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Value Added Tax policy and the case for uniformity: Empirical evidence from Mexico*

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Abstract:

Value added taxes (VAT) are an important, and in many cases increasing, source of revenue in both developed and developing countries. Unsurprisingly there is an intense academic and policy debate about the appropriate VAT rate structure, for both equity and efficiency reasons. In this paper we examine the distributional and efficiency case for VAT rate differentiation in Mexico, and analyse the effects of the 2010 reforms to Mexico's tax system, making use of a tax micro-simulation model, MEXTAX.

The amendments to the initial proposed reforms were made to make the tax change more 'progressive'. We find that, measured as a proportion of income or expenditure, poorer households did gain most from the amendments, but that the cash-terms gains were much larger for households with high levels of income and expenditure. In other words, the reduction in tax take from the amendments was weakly targeted at poorer households; even simple universal cash transfers would have been much more beneficial to poor households. This shows the distributional case for zero rates of VAT on goods like food is weak – especially given the growing sophistication of cash transfer programmes in particularly middle income countries.

We then examine the efficiency implications of Mexico's VAT rate structure. We find that deviations from uniformity have a notable effect on spending patterns, but very little effect on aggregate welfare and economic efficiency as estimated by a standard QUAIDS model of consumer demand. We then argue that economic informality may actually provide an efficiency reason for lower rates of tax on goods like food for which informal production and transactions seem to be much more prevalent. This may turn the typical arguments about differential VAT rates on their head. Rather than being justifiable on distributional grounds, but entailing an efficiency cost, the reverse may actually be true.

JEL classification: H20, H21, H31, D12, D30

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1. Introduction

Value added taxes (VAT) are an important, and in many cases increasing, source of revenue in both developed and developing country. Perhaps unsurprisingly there is an intense academic and policy debate about the appropriate VAT rate structure, for both equity and efficiency reasons. Many economists advocate applying a single (or uniform) rate of VAT to all (or nearly all) goods and services for reasons of both economic efficiency, and administrative simplicity.¹ In doing so, they also highlight that the redistributive power of VAT rate variation is often relatively weak – an argument that plays a central role in this paper. In contrast, others emphasise the importance of VAT rate differentiation as a tool for redistribution, especially in the context of developing countries where the scope for redistribution via direct taxes and transfers may be more limited.² And a number of factors can mean that the efficiency of the VAT system may actually be improved by having different rates on different goods and services. This paper pays particular attention to one: differences in the opportunities for tax evasion and home production across different goods and services.

The issue of VAT structure is of particular relevance in Mexico for a number of reasons. First, broad VAT exemptions, the zero-rating of food and many other goods and services, as well as significant evasion, mean Mexico's VAT system has the lowest C-efficiency rating in the OECD.³ Second is that Mexico needs to increase general tax revenues to strengthen its public finances, reduce its dependence on volatile oil revenues, and fund increases in social and infrastructure spending; continuing difficulties with raising substantial revenues from income tax make VAT an obvious tax to consider.

In fact, in 2009, the Mexican government considered a fundamental reform to its system of expenditure taxes. The standard system of VAT with its exemptions and zero rates would be retained, but in addition, the government proposed a 2% tax on *all* goods and services including those not subject to VAT. That is the non-uniform VAT would be supplemented by a (much lower) uniform expenditure tax. Opposition to this policy – in large part on the grounds that it would be 'regressive' and was perceived to have a particularly harmful effect on poorer households – resulted in it being rejected by the Congress. Amended Budget proposals instead increased the standard rate of VAT from 15% to 16% with no change in coverage.

In this paper we examine the distributional and efficiency case for VAT rate differentiation in Mexico, making use of a tax micro-simulation model, MEXTAX. This model was initially developed to assess the distributional (and other) impacts of the proposed and enacted 2010 reforms in Mexico (see Abramovsky et al (2010, 2011)). In the first instance, we use MEXTAX to compare the revenue and distributional effects of the proposed and implemented reforms to look at whether the amendments did make the reforms more progressive. We find that,

¹ See for instance Ebrill et al (2001), Mirrlees et al (2011) and Anton et al (2012).

