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Teze doktorské práce[1]
Dissertation thesis summary

Název / Title	Microeconomic Analysis for Evidence-Based Policy
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Studijní program / Study program	Ekonomie
Školitel / Advisor	PhDr. Michal Bauer, Ph.D.
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Oponenti / Opponents	1. Prof. Richard Blundell
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Termín a místo obhajoby / Term and venue of defence	18.12.2013, Institut ekonomických studií

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Abstrakt / Abstract[2]

Dizertace se zaměřuje na mikroekonomickou analýzu veřejných politik v České republice. Dizertace se skládá ze tří částí. První dvě se zabývají analýzou daňových politik, třetí část zkoumá rozdílné dopady inflace.

První kapitola dizertace se zabývá analýzou daně z přidané hodnoty (DPH). Sazby DPH se nedávno měnily v České republice a v této kapitole simuluji dopad těchto reforem. Tyto reformy jsou příkladem změn v nepřímém zdanění, které mění ceny zboží a služeb, na které můžou reagovat domácnosti přizpůsobením svých výdajů. Nejdříve odhaduji behaviorální reakci spotřebitelů na změny cen v České republice aplikací spotřebitelského poptávkového modelu kvadratického téměř dokonalého poptávkového systému (QUAIDS) na základě dat Českého statistického úřadu o vývoji spotřeby domácností a cen mezi roky 2001 a 2011. Dále odvozuji odhady vlastních i křížových cenových a příjmových elasticit pro jednotlivé domácnosti. Pak používám tyto elasticity pro odhad dopadu změn v sazbách DPH, které byly navrhnuty nebo implementovány mezi roky 2011 a 2013, na změnu v domácnostmi poptávaném množstvím a vládních příjmech. Jedno z hlavních zjištění se týká rozdílu v různých odhadech dopadů na vládní příjmy: zohlednění behaviorální reakce spotřebitelů oproti statické simulaci snižuje odhadované změny o více než jednu čtvrtinu.

Druhá kapitola se zaměřuje na analýzu spotřebních daní. Spotřební daně jsou důležitým zdrojem vládních příjmů a jejich sazby se v České republice mění relativně často. Reformy spotřebních daní mění ceny zboží a služeb, na což mohou reagovat domácnost změnou svých výdajů. Používám detailní data Českého statistického úřadu a diskutuji jejich omezení. Dále beru odhady elasticit z první kapitoly a vytvářím mikroekonomický simulační model, který mi umožňuje simulovat dopad změn spotřebních daní na množství poptávané domácnostmi. Ukazuji distribuční dopad současných spotřebních daní a simuluji dopad hypotetického zvýšení o deset procent každé z nich. Dále simuluji dopad určitých schválených nebo navržených změn ve spotřebních daní včetně neúspěšného návrhu z roku 2012 na zavedení spotřební daně na víno.

Třetí kapitola zkoumá rozdílné dopady inflace. Domácnosti se liší v tom, za co utrácení a existují i rozdíly mezi nárůsty cen různých zboží a služeb. Proto různé domácnosti zažívají různé nárůsty cen. Tyto rozdíly se jeví jako důležité v České republice mezi lety 1995 a 2010. Jenom zhruba 60% domácností bylo vystaveno zhruba průměrnému nárůstu cen. Čím vyšší inflace v daný rok byla, tím menší byl podíl domácností, který byl vystaven průměrnému nárůstu cen. Hlavní determinanty inflace byly výdaje za bydlení, energie, a, především pro nízkopříjmové domácnosti a důchodce, výdaje za jídlo a nealkoholické nápoje. Po většinu zkoumaných let nízkopříjmové domácnosti a důchodci čelily vyšším nárůstům cen než zbytek obyvatel.

[2] Pro disertace napsané česky vložte abstrakt anglicky. Pro disertace psané anglicky vložte abstrakt česky. / For thesis in Czech fill in abstract in English. For thesis in English fill in abstract in Czech.

Dissertation summary

This dissertation thesis is focused on the microeconomic analysis of public policy in the Czech Republic. It consists of three parts, the first two parts deal with the analysis of tax policy; the third part of this thesis is focused on inflation differentials.

The first chapter deals with the analysis of value added tax and I describe this chapter in detail in this summary. I sum up the two other chapters at the end.

Value added tax (VAT) is one of the most important taxes in the Czech Republic, as well as in the rest of the developed world. The impact of VAT changes depends on the microeconomic behaviour of the consumers and my objective here is to shed more light on the behavioural responses of Czech consumers to tax rate changes.

