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KVARTS - modelling of the Consumer Price Index

The impact on domestic consumer prices of tax changes and foreign prices

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Thomas von Brasch, Ådne Cappelen and Arnaldur Sölvi Kristjansson

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Preface

In this document, we provide an analytical decomposition of the Consumer Price Index and outline how prices are determined in the KVARTS macroeconomic model. This document has been financed by the Ministry of Finance under the contract with Statistics Norway for developing the KVARTS model.

Statistisk sentralbyrå, 30. oktober 2020

Linda Nøstbakken

Abstract

In this document, we provide an analytical decomposition of the Consumer Price Index (CPI) and outline how prices are determined in the KVARTS macroeconomic model. We use simulations performed with the model to analyse how changes in foreign prices and consumption taxes impact different measures of inflation. Four main conclusions emerge from our analysis. First, we find that the first-year effect on the CPI of a 1 per cent change in import prices is 0.4 per cent. Second, VAT and ad valorem excise tax rates have a much lower impact on inflation than excise taxes based on unit of sales. Third, most of the first-year impact of tax changes on the CPI is due to direct effects and not general equilibrium effects. Fourth, the CPI adjusted for taxes (CPI-AT) is also impacted by tax changes since excise taxes based on unit of sales are adjusted for CPI inflation.

Contents

1. Introduction

KVARTS is a macroeconomic model of the Norwegian economy. Norway. In some respects, KVARTS resembles the macro-econometric models used by the Federal Reserve in the U.S., the Reserve Bank of Australia and the Ministry of Finance in Italy.[1] In contrast to these models, however, KVARTS is relatively disaggregated, with an input–output core based on the national accounts. In the short run, the production level is determined by aggregate demand according to a traditional Keynesian framework for an open economy with inflation targeting. In the longer run, the supply side also contributes to the determination of production through labour supply and wage formation. The model has been developed continuously since the 1980s; see Biørn, Jensen and Reymert (1987) for a presentation of an early version. Most structural equations in the model have standard theoretical underpinnings (mark-up pricing, KLEM production structure, system of consumer demand) except for the labour market, where wage bargaining is modelled in line with the Scandinavian model of inflation; see Gjelsvik, Nymoen and Sparrman (2020).

At the core of the model is price determination. One key statistical measure of prices is the consumer price index (CPI). This index describes developments in consumer prices for goods and services purchased by private households in Norway. KVARTS links the empirically identified pricing behaviour at product level with the aggregate measure of inflation as represented by the CPI. There are several different measures of underlying inflation related to the CPI: the CPI adjusted for tax changes and excluding energy products (CPI-ATE), the CPI adjusted for tax changes (CPI-AT) and the CPI excluding energy products (CPI-AE).[2] In KVARTS, all these indices are defined in a manner which is consistent with Statistics Norway's definitions of consumer price indices.

In this document, we provide an analytical decomposition of the abovementioned consumer price indices and outline how prices are determined in KVARTS. The rest of the document proceeds as follows: Section 2 defines the CPI and the CPI-ATE. Section 3 outlines the pricing-to-market theory which underlies domestic prices excluding taxes. In Section 4, we analyse how changes in foreign price levels impact the consumer price index. In Section 5, we investigate how changes in consumption taxes impact inflation as measured by the CPI and the CPI-ATE.

[1] Information about the FRB/US-model can be found at: https://www.federalreserve.gov/econres/us-models-about.htm, while the MARTIN- (Australia) and ITEM- (Italy) models are documented in Ballantyne et al. (2019) and Cicinelli et al. (2010), respectively.

[2] Rønnevik (2014) provides an overview (in Norwegian) of how tax changes are handled in the harmonized consumer price index.

2. The CPI and the CPI-ATE

The CPI describes developments in consumer prices for goods and services purchased by private households in Norway. Table 2.1 shows the weights used for the consumer price indices, both including energy products (CPI and CPI-AT) and excluding energy products (CPI-AE and CPI-ATE). The table is based on the KVARTS aggregation level.

Table 2.2 CPI weights, including and excluding energy products (2020)

	CPI and CPI-AT	CPI-AE and CPI-ATE
Food	10,6	11.3
Beverages and tobacco	5,3	5.6
Electricity	3,8	-
Gas and other fuels	0,4	-
Operation of personal transport equipment	2,5	-
Other goods	15,7	16,9
Power-intensive industry	6,1	6.5
Furnishings, household equipment and routine maintenance	5,1	5,5
Housing	20.3	21.8
Other services	30,2	32.4

Source: Statistics Norway, KVARTS database

Note that in contrast to the deflator for household consumption in the national accounts, for practical reasons the consumer price index does not include Norwegians' spending on foreign travel, nor does it include indirectly measured financial intermediation services (FISIM). These two products constituted about 8 per cent of total household consumption in 2017.

