2001 and October 2012. We show that the Common Correlated Effects Estimator produces robust estimates, especially when divergent macroeconomic trends make identification more difficult. Furthermore, we show that the choice of the control group is of lesser importance once sufficient control variables are included. Our results indicate, in accordance with most findings in the literature, that we cannot reject the null-hypothesis of a full pass-through for both Dutch tax-hikes.

JEL codes: E31, H22

Keywords: Value Added Tax, Tax Incidence, Common Correlated Effects Estimator

*Corresponding author: Tinbergen Institute, Erasmus School of Economics, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Email: vrijburg@ese.eur.nl, Phone: +31-10-408-1481, Fax: +31-10-408-91 66.

†CPB. E-mail: M.C.Mellens@cpb.nl. Views are those of the authors and should not be attributed to the CPB Netherlands Bureau for Economic Policy Analysis.

1 Introduction

On October 1, 2012, the Dutch government increased the standard rate for the Value Added Tax (VAT) from 19 percent to 21 percent. This was the first VAT-hike since January 2001, when the VAT was increased from 17.5 percent to 19 percent as part of an overall restructuring of the whole Dutch tax system.

In this paper we estimate how these VAT-hikes have affected inflation. We compare a standard panel fixed-effects estimator (used by amongst others Carare and Danninger, 2008) with the Common Correlated Effects (CCE) estimator suggested by Pesaran (2006). The CCE-estimator allows for heterogeneous responses to aggregate shocks by the different product categories and is a novelty in the literature that studies the VAT pass-through. It is important to allow for differentiated responses for the various product categories, especially during an economic downturn when income uncertainty affects consumption patterns (for example durable goods versus non-durables, see Blundell, 2009). For both methods, we alternate between low-taxed goods in the Netherlands (see Carare and Danninger, 2008; and Carbonnier, 2005) and high-taxed goods in Belgium as the control group (see Kesselman, 2011; and Smart and Bird, 2009, for a similar identification strategy).

We find that the CCE estimator yields robust results where the point estimates suggest that consumer prices are increased by the full amount of the tax (a full pass-through). These results are in line with the literature, see IFS *et al.* (2011) for a thorough overview of this literature. CCE outperforms standard fixed-effects especially in 2001, when both the introduction of the Euro and a sharp increase in labor costs in the Netherlands relative to Belgium makes identification difficult.

The structure of this paper is as follows. First, Section 2 discusses the different methodologies used in the paper. Section 3 discusses the results and concludes.

2 Methodology and Data

We write the general econometric model as follows

$$P_{ijt} = \beta_1 D^0_{ijt} + \beta_2 D^T_{ijt} + \beta_3 D^5_{ijt} + X_{ijt}\gamma + \epsilon_{ijt}, \tag{1}$$

$$= Z_{ijt}\theta + \epsilon_{ijt}, \tag{2}$$

with t counting the months, either from January 1999 until December 2002, or from January 2011 until December 2013 depending on which reform is studied, i stands for different commodities and j stands for different countries (the Netherlands and Belgium).[1] The vector $Z_{ijt} = [D^0_{ijt}, D^T_{ijt}, D^5_{ijt}, X_{ijt}]$ contains all explanatory variables, whereas $\theta = [\beta_1, \beta_2, \beta_3, \gamma^\top]^\top$

[1] The choice of sample for the reform in 2001, two years before the reform and two years after, is analogous to the analysis by Carare and Danninger (2008). Only for the reform in 2012 we where restricted by data availability and therefore decided to also shorten the pre-reform period.