A rigorous analysis of impact is particularly pertinent in the Czech Republic since the value added tax rates have recently gone through important changes. They were, respectively, 10% and 20% in 2011, 14% and 20% in 2012, and – after a last-minute change from the previously approved unification of rates at 17.5% - a one percentage point increase in both rates to 15% and 21% in 2013.

The existing impact evaluations of these VAT reforms have, at best, made use of microeconomic data and first order approximations such as (Dušek & Janský 2012a) and (Dušek & Janský 2012b). However, these studies used a static micro-simulation with no behavioural response and did not properly account for the potential for consumers to substitute goods as relative prices change (Banks et al. 1996). In the case of VAT rate increases, this might cause over-estimation of the effects of VAT rate increases on government revenues.

For a more rigorous analysis it is useful to have detailed knowledge of consumers' individual preferences about which, however, information is not readily available. So as a first step, this paper derives second order approximations which do not display systematic biases as shown in (Banks et al. 1996), but which, in contrast to first order approximations, require knowledge of the elasticities. Specifically, I estimate the Quadratic Almost Ideal Demand System (QUAIDS) as developed by (Banks et al. 1997).

The QUAIDS model was previously estimated for the Czech Republic by (Dybczak et al. 2010) to derive elasticities and analyse the impact of regulated price changes on consumer demand. The QUAIDS model has also been applied in the analysis of VAT reforms in the UK by (Crawford et al. 2010) or Mexico by (Abramovsky et al. 2012). Therefore, to the best of my knowledge, this is the second QUAIDS model for the Czech Republic, and the first QUAIDS model built specifically for the analysis of tax policy in the Czech Republic.

The model employs household expenditure and demographic data from the Household Budget Survey (HBS) and price data from the Consumer Price Index (CPI), both from the Czech Statistical Office (CZSO). This demand system differs from the existing models for the Czech Republic in terms of the consumer price information used. Regarding prices, I rely solely on the CPI, rather than on the HBS or on a combination of the two. The exclusive use of official

figures on prices in CPI, instead of on unit values derived from expenditures and quantities recorded in the HBS, lowers the risk that any observed price variation may in reality reflect a variation in quality.

I have chosen to classify expenditure in order that it reflects not only functional groupings (e.g. food, clothes) but also identifies goods and services that incur different rates of VAT. I thus apply an approach similar to (Abramovsky et al. 2012), who pioneered the use of QUAIDS to analyse the impacts of VAT changes. The estimated price and income elasticities appear plausible in magnitude and sign. For instance, food is found to be a necessity while eating out is found to be a luxury. Strong luxuries include transport and recreation and household goods. This categorization and these estimates of elasticities, together with a simple microeconomic simulator, enable me to estimate how consumers respond to changes in VAT rates and the implications for consumers' spending patterns, quantity demanded and government tax revenues.

I then use this model to simulate the recent VAT reforms. In line with (Banks et al. 1996) and similarly to previous research by (Crawford et al. 2010) or (Abramovsky et al. 2012), I find that for the Czech Republic too, allowing for behavioural response makes a difference to estimates of the tax revenues, which are lower in comparison to the estimates produced by a first order approximation holding behaviour fixed, specifically the static micro-simulation model that did not allow for any behavioural response and held the quantity of purchases fixed (nominal rise or fall of expenditures in line with the rise of fall in VAT rates).

The literature on consumer demand and VAT is quite large and I will therefore focus on only three areas. First, I briefly introduce the most important contributions to demand system estimation. Second, I discuss existing articles that estimate demand systems for the Czech Republic. Third, I provide an overview of the literature on the impacts of VAT in the Czech Republic.

(Stone 1954) first pioneered the estimation of a demand system based on consumer preferences theory; specifically, he estimated linear expenditure systems as developed by (Klein & Rubin 1947). A number of improvements have been elaborated and proposed over the decades. One demand system that is often estimated nowadays is the Almost Ideal Demand System (AIDS) developed by (Deaton & Muellbauer 1980). The Quadratic Almost Ideal Demand System (QUAIDS), developed by (Banks et al. 1997), is essentially a version of AIDS that allows Engel curves to be quadratic. Furthermore, (Poi 2002) and (Poi 2008) are useful introductions to estimating QUAIDS using the STATA software, as I do here. Recent applications of the QUAIDS model similar to this paper are (Crawford et al. 2010), who present estimates of impact of a hypothetical unification of VAT rates in the UK and also discuss the implications of VAT for labour market participation based on UK data, and (Abramovsky et al. 2012), who evaluate Mexican tax reform.