² See Bird and Zolt (2005) and Bird and Gendron (2007), for instance.

³ C-Efficiency is the ratio of VAT revenue to consumption, divided by the standard VAT rate; it measures the amount of VAT revenue actually raised as a fraction of the VAT revenue that would be collected if the standard rate was successfully levied on all consumption. OECD statistics on C-Efficiency available in Consumption Tax Trends, available at: <http://www.oecd.org/ctp/consumption/consumption-tax-trends-19990979.htm>. Note the OECD uses the term 'VAT revenue ratio' rather than C-Efficiency.

measured as a proportion of income or expenditure, poorer households did gain most from the reforms, but that the cash-terms gains were much larger for households with high levels of income and expenditure. In other words, the reduction in tax take from the amendments was weakly targeted at poorer households; even simple universal cash transfers financed through the additional revenue raised by the 2% expenditure tax would have been much more beneficial to poor households. This shows the distributional case for zero rates of VAT on goods like food is weak – especially given the growing sophistication of cash transfer programmes in particularly middle income countries such as Mexico.

We then turn to examine the efficiency implications of Mexico's VAT rate structure. MEXTAX contains a built-in consumer demand model of the quadratic almost ideal (QUAIDS) form. One of the assumptions underlying models of this sort is that deviations from uniform VAT rates reduce the efficiency of the VAT system by distorting consumption. We examine how important such distortions could be if such an assumption holds – by comparing measures of consumer welfare under the existing VAT system with a revenue-neutral uniform system. We find that deviations from uniformity have a notable effect on spending patterns, but very little effect on aggregate welfare and economic efficiency.

We then turn to the case if the assumptions underlying standard demand models do not hold. In particular, we examine how tax evasion, informal transactions, and home production, influence optimal VAT rate structure. Building on the work of Kleven et al (2000) and Piggott and Whalley (2001) we argue that if consumers are able to substitute away from taxed formal sector transactions to untaxed informal purchases or production to a differing extent for different goods and services, it is efficient to tax different goods at different rates. We also show that informal purchases and production are much more significant for some goods than others in Mexico – notably food, to which a zero rate is currently applied. Taken together, this suggests that there may be an efficiency case for applying lower rates of VAT on food in Mexico in order to reduce incentives to avoid or evade tax by engaging in informal transactions.

This may turn the typical arguments about differential VAT rates on their head. They are usually justified from a distributional perspective, but having the drawback of some loss of economic efficiency. Instead, we argue that given the growing ability of middle income countries like Mexico to undertake more targeted redistribution via cash transfers means that reduced rates of VAT on certain goods like food seem to have little justification from an equity standpoint. But instead they may be justifiable instead on efficiency grounds – to *reduce* distortions to consumption and economic activity by minimising tax evasion and incentives for home and informal production. Investigating this in practise is the subject of the next stage of research.

The findings from this paper are relevant not only for Mexico. Indirect tax reform is an active issue in many of the largest developing countries. In Brazil, for instance, there is concern about the plethora of rates on different goods and services (as well as cascading due to not all input VAT being reclaimable by businesses). India is currently debating the replacement of separate state and national taxes on goods and services with a simpler and broader-based national VAT (which it labels the General Sales Tax). And China is piloting the replacement of 'Business Tax' (a turnover tax) levied on many services with VAT, as part of wider reforms to its indirect tax system. Assessment of the distributional rationale for differentiated VAT rates, and analysis of

how informality and tax evasion affects optimal VAT rate structure, can contribute to the reform agendas in these (and other) developing countries too.

This paper contributes to several strands of the literature. First it contributes to the growing body of empirical analysis of the distributional effects of tax and transfer systems in Latin America and other middle income countries using microsimulation and associated models (Lustig et al (2014), Urzua (2012)). Second it adds a behavioural/efficiency angle to this, through an integrated QUAIDS model, and a discussion of extensions to allow for responses on the informality/tax evasion margin. Finally, using these two components, it contributes to the literature on indirect tax policy and design in the context of the opportunities and constraints facing many developing countries: a growing ability to target resources using cash-transfers, but continuing difficulties with tax evasion and informal economic activities, concentrated in particular sectors.