Table 1: Data Sources

Variable	Definition	Observation	Source
HICP Inflation (1)	Year-on-year growth in the Harmonized Index of Consumer Prices	Monthly data by COICOP Category and country	Eurostat
Unemployment Rate	Harmonized Unemployment Rate (percentage of active population)	Monthly data by country	OECD.Stat
Unit Labor Costs (2)	Year-on-year growth in real unit labour costs	Quarterly data per country	Eurostat
Labor Productivity (2)	Year-on-year growth in real labor productivity	Quarterly data per country	Eurostat
EA Inflation (3)	Year-on-year growth in the Harmonized Index of Consumer Prices in the Euro Area *exclusive* country j	Monthly data by COICOP Category and country	Eurostat and own computation

Notes: (1) COICOP stands for Classification Of Individual Consumption by Purpose. This classification scheme is developed by the United Nations and used by amongst others the European Commission. (2) These series are seasonally adjusted by working days. (3) Using GDP shares we corrected the Euro Area average for the inflation in country j.

is a vector containing all regression coefficients. We use a General Method of Moments estimator in all cases discussed below which implies that our estimators do not require specific assumptions on the residual (ϵ_{ijt}), just assuming the innovations are (apart from potential serial correlation) i.i.d. is sufficient to obtain consistent estimates.

P_{ijt} denotes the inflation rate of the commodities we include in the regression. We use *monthly* observations on the *annual* percentage change in the Harmonized Index of Consumer Prices (HICP) for a specific good as an indicator for inflation.[2] The estimators considered below weigh the equations in Eq. (1) to allow larger product groups to have a larger effect on the estimated coefficient. The weights used are time-averages of the weights used by Eurostat for computing aggregate HICP inflation.

D^T_{ijt} is the treatment dummy variable capturing the VAT increase. It equals one for goods subject to the high VAT-rate in the Netherlands in the twelve months following the VAT increase, and zero otherwise. D^0_{ijt} is a dummy variable that equals one for the high-VAT goods in the Netherlands in the three month period prior to the VAT increase, it measures the anticipation effect. Finally D^5_{ijt} is a dummy variable that equals one for the high-VAT goods in the Netherlands in the fifth quarter after the VAT increase, when we don't expect the VAT increase to affect inflation anymore. It is important to recognize that a price change of a specific commodity can be decomposed in: i) price changes related to developments in the market for that particular commodity (M_{it}); ii) price changes related to macroeconomic

[2]Whereas 90 commodity items are available, we exclude the communication (cp08), education (cp10) and health (cp06) categories. In the former case, rapid technological developments in the communications category have affected price developments. The latter two categories are strongly affected by government legislation. We also exclude goods subject to excises to avoid interference with changes in excise duties. Finally, cp0442 (refuse collection) and cp0513 (repair of furniture) are dropped because of insufficient observations. See Table B.1 in Appendix B for an overview.

developments within the respective country (G_{jt}). These variables are included in the $1 \times q$ vector $X_{ijt} = [M_{it}, G_{jt}]$, where q indicates the number of control variables.

When we use low-taxed goods in the Netherlands as a control group, observations from Belgium (the j-index) are dropped. Using low-taxed taxed goods as control group sufficiently controls for macroeconomic shocks (including the simultaneous overall restructuring of the Dutch tax system), when those affect high-tax and low-tax goods similarly. But products are not randomly assigned to the low or high VAT-rate. Therefore, the inflation trend may differ between the control and treatment group and be correlated with the VAT increase. To control for this divergent trend, we include the average inflation in other Euro Area countries (corrected for the inflation in country j).

As an alternative, we use commodities that are subject to the high-VAT rate in Belgium, which remained constant during the period studied, as the control group (and drop all low-taxed commodities). Assuming that market conditions for commodity i are similar in Belgium and the Netherlands, this implicitly controls for developments within product categories. But, both inflation and tax policies might be affected by divergent macroeconomic shocks. To control for this we include lagged unemployment and unit-labor costs (we use labor productivity in a robustness check).

The main contribution of the paper is that we improve the estimates obtained from a standard panel fixed-effects estimator by allowing heterogenous responses by different commodities to an unobserved common shock to inflation. In its most general form, the error term is given by

$$\epsilon_{ijt} = \alpha_{ij} + \delta_{ij} f_t + \nu_{ijt}. \tag{3}$$

with α_{ij} representing a commodity fixed-effect, f_t is an unobserved common factor which is potentially correlated with Z_{ijt}, δ_{ij} denote the accompanying commodity-specific factor loadings, and ν_{ijt} an i.i.d. error term. A fixed-effects panel data estimator assumes $\delta_{ij} = 1$ for all combinations of i and j, such that f_t equals a time fixed-effect that has a similar impact on each commodity. These time fixed-effects are important in capturing common shocks to inflation in the period studied (for example the introduction of the Euro in January 2002). Failing to do so leads to a bias in the estimated coefficient when f_t is correlated with the VAT-hike.