Second, demand systems have recently been estimated for the Czech Republic most notably in two research papers. Using the AIDS in a modification by (Edgerton 1996), (Janda et al. 2010) estimated elasticities focusing on alcoholic beverages and found, for example, a very low own-price elasticity of demand for beer. (Dybczak et al. 2010) were the first to estimate

the QUAIDS for the Czech Republic, and divide expenditure into eight categories - food, clothing, energy, house, health, transport, education and other - that do not, however, align with VAT rates (as do the categories used in this paper). They estimated own- and cross-price and income elasticities and used them to analyse the impact of changes in regulated prices on consumer demand. In addition, a number of studies such as (Dubovicka et al. 1997) or (Janda et al. 2000) have focused on estimating Czech food demand elasticities using flexible function forms, to which both AIDS and QUAIDS also belong. Last, but not least, (Crawford et al. 2004) developed a new method for the estimation of price reactions, and applied it to the Czech data. By estimating the QUAIDS model with the most recent data and for the purposes of indirect tax policy analysis, I contribute to the existing literature on demand system estimation in the Czech Republic, most notably (Dybczak et al. 2010).

Third, by way of a short overview of VAT in the Czech Republic and related literature: the Czech Republic introduced VAT in 1993, and it applies to most household expenditures at one of its two rates. In recent years these rates have been, respectively, 10% and 20% in 2011, 14% and 20% in 2012, and in 2013 – after a last-minute change from the previously approved unification of rates at 17.5% - the government increased both its reduced and standard rates by one percentage point to 15 % and 21 %, respectively. VAT and its changes in the Czech Republic have been studied by (Schneider 2004), who analysed the tax burden of households and found VAT to be relatively regressive, and more recently by (Klazar et al. 2006), who use a micro simulation model to estimate incidence of taxes, but without the use of elasticities, and by (Klazar et al. 2007), who focused on the impact of EU-accession related harmonisation of VAT rates. (Klazar & Slintáková 2010) studied VAT in the Czech Republic and its impact on households, and found VAT to be regressive when annual income is analysed, although their lifetime income analysis indicated that VAT is progressive.

Most recently (Dušek & Janský 2012a) and (Dušek & Janský 2012b) used a simple static micro-simulator – without using a demand system and accounting for behavioural response to VAT changes as I do in this paper – to provide the first independent estimates of the impact of the recently proposed VAT rates changes in the Czech Republic on the living standards of households as well as on the government's tax revenues. One objective of this paper is to compare the results of analysis of these VAT reforms according to whether behavioural change is taken into account or not. By accounting for behavioural response in tax policy analysis and showing the differences in the result when compared with static micro-simulation methodology that holds fixed the quantity of goods and services purchased, I contribute to the existing literature on simulation of VAT reforms in the Czech Republic (Dušek & Janský 2012a) and (Dušek & Janský 2012b).

I estimate the demand system according to the Quadratic Almost Ideal Demand System (QUAIDS) form developed in (Banks et al. 1997) and I further use this for indirect tax policy analysis, as proposed by (Banks et al. 1996) and applied in (Crawford et al. 2010) or (Abramovsky et al. 2012). The QUAIDS model allows me to take consumers' substitution responses into account when relative prices change due to VAT reforms, and is the first such model built in the Czech Republic specifically for the analysis of tax policy.

The model is based on an indirect utility function from which the shares of expenditure on various goods and services categories are derived, and these are then updated with demographic characteristics. Similarly to the only QUAIDS previously estimated for the Czech Republic by (Dybczak et al. 2010), demand depends not only on prices and incomes, but also on other household characteristics such as the size of the household or the employment status or age of the household's head. It is estimated by seemingly unrelated regression equations with parameter restrictions such that the estimated demand system satisfies the conditions of adding-up, homogeneity, symmetry and negativity (negative semidefiniteness).

The QUAIDS model is a generalization of Almost Ideal Demand System (AIDS) model that allows for quadratic Engel curves. The QUAIDS can therefore allow a good to be a luxury at one level of income and a necessity at another, a property that (Banks et al. 1997) found to be of empirical relevance for the UK and they also showed that it is sufficient for the nonlinear term to be a quadratic in log income. This was documented for the Czech Republic by (Dybczak et al. 2010).