Price indices in KVARTS

For each consumption group *k* (see Table 2.3 for consumption goods) we define a consumer price index at time *t*

$$P_{kt} = \sum_i a_{ik}(1+\tau_{ikt})\left[(1+\tau_{ikt}^{ET})P_{it}^{HF} + b_{ik}^{ET}P_{ikt}^{ET} + c_{ik}P_{ikt}^{TM}\right], \qquad (1)$$

which is summed over products (*i*). The squared bracket is a weighted sum of domestic and foreign product prices (P_{it}^{HF}), which is taxed at the excise tax rate τ_{ikt}^{ET}, excise taxes based on unit of sales[3] (P_{ikt}^{ET}), and trade margins (P_{ikt}^{TM}). Trade margins have been shown empirically to cushion exchange rate fluctuations by significantly delaying pass-through to consumer prices; see Boug, Cappelen, and Eika (2013).

The composite price index P_{it}^{HF} is a weighted average of domestic (P_{it}^{H}) and foreign (P_{it}^{F}) product prices (import prices), both measured in domestic currency,

$$P_{it}^{HF} = (1-IS_{it})P_{it}^{H} + IS_{it}P_{it}^{F}, \qquad (2)$$

where IS_{it} is the import share for products *i*. The average import share was about 19 per cent in 2017.

The value added tax rate is denoted by τ_{ikt}, and the sales-based (ad valorem) excise tax rate is denoted by τ_{ikt}^{ET}. Both rates vary across products.[4]

[3] In addition, subsidies are defined as negative excise taxes. An additional term with negative sign is included. To simplify, we exclude the subsidies from this representation since the CPI-ATE does not adjust for subsidies.

[4] There are three VAT rates in Norway (12, 15 and 25 per cent). Tax rates for goods in a given product and consumption group will be taxed at different rates. The tax rates τ_{ikt} are therefore average rates and are not equal to the official VAT rates.

Domestic prices, P_{it}^{H}, are determined according to the mark-up pricing model by Krugman (1987), see Section 0. Import prices P_{it}^{F} are mostly exogenous in foreign currency, although for some goods there are pricing-to-market effects; see Benedictow and Boug (2013).

Weights (denoted by lower case letters) are calibrated constants based on the national accounts for a given base year. a_{ik} denotes the input-output coefficients[5], b_{ik} denotes the share of excise tax in total consumer prices in the base year, and c_{ik} represents the share of the trade margins in total consumer prices for each consumption group in the base year. The weights sum to unity in the base year, i.e.

$$\sum_i a_{ik}(1+\tau_{ik0})\left(1+\tau_{ik0}^{ET}+b_{ik}+c_{ik}\right)=1,$$

where year 0 is the base year. This means that the consumer price index for good *k* in (1) can be interpreted as a weighted average of net prices and excise taxes. The input-output coefficients measure the share of basic values (the amount receivable by the producer from the purchaser of a unit of a good or service) at market value (the price consumers pay). Due to consumption taxes and trade margins, they sum to less than unity, i.e. $\sum_i a_{ik} < 1$.

The price index P_{kt} can be decomposed into a price index for consumption taxes and a price index for net prices:

$$P_{kt}^{T} = \sum_i a_{ik}\left\{\tau_{ikt}\left[(1+\tau_{ikt}^{ET})P_{it}^{HF}+b_{ik}^{ET}P_{ikt}^{ET}+c_{ik}P_{ikt}^{TM}\right]+\tau_{ikt}^{ET}P_{it}^{HF}+b_{ik}^{ET}P_{ikt}^{ET}\right\},$$

$$P_{kt}^{N} = \sum_i a_{ik}\left[P_{it}^{HF}+c_{ik}P_{ikt}^{TM}\right],$$

where $P_{kt}=P_{kt}^{T}+P_{kt}^{N}$. The first term in the braces in P_{kt}^{T} represents the price index for VAT payments and the second and third terms represent the ad valorem and per unit of sales excise tax price index, respectively.