Alternatively, when an estimate of f_t is available, one could identify a product-specific response (δ_{ij}) to this unobserved common factor of inflation. Failing to allow for such a product-specific response biases the estimates in case there is a correlation between the VAT increase on P_{ijt} and the responsiveness to common shocks. Pesaran (2006) suggests to substitute f_t in Eq. (3) with weighted cross-section averages (CSAs) of the dependent and independent variables and include these along-side the original regressors in Eq. (1). The weights used are again the time-averages of the weights used by Eurostat for computing aggregate HICP

inflation. We apply this so-called CCE estimator and obtain consistent estimates of θ and the combined parameters: $\delta_i\theta^\top$.[3] Note, we make the assumption that the response to a common shock of a particular commodity is the same in the Netherlands and Belgium: δ_{ij}'s generally differ from 1, but are heterogeneous over i only.

Finally, we report the estimates of a rather simple method that, according to Bertrand, Duflo and Mullainathan (2004) yields a relative efficient estimator. It is based on taking the average of inflation in a year (month) before and a year (month) after the VAT-increase, and estimates the treatment effect with Ordinary-Least-Squares (OLS) on this two-period panel.

3 Results and Conclusion

Table 2 presents the results following from the base regression. The upper part of the table shows the results when high-taxed goods in Belgium are used as a control group, the lower-part adheres to low-taxed goods. The first two columns estimate the VAT pass-through for the VAT increase in 2001, the final two columns study the VAT-hike in October 2012. In each period, the first column shows the results from a standard fixed-effects estimator, while the second presents the CCE estimator. Note that in case of a full pass-through of the VAT in consumer prices we would observe a coefficient for the treatment Dummy of 1.28 in 2001 and 1.68 in 2012.[4]

The CCE estimator shows a significant treatment effect in all cases, this in contrast to the fixed-effects estimator. In addition, there is generally no anticipation effect nor an effect in the fifth quarter after the VAT-hike. The CCE estimator yields larger point estimates compared to a fixed-effects estimator. This signals that common shocks asymmetrically affect different commodities beyond the effects captured by the control variables. The product-specific coefficients of the CCE estimator do allow these shocks to have an asymmetric impact on inflation. The estimated treatment effects by the CCE estimator are generally above the full pass-through coefficient, but the difference is never statistically significant. The results for both control groups are similar, although the point estimates are somewhat higher when Belgium is used as a control group.

Table 3 reports treatment effects for different specifications. The vast majority of estimated treatment effects are within the confidence bounds of the estimates in Table 2. The CCE estimator reports larger point estimates with a higher level of significance compared to the fixed-effect estimator. The choice of specification matters especially for the 2001 VAT-hike.

[3] $\bar{P}_t$ seems endogenous. Therefore, as a robustness check we used fitted values of $\bar{P}_t$ based on a first-round regression,yielding similar results.

[4] To see this, note that the consumer price (p_c) equals $p_c = p_r(1 + VAT)$ where p_r denotes the retailer price before-tax and VAT. In case of a full pass-through the retailer price remains constant, the consumer pays for the VAT increase. The change in the consumer price is given by: $dp_c = p_r dVAT$ and $\frac{dp_c}{p_c} = \frac{dVAT}{1+VAT}$, which leads to the numbers in the text for an increase of 1.5 percent on a VAT of 17.5 percent in 2001, and an increase of 2 percent on a VAT of 19 percent in 2012.