To estimate the QUAIDS model I employ the best available data for the Czech Republic in the form of two datasets from the Czech Statistical Office (CZSO). The Household Budget Survey (HBS) is a representative sample collected on a yearly basis of around 3000 Czech households. For each of them, the HBS contains information on how much they spend on various goods and services (around 250 expenditure items), who they are (around 60 demographic variables) and how they earn their income (around 30 income items). The HBS has been applied to the estimation of demand systems by both (Janda et al. 2010) and (Dybczak et al. 2010) and it was also used by (Crawford et al. 2004). In terms of the years, there is a trade-off between the amount of data and its quality and consistency; I solve this by using 11 years. I employ data for the period between 2001 and 2011 and therefore I have data from around 33000 households in total and I assume this to be a representative sample for the Czech Republic.

I use CZSO price data, gathered for the purpose of the Consumer Price Index (CPI), that is classified into around 150 categories according to the classification of individual consumption by purpose (COICOP). The price information is available for the Czech Republic as a whole, and also separately for the capital city of Prague.

I rely on the CPI as the sole source of price information; this is in contrast to both (Janda et al. 2010) and (Dybczak et al. 2010), who used the HBS not only as a source of expenditure information, but also as a source of price information. Specifically, they divided the expenditures by the quantity of purchased goods and services. In this way they derived unit values, and used these as prices. This has the advantage of relatively easily obtaining very detailed expenditure- and household-specific prices, but it can in some cases be inaccurate, and another drawback is that the HBS data for the quantity of purchased goods and services is incomplete.

There are three reasons why I opt to use the CPI as my only source of prices. First, differences in unit values can be caused by product quality differences, rather than by the price

differences that I aim to study. With these unit values it is almost impossible to distinguish between the influence of changes in price and in quality, since risk observed price variation may instead reflect variations in quality. By using the CPI data, I limit the extent of this problem. Second, the HBS only includes information on the quantity of purchased goods and services for a limited number of expenditure items. Unit values can be thus only be constructed for those goods for which quantity information is available. Therefore if I used the HBS data for prices, I would need to limit my analysis to a small subset of overall expenditures, as (Janda et al. 2010) did, or alternatively fill in the HBS unit values whenever these are not available using the CPI prices, as was done by (Dybczak et al. 2010). In contrast to (Janda et al. 2010), I prefer to analyse as high a share of overall household consumption as possible, and this is made possible by applying the CPI data. In contrast to (Dybczak et al. 2010), I prefer the consistency of using only one complete source for information on prices, namely the CPI.

In the expenditure share equations estimated in QUAIDS I include a time trend and a number of demographic variables to take account of preference variation that may be correlated with total expenditure or prices in a way that is consistent with the model. Table 1 provides the list of these variables.

I classify the HBS expenditure data according to the VAT rates, reduced and standard, presented in the appendices to the law on VAT as of January 2013. When HBS classification is not detailed enough to allow accurate division according to VAT rate, or when some expenditures are exempted from VAT, I assign the VAT rate according to the one prevailing for that group. I merge the HBS and the CPI data using the HBS codes and COICOP codes and although these two classifications do not always match perfectly and both of them have undergone revisions over time, no substantial compromises had to be made during the matching process.

In order to estimate QUAIDS, I divided the detailed expenditure items into eight groups. I followed three principles while grouping the expenditure items, and in this I differ from the previously estimated demand systems for the Czech Republic. Firstly, the division should correspond to natural categories as people might think about them, which was essentially the case in (Dybczak et al. 2010). Secondly, the expenditure groups should be similar in size, which is advantageous both for the estimation of the model and for the interpretation of the results. Thirdly and most importantly for my analysis, the expenditure groups should be divided according to VAT rate as far as possible. A number of compromises had to be made when following these three principles, and when considering these, I have given highest priority to the third principle. I calculate the price indices of aggregated commodities as weighted arithmetic averages of the price indices of the individual goods and services making up the aggregated commodity for each year, and then aggregate them for each household to arrive at overall expenditure group-, household- and year-specific price indices. Table 2 provides the names and shares in total expenditures of the eight expenditure groups for the year 2011. A more detailed description can be found in Table 10 and basic summary statistics in Table 11, in the Appendix. I use this categorisation of expenditures into groups in my estimation.

Table 3 below presents the parameter estimates for the QUAIDS and the estimated parameters correspond to the equation number 1 above. The table uses asterisks to indicate the statistical significance of the estimates, which is rather low and I discuss this problem below with regard to elasticities. It is difficult to interpret the parameters of QUAIDS directly and I therefore mainly discuss the elasticities, as is also common in the existing literature. Specifically, I present the estimates of income, own- and cross-price elasticities.