CPI, CPI-AE, CPI-AT and CPI-ATE inflation rates

The set of all consumption goods is defined by *N*, see Table 2.4. The set *N* is the sum of energy consumption goods and other goods,

$$N = N^{E} + N^{AE},$$

where N^{E} is the set of energy consumption goods and N^{AE} is the set of other consumption goods.

The CPI inflation rate, π_t^{CPI}, can be written as the sum of the CPI-AT inflation rate, $\pi_t^{\text{CPI-AT}}$, and the inflation rate for real taxes, $\hat{\pi}_t^{T}$, i.e,

$$\pi_t^{\text{CPI}} = \pi_t^{\text{CPI-AT}} + \hat{\pi}_t^{T}.$$

In the following we derive the analytical expressions underlying these three terms.

The CPI inflation rate is defined in KVARTS as the weighted average of inflation rates for individual consumption goods and is denoted by

$$\pi_t^{\text{CPI}} = \sum_{k\in N} \omega_{k,t-1}\pi_{k,t}, \qquad (3)$$

[5] The input-output coefficient is defined as: $a_{ik} = \frac{\text{Basic value of product } k \text{ in industry } i}{\sum_i \text{Market value of product } k \text{ in industry } i}$

where $\omega_{k,t} = P_{k,t}X_{k,t} / \sum_{k\in N} P_{k,t}X_{k,t}$ denotes the weight of consumption good *k* in aggregate consumption, with $\sum_{k\in N} \omega_{k,t} = 1$, and $X_{k,t}$ denotes aggregate consumption of good *k*. The individual consumption goods are weighted with lagged weights, which is an approximation of the CPI method. The inflation rate for consumption good *k* is denoted by $\pi_{k,t} = P_{k,t}/P_{k,t-1}$, where $P_{k,t}$ is the price index for consumption good *k*.
Inflation rates for a single consumption good can be expressed as a weighted average of subcomponents of the price index for the good,

$$\pi_{k,t} = s^T_{k,t-1}\pi^T_{k,t} + s^N_{k,t-1}\pi^N_{k,t}, \qquad (4)$$

where inflation rates for nominal consumption tax payments and net prices for good *k* are denoted by $\pi^T_{k,t} = P^T_{k,t}/P^T_{k,t-1}$ and $\pi^N_{k,t} = P^N_{k,t}/P^N_{k,t-1}$, respectively. $s^T_{k,t} = P^T_{k,t}/P_{k,t}$ and $s^N_{k,t} = P^N_{k,t}/P_{k,t}$ denote the share of consumption tax payments and net price for good *k* in the price index $P_{k,t}$, respectively.[6]

By insterting (4) into (3), we derive the following decomposition of the inflation rate

$$\pi^{\text{CPI}}_t = s^T_{t-1}\pi^T_t + s^N_{t-1}\pi^N_t, \qquad (5)$$

where $\pi^T_t = \sum_{k\in N} \omega^T_{k,t}\pi^T_{k,t}$ and $\pi^N_t = \sum_{k\in N} \omega_{k,N,t-1}\pi^N_{k,t}$ are the weighted average inflation rates for taxes and net prices, respectively. $\omega^T_{k,t} = P^T_{k,t}X_{k,t} / \sum_{k\in N} P^T_{k,t}X_{k,t}$ is the share of taxes in total expenditure for good *k*, and $s^T_t = \sum_{k\in N} P^T_{k,t}X_{k,t} / \sum_{k\in N} P_{k,t}X_{k,t}$ denotes the aggregate share of taxes in expenditures. Identical notation applies for the weights of net prices.[7]

The CPI adjusted for tax changes (CPI-AT) is an indicator in which the weights and the calculations are identical to the CPI. The CPI-AT is based on actual, observed prices, but these are adjusted for real changes in taxes. Consumption taxes that are based on the value of sales (ad valorem) are adjusted by the price change of the tax base, i.e. by assuming full pass-through from taxes to prices at the product level.[8] In practice, this is done by setting the tax rates τ_{ikt} and τ^{ET}_{ikt} equal to their base year values (τ_{ik0} and τ^{ET}_{ik0}). Excise taxes based on the unit of sales are adjusted with the CPI. In practice, this is done by replacing the unit of sales excise tax index P^{ET}_{ikt} with the CPI index, where both indices have a base year value of 1.[9]

Since consumption taxes have different deflators for calculating the CPI-AT, we decompose the tax term in (5) further into an ad valorem tax component and a tax component based on unit of sales,

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[6] By dividing both sides of $P_{k,t} = P^T_{k,t} + P^N_{k,t}$ by $P_{k,t-1}$, and multiplying the first and second terms on the right hand side by $P^T_{k,t-1}$ and $P^N_{k,t-1}$, respectively, we obtain (3).