Identification is hampered in this case through a sharp increase in labor costs in the Netherlands relative to Belgium between the final quarter of 2000 and the first quarter of 2003, and the introduction of the Euro in January 2002. Under these circumstances, the CCE estimator produces robust results whereas the fixed-effect estimator is unable to identify a significant treatment effect. Still, additional control variables remain important. For example, failing to include control variables would suggest over-shifting in 2012 in case high-taxed goods in Belgium are the control group.

The final part of Table 3 presents the result of applying OLS to a panel with length two periods; one month before the VAT-hike and one month after the VAT-hike. We observe that a large part of the VAT-hike is already included in prices in the first month after a VAT increase. An advantage of the latter method is that the relative short period excludes the impact of confounding variables on inflation when these changes occurred earlier or later then the two months range around VAT-hike.

Based on our study, we conclude that the CCE estimator produces stable estimates of the treatment effect where the estimates of a fixed-effects panel data estimator are more sensitive to the specification. The treatment effect can be identified by the CCE estimator using both control groups. Additional control variables are important for good identification. Overall we cannot reject, in accordance with the existent literature, that a VAT increase is immediately and completely passed-through into prices.

Acknowledgements

The authors thank Leon Bettendorf, Rob Euwals, Bas Jacobs, Eva Gavrilova, Arjan Lejour, Richard Paap, Daniël van Vuuren and seminar participants at the CPB Netherlands Bureau of Economic Policy Analysis for helpful comments.

Table 2: Base Regression

Control group: Belgium

	January 1999 - December 2002		January 2011 - December 2013	
	Fixed Effects	CCE	Fixed Effects	CCE
Anticipation Dummy	-0.231	-0.004	0.714	0.950*
	(0.466)	(0.451)	(0.562)	(0.495)
Treatment Dummy	1.204	1.379*	1.889***	2.229***
	(0.821)	(0.720)	(0.695)	(0.621)
Dummy Q5	0.870	0.878	-0.481	-0.106
	(0.750)	(0.558)	(0.880)	(0.698)
Unit Labor Costs	0.123	0.144	-0.285	-0.318***
	(0.186)	(0.195)	(0.173)	(0.118)
Unemployment Lagged	0.136	0.160	0.265	0.304**
	(0.379)	(0.246)	(0.170)	(0.138)
Observations	2160	2160	1620	1620
R-squared	0.139	0.462	0.120	0.507
Month Dummies	yes	CCE	yes	CCE
Category Dummies	yes	yes	yes	yes

Control group: Low-Taxed goods

	January 1999 - December 2002		January 2011 - December 2013	
	Base	CCE	Base	CCE
Anticipation Dummy	1.275	-0.511	0.491	0.690
	(1.040)	(0.759)	(0.759)	(0.513)
Treatment Dummy	-0.023	1.787**	1.443*	2.097**
	(0.534)	(0.827)	(0.836)	(0.799)
Dummy Q5	-0.422	1.217	0.623	0.774
	(0.820)	(0.755)	(0.909)	(0.667)
EA Inflation	1.057***	1.061***	0.853***	0.575***
	(0.166)	(0.310)	(0.161)	(0.146)
Observations	2351	2351	1764	1764
R-squared	0.401	0.474	0.255	0.600
Month Dummies	yes	CCE	yes	CCE
Category Dummies	yes	yes	yes	yes

Notes: ***, **, * denote significance at the 1, 5 or 10 percent level, respectively. Standard errors for the fixed-effects estimator and CCE are clustered by commodity. Following Bertrand *et al.* (2014) this is a sufficient control for serial correlation.

Table 3: Overview Treatment Effects from Alternative Specifications

Control group: Belgium

	January 1999 - December 2002		January 2011 - December 2013	
	Fixed Effects	CCE	Fixed Effects	CCE
No Controls	1.022	1.166**	1.640**	1.953***
	(0.641)	(0.442)	(0.765)	(0.644)
Labor Costs	1.204	1.379*	1.889***	2.229***
	(0.821)	(0.720)	(0.695)	(0.621)
Labor Prod.	1.103	1.239**	1.532*	1.829***
	(0.690)	(0.495)	(0.769)	(0.650)
Month Dummies	yes	CCE	yes	CCE
Category Dummies	yes	yes	yes	yes