Table 3. QUAIDS parameter estimates for the Czech Republic

	Food	Eating out	Household goods	Clothing	Other services	Transport, recreation	Energy	Other goods
α	0.034629	0.129872***	0.146827***	0.095397***	0.142082***	0.296177***	0.027498	0.127519***
α_{age}	0.001327***	-0.000792***	-0.000679***	-0.000576***	0.000644***	-0.001347***	0.001123***	0.000300***
$\alpha_{members}$	0.049455***	-0.000453	-0.018151***	-0.007281***	-0.010875***	-0.017419***	0.013783***	-0.009059***
α_{child}	- 0.012259***	-0.017422***	0.005543***	0.005970***	0.023873***	0.001021	-0.008192***	0.001467*
$\alpha_{empstat}$	-0.004928***	0.014813***	-0.014546***	0.008293***	0.003614**	-0.015708***	0.008814***	-0.000350
$\alpha_{educlow}$	0.013543***	0.005296***	0.002189**	-0.004761***	-0.016510***	-0.001317	0.000541	0.001019
$\alpha_{educmid}$	0.006367***	0.005712***	0.001941*	-0.003052***	-0.008226***	-0.001056	-0.004179***	0.002493***
α_{Praha}	0.003985***	0.000245	-0.012013***	-0.004137***	-0.010341***	-0.000307	0.010270***	0.012298***
$\alpha_{city\ size}$	0.002271***	-0.005977***	0.000127	-0.002026***	-0.037137***	0.008055***	0.030973***	0.003715***
γ_1	0.128462***	0.001691	0.006585	-0.022831**	-0.005289	-0.058485***	-0.044166***	-0.005967
γ_2	0.001691	-0.021096	0.016954	-0.017499	0.049918	-0.000690	-0.021749	-0.007529
γ_3	0.006585	0.016954	-0.046039	-0.001063	0.003730	0.032677	0.002452	-0.015295
γ_4	-0.022831**	-0.017499	-0.001063	0.035773*	-0.023621	0.018662	0.032879***	-0.022300**
γ_5	-0.005289	0.049918	0.003730	-0.023621	0.000290	-0.016791	-0.020636	0.012399
γ_6	-0.058485***	-0.000690	0.032677	0.018662	-0.016791	0.060468**	-0.021107	-0.014734
γ_7	-0.044166***	-0.021749	0.002452	0.032879***	-0.020636	-0.021107	0.070200***	0.002126
γ_8	-0.005967	-0.007529	-0.015295	-0.022300**	0.012399	-0.014734	0.002126	0.051301***
β	-0.161067***	0.012994***	0.073417***	0.028031***	-0.027351***	0.147496***	-0.062735***	-0.010784
λ	-0.014765***	0.001109	0.001045	0.003093***	0.003548*	0.013542***	-0.002783*	-0.004790
Time trend	-0.001333	0.000404	0.005687***	0.000695	-0.000581	-0.001944	-0.003641***	0.000713
V 1	0.187960***	-0.034971	0.052232	0.062695**	0.069491	-0.701702***	0.312978	0.051318
V 2	-0.079719*	0.182203***	0.242166***	0.110696***	-0.038433	-0.515080***	0.006774	0.091394
V 3	-0.065040***	0.060609***	0.088550***	0.038058***	-0.009418	-0.117508***	-0.026025	0.030774
V 4	-0.006439**	0.000790	-0.002883	-0.003132***	-0.003261	0.028565***	-0.011619	-0.002021
V 5	0.000061	-0.000360***	-0.000400***	-0.000221***	0.000002	0.001088***	-0.000026	-0.000144
V 6	0.000004***	-0.000005***	-0.000007***	-0.000004***	0.000000	0.000012***	0.000002	-0.000002

*Notes: The parameters V1-6 relate to the linear, square and cubic terms of the residuals from two regressions as described in a footnote number 9. The cells with parameters are complemented with asterisk in line with their significance: *** implies significance at the 1% level, ** implies significance at the 5% level and * implies significance at the 10% level.*

I calculate the elasticities for each household individually and I subsequently construct a weighted average, with the weights being equal to the household's share of the total expenditure and to the total sample expenditure for the relevant good, for the income and price elasticities, respectively.