[7] Using (3) we can rewrite the inflation rate as

$$\pi^{\text{CPI}}_t = \sum_k \left[\frac{P_{k,t-1}X_{k,t-1}}{\sum P_{k,t-1}X_{k,t-1}} s^T_{k,t-1}\pi^T_{k,t} + \frac{P_{k,t-1}X_{k,t-1}}{\sum P_{k,t-1}X_{k,t-1}} s^N_{k,t-1}\pi^N_{k,t}\right].$$

Using the definition for $s^T_{k,t-1}$ and rearranging, we can express the first term as

$$\sum_k \frac{P_{k,t-1}X_{k,t-1}}{\sum P_{k,t-1}X_{k,t-1}} \frac{P^T_{k,t}X_{k,t-1}}{P_{k,t}X_{k,t-1}} \pi^T_{k,t} = \frac{\sum P^T_{k,t-1}X_{k,t-1}}{\sum P_{k,t}X_{k,t}} \sum_k \frac{P^T_{k,t}X_{k,t-1}}{\sum P^T_{k,t-1}X_{k,t-1}} \pi^T_{k,t}.$$

Applying the same manipulation to the second term yields expression (4).

[8] Gaarder (2019) finds that taxes levied on food are completely shifted to consumer prices in a study of the sharp change in VAT policy on food in 2001.

[9] See Shang, Ngo and Chaloupka (2020) for a study of the pass-through of alcohol excise taxes to prices in OECD countries (including Norway).

$$s_{t-1}^{T}\pi_t^{T} = s_{t-1}^{AV}\pi_t^{AV} + s_{t-1}^{US}\pi_t^{US}. \qquad (6)$$

Using this we can express the inflation rate as

$$\pi_t^{\text{CPI}} = \underbrace{\left[s_{t-1}^{AV}\hat{\pi}_t^{AV} + s_{t-1}^{US}\pi_t + s_{t-1}^{N}\pi_t^{N}\right]}_{\pi_t^{\text{CPI-AT}}} + \underbrace{\left[s_{t-1}^{AV}(\pi_t^{AV} - \hat{\pi}_t^{AV}) + s_{t-1}^{US}(\pi_t^{US} - \pi_t)\right]}_{\hat{\pi}_t^{T}}, \qquad (7)$$

where $\hat{\pi}_t^{AV} = \sum_{k\in N}\omega_{k,t}^{AV}\hat{\pi}_{k,t}^{AV}$ is the inflation rate for ad valorem consumption taxes with baseline year values of the tax rates (τ_{ik0} and τ_{ik0}^{ET}), i.e. unchanged tax rates between $t-1$ and t.[10] The first term is the CPI-AT inflation rate and the second term is the inflation rate for real taxes.

From equation (7) we see that an increase in consumption taxes will lead to an increase in the CPI-AT inflation rate, which is intended to adjust for changes in real taxes. This is because excise taxes based on unit of sales are adjusted for the CPI inflation rate.

The CPI excluding energy products (CPI-AE) is an index from which the price and weights of the energy products have been excluded. Other computations are identical to the computation process for the CPI,

$$\pi_t^{\text{CPI,AE}} = \sum_{k\in N^{AE}}\omega_{k,t-1}\pi_{k,t}.$$

The CPI adjusted for tax changes and excluding energy products (CPI-ATE) is an index which adjusts for real changes in taxes. Other computations are identical with the computation process for the CPI-AE. We can follow the same procedure as above and decompose the CPI-AE inflation rate into a CPI-ATE inflation rate and an inflation rate for real tax payments, from which energy products have been excluded,

$$\pi_t^{\text{CPI,AE}} = \underbrace{\left[s_{t-1}^{AV,AE}\hat{\pi}_t^{AV,AE} + s_{t-1}^{US,AE}\pi_t^{CPI,AE} + s_{t-1}^{N,AE}\pi_t^{N,AE}\right]}_{\pi_t^{\text{CPI-ATE}}} + \underbrace{\left[s_{t-1}^{AV,AE}\left(\pi_t^{AV,AE} - \hat{\pi}_t^{AV,AE}\right) + s_{t-1}^{US}(\pi_t^{US,AE} - \pi_t^{CPI,AE})\right]}_{\hat{\pi}_t^{T,AE}},$$