Control group: Low-Taxed goods

	January 1999 - December 2002		January 2011 - December 2013	
	Fixed Effects	CCE	Fixed Effects	CCE
No Controls	-1.702*	2.774***	1.095	1.717
	(1.013)	(0.639)	(0.932)	(1.170)
EA Inf.	-0.023	1.787**	1.443*	2.097**
	(0.534)	(0.827)	(0.836)	(0.799)
Month Dummies	yes	CCE	yes	CCE
Category Dummies	yes	yes	yes	yes

Estimators based on averaging

	Tax-hike 2001		Tax-hike October 2012	
	Belgium	Low-Tax	Belgium	Low-Tax
Dif-in-Dif	1.145***	-1.279	1.396***	0.879**
	(0.289)	(1.402)	(0.402)	(0.410)

Notes: ***, **, * denote significance at the 1, 5 or 10 percent level, respectively. Standard errors for the fixed-effects estimator and CCE are clustered by commodity. Following Bertrand *et al.* (2014) this is a sufficient control for serial correlation.

Table B.1: COICOP Categories Included

Low-Taxed

Count	Code	Description	Weights Net.	Weights Bel.
1	cp0111	Bread and cereals	0.03	0.04
2	cp0112	Meat	0.04	0.06
3	cp0113	Fish and seafood	0.01	0.01
4	cp0114	Milk, cheese and eggs	0.03	0.03
5	cp0115	Oils and fats	0.00	0.01
6	cp0116	Fruit	0.01	0.01
7	cp0117	Vegetables	0.02	0.02
8	cp0118	Sugar, jam, honey, chocolate and confectionery	0.01	0.01
9	cp0119	Food products, n.e.c.	0.01	0.01
10	cp0121	Coffee, tea and cacao	0.01	0.00
11	cp0122	Mineral waters, soft drinks, fruit and vegetable juice	0.01	0.02
12	cp0322	Repair of footwear	0.01	0.01
13	cp0411	Housing rent	0.05	0.04
14	cp0444	Other services related to dwellings n.e.c.	0.01	0.00
15	cp0562	Domestic services and household services	0.01	0.01
16	cp0731	Passenger transport by railway	0.01	0.00
17	cp0732	Passenger transport by road	0.01	0.00
18	cp0733	Passenger transport by air	0.01	0.00
19	cp0734	Passenger transport by waterway	0.00	0.00
20	cp0736	Other purchased transport services	0.00	0.00
21	cp0941	Recreational and sporting services	0.02	0.01
22	cp0942	Cultural services	0.02	0.03
23	cp0951	Books	0.01	0.01
24	cp0952	Newspapers, books and stationery	0.01	0.01
25	cp0961	Holidays in the Netherlands	0.01	0.02
26	cp0962	Holidays abroad	0.01	0.02
27	cp1111	Restaurants, cafes and the like	0.06	0.08
28	cp1112	Canteens	0.01	0.00

High-taxed

Count	Code	Description	Weights Net.	Weights Bel.
1	cp0311	Clothing materials	0.00	0.00
2	cp0312	Garments	0.06	0.07
3	cp0313	Other articles of clothing and clothing accessories	0.00	0.00
4	cp0314	Cleaning, repair and hire of clothing	0.00	0.00
5	cp0321	Shoes and other footwear	0.01	0.01
6	cp0412	Garage rent	0.05	0.04
7	cp0431	Products for maintenance and repair dwelling	0.02	0.02
8	cp0432	Services for maintenance and repair dwellings	0.01	0.01
9	cp0442	Refuse collection	0.01	0.00
10	cp0511	Furniture and furnishings	0.04	0.03
11	cp0512	Carpets and other floor coverings	0.01	0.00
12	cp0513	Repair of furniture, furnishings and floor coverings	0.00	0.00
13	cp0521	Curtains, blinds, screens, etc.	0.00	0.00
14	cp0522	Bed clothes	0.00	0.00
15	cp0523	Household linen	0.00	0.00
16	cp0531	Major household appliances	0.01	0.01
17	cp0532	Small household appliances	0.01	0.01
18	cp0533	Repair of household appliances	0.00	0.00
19	cp0561	Non-durable household goods	0.01	0.02

Column (2) shows the codes of the COICOP-categories included in the analyses, subdivided by low-tax goods and high-taxed goods. Column (3) shows the content of the category, whereas Columns (4) and (5) show the (normalized) COICOP weights for the Netherlands and Belgium respectively.