Table 4 presents the income elasticities, estimated using the total expenditure variable. For comparison, the table shows also the own-price elasticities, both the Marshallian (uncompensated) and the Hicksian (compensated) (that are also shown together with cross-price elasticities shown in tables 5 and 6 below).

Only half of the income elasticities are statistically significant at least at the 10% level, and so these results should be interpreted with caution. More optimistically, the estimated income elasticities seem reasonable. Other services, including public services, are a necessity, and the

same holds for other goods, although these have an income elasticity of just below 1. Food and energy are both necessities, albeit not statistically significant. So both expenditure groups with the reduced VAT rate – food and other services – are necessities. Eating out, clothing, household goods and transport and recreation all have the income elasticity greater than 1 and are therefore considered luxuries.

The patterns of income elastiticities are relatively comparable to those estimated by (Dybczak et al. 2010). Food and energy are in both cases expenditure groups with the lowest income elasticity and transport with the highest one.

Table 4. Income and own-price elasticities.

Group	Expenditure	Income Elasticity	Marshallian own-price elasticities	Hicksian own-price elasticities
1	Food	0.419	-0.311*	-0.194
2	Eating out and other luxuries	1.100***	-1.202	-1.081
3	Household goods	1.794***	-1.540***	-1.366***
4	Clothing	1.295	-0.533	-0.431
5	Other services	0.724*	-0.966*	-0.851
6	Transport and recreation	2.097	-0.738***	-0.414
7	Energy	0.445	-0.186	-0.139
8	Other goods	0.991***	-0.522***	-0.413***

*Notes: The cells with parameters are complemented with asterisk in line with their significance: *** implies significance at the 1% level, ** implies significance at the 5% level and * implies significance at the 10% level.*

In the case of the Czech Republic, there are a number of recent changes in VAT rates suitable for simulation. The reduced and standard VAT rates were, respectively, 10% and 20% in 2011, the last year for which there is available data. Then in 2012, the rates were 14% and 20% and these were increased by one percentage point to 15% and 21% in 2013. Furthermore, there was another proposal, initially legislated and then repealed during late 2012, that in 2013 the two rates would be unified at 17.5%. The objective of this simulation is to evaluate the latest reform, namely the increase in both rates by one percentage point in 2013, and compare this with the unification proposal.

The last available year of data is from 2011, when the VAT rates were 10% and 20%, and therefore I first simulate the expenditures under VAT rates of 14% and 20% that were in place in 2012 and establish that as the status quo. Based on this, I then simulate the outcome in 2013, in order to estimate the changes between 2012 and 2013 and compare these with the unification proposal.

I use the estimated elasticities to simulate the impacts of VAT reforms on consumer spending patterns and tax revenues. For this I use the Marshallian (uncompensated) price elasticities. The estimates of elasticities are largely statistically insignificant at the standard levels and so the results of these simulations should be interpreted with caution.

Estimates incorporating such behavioural response are then compared to those based on the no-behavioural-response static micro-simulation results. When using the demand system results for these purposes I model changes in VAT rates as changes in the prices of the eight aggregate expenditure groups used in the QUAIDS demand system. Also on the basis of discussion in (Dušek & Janský 2012a) I assume that changes in VAT rates are fully reflected in the prices. This assumption is more likely to be fulfilled in the long term rather than the short term, and this should be taken into account when interpreting the results.

Table 7 shows simulated estimates of average expenditure shares after the 2012 as well as 2013 – including the earlier proposal – VAT rate changes. Overall, neither the 2012 nor 2013 approved VAT changes have a very substantial impact on spending patterns; the expenditure shares change only in terms of tenths of a per cent. The simulation of the introduction of a uniform 17.5% rate of VAT suggests a larger and more varied impact, which is not surprising due to the fact that this implies a greater change in both rates in terms of percentage points, and the fact that the two rates move in opposite directions. In particular, the share of food, on which reduced VAT rate is currently levied, increases substantially by more than half a percentage point, reflecting its low own-price elasticity of demand, while the share of other goods generally falls.

Table 7. Simulated average expenditure shares after changes in VAT rates (%).

Group	Expenditure	2012 (14% and 20%)	2013 realised reform (15% and 21%)	2013 proposed reform (17.5% and 17.5%)
1	Food^{R}	24.9	25.1	25.5
2	Eating out and other luxuries^{S}	10.9	10.8	11.1
3	Household goods^{S}	7.4	7.4	7.5
4	Clothing^{S}	6.2	6.0	5.8
5	Other services^{R}	16.1	16.1	16.0
6	Transport and recreation^{S}	10.9	11.0	10.8
7	Energy^{S}	11.7	11.7	11.4
8	Other goods^{S}	11.9	11.9	11.9
	Total	100	100	100

Notes: The superscripts R and S denote the prevailing VAT rate as the reduced and the standard one, respectively.