where $s_t^{AV,AE} = \sum_{k\in N^{AE}}P_{k,t}^{AV}X_{k,t} \,/\, \sum_{k\in N^{AE}}P_{k,t}X_{k,t}$ denotes the aggregate share of ad valorem excise taxes in expenditures excluding energy goods (as we sum over goods other than energy consumption goods N^{AE}). $s_{t-1}^{US,AE}$ and $s_{t-1}^{N,AE}$ have similar definitions where we sum over N^{AE}. $\hat{\pi}_t^{AV,AE} = \sum_{k\in N^{AE}}\omega_{k,t}^{AV}\hat{\pi}_{k,t}^{AV}$ is the inflation rate for ad valorem consumption taxes with baseline year values of the tax rates (τ_{ik0} and τ_{ik0}^{ET}).

[10] Where $\hat{\pi}_{k,t}^{T} = \hat{P}_{k,t}^{AV}/\hat{P}_{k,t-1}^{AV}$ and $\hat{P}_{k,t}^{AV} = \sum_i a_{ik}\{\tau_{ik0}\left[(1+\tau_{ik0}^{ET})P_{it}^{HF} + b_{ik}^{ET}P_{ikt}^{ET} + c_{ik}P_{ikt}^{TM}\right] + \tau_{ik0}^{ET}P_{it}^{HF}\}$.

3. Domestic prices excluding taxes

In KVARTS, domestic prices excluding taxes, P_{it}^{H}, are determined as mark-ups over marginal costs, where the latter are derived from the production function. The producer price for each product is determined by maximizing real profits, given that producers face a downward declining demand curve for their products on both domestic and export markets. Products are generally assumed to be imperfect substitutes; hence the Norwegian product prices may differ from prices set by foreign competitors. Norwegian producers take foreign prices into account in their price-setting, in line with theories of monopolistic competition. In each industry, producer prices for domestic goods and exports (excl. taxes) are the product of mark-up (μ_{it}) and marginal cost (MC_{it}). Hence, producer prices excl. taxes (P_{it}^{H}) are determined as

$$P_{it}^{H} = \mu_{it}\, MC_{it}.$$

Standard theory tells us that the mark-up is a function of relative prices and total expenditure. We simplify and let each industry mark-up be a function of the price relative (P_{it}^{F}/P_{it}^{H}) only:

$$\mu_{it} = \mu \left(\frac{P_{it}^{F}}{P_{it}^{H}}\right)^{m},$$

where P_{it}^{F} is the competing foreign price and μ and m are parameters. In the base year, when all price indices are equal to one, $\mu_{it} = \mu$, so this parameter is the mark-up in the base year. Inserting the expression for the mark-up in the price equation gives

$$P_{it}^{H} = \mu^{1/(1+m)} (P_{it}^{F})^{m/(1+m)}\, MC_{it}^{1/(1+m)} \qquad (8)$$

If m=0, the mark-up is constant. In this case, price equals marginal cost multiplied by μ. If, on the other hand, the export price or the price in domestic markets for each good equals the competitor's price, P_F, there is price-taking behaviour and output (gross production) is determined by supply (small open economy case). Such price-taking behavior is the case in the petroleum industry where the crude oil price is exogenous in the model and all prices are equal (except for some short-run differences). In the standard case with mark-up pricing, output in each industry is determined by a weighted sum of demand categories in the model.

4. Effects of foreign prices

In the following, we investigate how changes in the foreign price level (measured in domestic currency) impact the consumer price index. It was shown above in equations (2) and (8) that foreign prices enter both directly in the composite price index P_{it}^{HF} and indirectly in the determination of domestic prices excluding taxes through mark-up pricing. To illustrate the importance of these two channels we use the macroeconomic model KVARTS to simulate the response of the CPI from a change in foreign prices. In KVARTS, there is a sluggishness in the pass-through from foreign prices in foreign currency to import prices in domestic currency (P_{it}^{F}). To make the impact of domestic import prices on the CPI easier to interpret, we scale the permanent change in foreign prices in foreign currency so that the annual change in import prices in domestic currency is exactly 1.0 per cent; see Table 4.1.