Table B.1: COICOP Categories Included, continued

High-Taxed (continued)

Count	Code	Description	Weights Net.	Weights Bel.
20	cp0711	Motor cars	0.05	0.07
21	cp0712	Motorcycles, scooters, mopeds	0.00	0.00
22	cp0713	Bicycles	0.00	0.00
23	cp0721	Spare parts and accessories for personal transport equipment	0.01	0.01
24	cp0722	Fuels and lubricants for personal transport equipment	0.05	0.05
25	cp0723	Maintenance and repair of private transport equipment	0.03	0.03
26	cp0724	Other services in respect of personal transport equipment	0.01	0.01
27	cp0911	Equipment for the reception, recording an reproduction of sound and picture	0.01	0.01
28	cp0912	Photographic and cinematographic equipment and optical instruments	0.00	0.00
29	cp0913	Information processing equipment	0.00	0.01
30	cp0914	Recording media	0.01	0.01
31	cp0915	Repair of audio-visual, photographic and information processing equipment	0.00	0.00
32	cp0921	Articles for outdoor recreation	0.00	0.00
33	cp0922	Articles for indoor recreation	0.00	0.00
34	cp0931	Games, toys and hobbies	0.01	0.01
35	cp0932	Equipment for sport, camping and open-air recreation	0.00	0.00
36	cp0933	Gardens, plants and flowers	0.01	0.01
37	cp0934	Pets and related products	0.00	0.00
38	cp0935	Veterinary and other services for pets	0.00	0.00
39	cp0953	Other printed matter, stationery	0.01	0.00
40	cp1211	Hairdressing salons and personal grooming establishments	0.01	0.02
41	cp1212	Electric appliances for personal care	0.01	0.02
42	cp1213	Other products for personal care	0.01	0.00
43	cp1231	Jewellery, clocks and watches	0.01	0.00
44	cp1232	Other personal effects	0.01	0.01

Column (2) shows the codes of the COICOP-categories included in the analyses, subdivided by low-tax goods and high-taxed goods. Column (3) shows the content of the category, whereas Columns (4) and (5) show the (normalized) COICOP weights for the Netherlands and Belgium respectively.

References

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Difference-in-Difference Estimates?," *The Quarterly Journal of Economics*, 119, 249–275.

Blundell, R. (2009): "Assessing the Temporary VAT Cut Policy in the UK," *Fiscal Studies*, 30, 31–38.

Carare, A., and S. Danninger (2008): "Inflation smoothing and the modest effect of VAT in Germany," IMF Working Paper, wp/08/175, IMF.

Carbonnier, C. (2005): "Is tax shifting asymmetric? Evidence from French VAT reforms 1995-2000," Paris-Jourdan Sciences Economiques Working Paper, wp/2005/09.

IFS *et al.* (2011): "A retrospective evaluation of elements of the EU VAT system," Fwc No. Taxud/2010/cc/104.

Kesselman, J. R. (2011): "Consumer Impact of BC's Harmonized Sales Tax: Tax Grab or Pass-through?," *Canadian Public Policy*, 37, 139–162.

Pesaran, M. H. (2006): "Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure," *Econometrica*, 74, 967–1012.

Smart, M., and R. M. Bird (2009): "The Economic Incidence of Replacing a Retail Sales Tax with a Value-Added Tax: Evidence from Canadian Experience," *Canadian Public Policy*, 35, 85–97.

Publisher:

CPB Netherlands Bureau for Economic Policy Analysis
P.O. Box 80510 | 2508 GM The Hague
T (070) 3383 380

December 2014 | ISBN 978-90-5833-670-5