Table 8 shows estimates of simulated changes in the quantity demanded in terms of percentage of total expenditure for the two VAT rate proposals in 2013. Table 8 includes confidence intervals, which I estimated on the basis of bootstrapped estimates of elasticities and that are relatively narrow, at least for both total estimates and the 2013 realised reform. I find that increasing both VAT rates by one percentage point to 15% and 21% results into relatively small drops in the quantity demanded, with the extent of the impact mostly corresponding with the income as well as own-price elasticities. For example, the groups that decreased the most – both household goods and transport and recreation, each by around 2% – also have the highest income elasticities and some of the highest own-price elasticities. This pattern also holds vice versa: the groups that decreased the least – both food and energy by 0.4% – also have the lowest income elasticities and lowest own-price elasticities. The estimated impacts for the unification proposal are once again more varied. The overall impact on quantity demand is only slightly negative, with the largest decline of 3.2% for other services and the largest increase of 4.6% for eating out.

Table 8. Simulated average percentage changes in the quantity demanded in 2013 after changes in VAT rates from the 2012 baseline (%).

Group	Expenditure	2013 realised reform (15% and 21%)	QUAIDS 95% confidence interval		2013 proposed reform (17.5% and 17.5%)	QUAIDS 95% confidence interval	
1	Food^{R}	-0.40	-0.41	-0.38	-0.49	-1.57	0.59
2	Eating out and other luxuries^{S}	-0.89	-0.95	-0.84	4.58	-1.21	10.37
3	Household goods^{S}	-1.74	-1.82	-1.67	3.07	-3.69	9.84
4	Clothing^{S}	-1.17	-1.22	-1.12	-2.14	-6.71	2.44
5	Other services^{R}	-0.67	-0.71	-0.63	-3.24	-6.79	0.32
6	Transport and recreation^{S}	-2.18	-2.25	-2.10	-3.12	-7.61	1.37
7	Energy^{S}	-0.42	-0.45	-0.38	-1.10	-3.61	1.41
8	Other goods^{S}	-0.85	-0.88	-0.82	2.30	0.49	4.11
	Total	-0.87	-0.87	-0.87	-0.10	-0.15	-0.05

Notes: The superscripts R and S denote the prevailing VAT rate as the reduced and the standard one, respectively.

Table 9 shows revenue estimates for the VAT changes on the basis of our sample of Czech households extrapolated for the whole population of the Czech Republic. These estimates necessarily reflect only the VAT levied on household consumption and, since the impact in other sectors is not taken into account, do not reflect the overall impact on government revenues. Also I do not model any administrative savings or lower tax evasion levels that the unification of rates might bring about.

The first part of Table 9 shows results for the realised proposal (15% and 21%), the second part for the 2013 repealed proposal (unified VAT rate of 17.5%).

In each of two parts of Table 9, the first column shows the estimated revenues from the reforms using a static micro-simulation allowing for no behavioural response and holding the quantity of purchases fixed, similar to that in (Dušek & Janský 2012a), i.e. no results from the QUAIDS model were employed to simulate these impacts. The second column uses the QUAIDS results to allow for spending patterns changing in response to the price changes. The third and fourth columns report their confidence intervals, which I estimated on the basis of bootstrapped estimates of elasticities. The confidence intervals are relatively narrow for most estimates. This is somewhat more encouraging from the point of view of relevance of this simulation than the low statistical significance of elasticities would suggest.

The magnitude of difference between the two estimation methods is in line with expectations: allowing for consumer spending patterns to change in response to VAT changes has a relatively large impact on the resulting change in VAT revenues. With the static micro-simulation model the estimated impact on VAT revenues is, rounding these figures, 10 billion CZK for the realised proposal (15% and 21%) and -1 billion CZK (Czech crowns) for the 2013 repealed proposal (unified VAT rate of 17.5%). The corresponding estimates using QUAIDS are around zero and 7 billion CZK, i.e. lower in total by around 1 and almost 3 billion CZK, respectively, and also lower for individual expenditure groups than the estimates with no behavioural response. Nevertheless, as the confidence intervals show, the differences seem more important in the case of the 2013 realised reform (15% and 21%) than the 2013 proposed reform (17.5% and 17.5%).