Table 4.1 First-year effect on the CPI of a permanent change in foreign prices. Percentage deviation from baseline

Foreign prices, foreign currency	2.22
Import prices, domestic currency[1]	1.00
Consumer Price Index, CPI[2]	0.40

Simulations are undertaken with exogenous exchange rates. [1] Import prices are measured by P_{it}^{F}.
[2] The CPI is measured by π_t^{CPI}.
Source: Statistics Norway, KVARTS database.

The direct effect of import prices in equation (2) of a 1.0 per cent change in import prices would in the long run equal the import share, which was about 19 per cent in 2017. Added to this direct effect is the impact of mark-up pricing. In total, the first-year impact on the CPI is 0.4 per cent.

Every year the elasticity of the exchange rate to consumer prices is reported in the annual report published by the Norwegian Technical Calculation Committee for Wage Settlements.[11] In 2020 this elasticity was found to be 0.12. This is lower than the impact of the elasticity of import prices shown above. The reason for this discrepancy is that it takes time for changes in the exchange rate to impact import prices. The first-year change in import prices due to a 1 per cent change in the exchange rate is about 0.4 per cent. Further empirical properties of the price equations are outlined in Bowitz and Cappelen (2001) and Boug, Cappelen and Swensen (2017).

5. Effects of tax changes

In the following, we investigate how changes in consumption taxes impact inflation as measured by the CPI and the CPI-ATE. Changes in consumption taxes will directly affect inflation, as is clear from the price index equation (1). In addition, general equilibrium effects will affect inflation through various channels. To decompose the two effects, we analyze three different models. First, we use a substantially reduced version of KVARTS which only includes the CPI, i.e. the CPI-ATE and its subcomponents. This will only yield the direct effect of consumption tax changes. Second, we analyze the tax changes using the KVARTS macroeconomic model with exogenous interest and exchange rates. Finally, we analyze the tax changes using KVARTS with endogenous interest and exchange rates. We permanently increase consumption taxes such that tax revenues mechanically increase by 0.5 per cent of 2019 mainland GDP (NOK 15,200 million).

We analyze four different consumption taxes: VAT rates, ad valorem excise tax rates, per unit excise tax on producers and per unit excise tax on wholesale and retail products. All payments are increased proportionally in all sectors and on all consumption goods. This means that all VAT rates increase by equal amounts.

Table 5.1 Effect on the CPI (in %) of a consumption tax increase. Tax increase equivalent to 0.5% of mainland GDP

		Total effect	
	Direct effect	Exogenous interest and exchange rate	Endogenous interest and exchange rate
VAT rate	0.58	0.66	0.80
Ad valorem excise tax rate	0.43	0.47	0.58
Per unit excise tax: producer	1.08	1.20	1.46
Per unit excise tax: wholesale and retail	0.87	0.98	1.20

Source: Statistics Norway, KVARTS database.

[11] See, https://www.regjeringen.no/en/topics/labour/lonn-og-inntekt/innsikt/inntektspolitikk-og-lonnsoppgjor/tbu/id439434/ and the report.

Table 5.2 Effect on the CPI-ATE (in %) of a consumption tax increase. Tax increase equivalent to 0.5% of mainland GDP

		Total effect	
	Direct effect	Exogenous interest and exchange rate	Endogenous interest and exchange rate
VAT rate	0.04	0.07	0.20
Ad valorem excise tax rate	0.03	0.04	0.14
Per unit excise tax: producer	0.07	0.11	0.34
Per unit excise tax: wholesale and retail	0.06	0.10	0.29

Source: Statistics Norway, KVARTS database.

Several interesting points emerge from the results in Tables 5.3 and 5.4. First, the effects on inflation due to an increase in consumption taxes are mainly driven by direct effects. Effects due to other components are much smaller. Second, the indirect effects are to a large degree driven by the exchange rate. An increase in consumption taxes leads to an exchange rate depreciation which in turn leads to higher inflation. Third, tax changes have a small but positive direct effect on CPI-ATE inflation. This is due to the fact that excise taxes based on unit of sales are adjusted for the CPI inflation rate, as discussed above. Fourth, VAT and valorem excise tax rates have a much lower impact on inflation than excise taxes based on unit of sales. This is because unit of sales taxes are directed at households to a larger extent than VAT and ad valorem taxes are. For example, while about 52 per cent of VAT taxes were directly levied on households in 2017, the corresponding figure is about 63 per cent for per-unit excise taxes. VAT generates much more tax revenue from investments and government consumption than is generated by per-unit excise taxes. For example, in contrast to per-unit excise taxes, VAT is levied on investments in new dwellings.

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