The estimated tax revenue after allowing for the consumers' behaviour to adjust (in accordance with QUAIDS preferences) is, as expected, lower in magnitude than the estimate using the static micro-simulation methodology that holds fixed the quantity of goods and services purchased. For the realised 2013 proposal – one percentage point increase in both VAT rates – the estimated increases in government revenues that take the consumer responses into account are 28% lower than the estimates with no behavioural response. These differences are important and have policy implications. The 28% difference is higher than the estimates for similar VAT simulation in Mexico presented in (Abramovsky et al. 2012), whose findings imply a difference of only about 7% and 16% for proposed and approved VAT reforms, specifically. The relatively high variation in these estimates suggests a need for further research as to the extent of this difference, which should be, at least before the estimates converge more closely, both country- and reform-specific.

For the proposed 2013 unification of VAT rates, the estimated decrease in government revenues that takes the consumer responses into account is approximately five times lower than the estimates with no behavioural response. These differences show that behavioural responses are quantitatively important and they should be taken into account in order for such revenue projections to be more precise.

Table 9. Effect of consumer demand response on revenues from changes in VAT rates (billions Czech crowns)

Group	Expenditure	2013 realised reform (15% and 21%)	2013 realised reform (15% and 21%)	2013 realised reform (15% and 21%)	2013 realised reform (15% and 21%)
		No behavioural response	QUAIDS	QUAIDS 95% confidence interval	
1	Food[R]	2.31	1.86	1.84	1.88
2	Eating out and other luxuries[S]	1.04	0.73	0.70	0.76
3	Household goods[S]	0.84	0.48	0.46	0.51
4	Clothing[S]	0.65	0.53	0.40	0.65
5	Other services[R]	1.53	1.13	1.09	1.17
6	Transport and recreation[S]	1.49	0.88	0.86	0.90
7	Energy[S]	0.97	0.74	0.71	0.77
8	Other goods[S]	1.11	0.78	0.76	0.80
	Total	9.95	7.13	6.99	7.27

Group	Expenditure	2013 proposed reform (17.5% and 17.5%)	2013 proposed reform (17.5% and 17.5%)	2013 proposed reform (17.5% and 17.5%)	2013 proposed reform (17.5% and 17.5%)
		No behavioural response	QUAIDS	QUAIDS 95% confidence interval	
1	Food^{R}	8.25	6.78	6.33	7.23
2	Eating out and other luxuries^{S}	-2.54	-1.53	-2.48	-5.88
3	Household goods^{S}	-2.06	-1.45	-2.03	-0.87
4	Clothing^{S}	-1.59	-0.59	-2.41	1.22
5	Other services^{R}	5.45	3.70	2.80	4.59
6	Transport and recreation^{S}	-3.64	-3.02	-3.20	-2.85
7	Energy^{S}	-2.37	-2.14	-2.36	-1.92
8	Other goods^{S}	-2.70	-1.97	-2.26	-1.69
	Total	-1.20	-0.23	-2.51	2.05

Notes: The superscripts R and S denote the prevailing VAT rate as the reduced and the standard one, respectively.

The second chapter deals with the analysis of excise duties. Excise duties are an important source of government revenue and their rates change relatively often in the Czech Republic. Reforms of excise duties change the prices of goods, a change to which households respond by adjusting their expenditures. I use detailed Czech Statistical Office data and estimates of own- and cross-price and income elasticities for individual households to create a microeconomic simulation model that enables me to simulate the impact of changes in excise duties on households' demands. I show the distributional impact of current excise duties and then I simulate the impact of hypothetical increases of 10 per cent in each of them. I further simulate impact of certain approved or proposed changes in excise duties including the unsuccessful 2012 proposal to introduce an excise duty on wine.

The third chapter deals with the analysis of inflation differentials. Households differ in their spending patterns and there are differences in the price growths of various goods and services. Therefore different households experience different inflation rates. These differences seem to have been significant in the Czech Republic during the period 1995-2010. Only around 60% of households experienced a real inflation rate that was closely similar to the national average inflation rate. Furthermore, the higher the magnitude of average inflation rate over time, the lower the percentage of households whose real inflation rate was similar to that average. The main determiners of inflation were expenditure for housing and energy and, especially for low-income households and pensioners, expenditure on food and non-alcoholic drinks. In most years, pensioners and low-income households faced significantly higher inflation rates than the average rate for the whole population.

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