The rest of this paper proceeds as follows. Section 2 describes the Mexican VAT system, and the 2010 tax reforms. Section 3 briefly explains the MEXTAX model,⁴ before moving on to present estimates (calculated using MEXTAX) of the distributional and revenue effects of the implemented 2010 reforms, vis a vis the initial proposals. Section 4 begins by utilising the QUAIDS model to analyse the potential efficiency effects of deviations from uniformity under standard consumer demand assumptions. We then introduce informality/tax-evasion to the mix to see how this changes the picture. Section 5 concludes. A set of appendices provides further information on the QUAIDS model used in Section 4.

2. The Mexican indirect tax system and the 2010 reforms

Like most countries, Mexico operates two main forms of indirect tax: excise duties on specific goods and services; and a general goods and services tax in the form of VAT.

The main specific duties are levied on:

- Alcoholic beverages;
- Carbonated beverages (soda) and processed juices;
- Tobacco products;
- And telecommunication services.

Motor fuels (petrol and diesel) are not subject to duties, per se, but prices are regulated; when international oil prices are high, fuel is in effect subsidised, and when oil prices are low, fuel is in effect taxed. Taken together, excise duties in Mexico raised the equivalent of 3.4% of overall tax revenues in 2009,⁵ or 0.6% of GDP, prior to the 2010 reforms.

VAT is a much more significant source of revenue. In 2009, it contributed 19.5% of overall tax revenues in Mexico, a lower proportion than the average for Latin America (31.9%), but a similar proportion to the OECD group of advanced economies (19.5%), to which Mexico belongs. But this similarity in the degree of reliance on VAT with the OECD is partly a result of

⁴ Further information on the models can be found in Abramovsky et al (2010, 2011).

⁵ Overall tax revenues are defined as tax plus social security contributions revenues. Note, it excludes non-tax revenues such as from Mexico's nationalised oil and gas industry. Source: IMF statistics. Regional averages are unweighted.

low tax revenues overall in Mexico – amounting to just 17.4% of GDP in 2009, for instance. Indeed, VAT raised a smaller proportion of GDP in 2009 in Mexico (3.4%) than both the regional (5.8%) and OECD (6.6%) averages.

This relatively low VAT tax take is not primarily the result of having a low standard rate of VAT (at 15% in 2009 it was similar to the average for Latin America and a little lower than the average for the OECD (19.1%)). Instead, revenues are suppressed due to the large scale exemptions and application of zero rates. Zero rates apply to agricultural activities and produce; nearly all foodstuffs; the supply of water to domestic premises; books, magazines and newspapers; and the wholesale jewellery and arts trades. Exempt goods and services include land and residential real estate; public transport; health services; education services; and certain cultural activities and shows. This means around VAT is not levied on goods and services making up around half of all consumer expenditure in Mexico.⁶ This relatively narrow base for VAT is the main factor underlying Mexico's VAT system's low C-Efficiency ratio – estimated at approximately 0.31 in 2012, for instance.⁷ This means that Mexico collects only around 30% of the VAT that it would if it successfully levied its standard rate of VAT on all final consumption expenditure (including that of households, non-profit organisations serving households, and government). It compares to an unweighted average OECD average C-Efficiency ratio of 0.55. A sizeable VAT collection gap (revenue that is uncollected due to evasion) of around 20% also contributes to this relatively poor performance vis a vis the OECD. For instance, the VAT gap averages 14% in the more pre-2004 members of the EU (excluding Greece).⁸ But the performance of Mexico on collecting the VAT due is actually rather better than in much of Latin America, where the VAT revenue gap averages 27%.⁹ This may reflect, in part, that Mexico levies a zero-rate of VAT on many of the goods on which VAT may be hard to collect – such as agricultural and food products –, an issue to which we return later.

Reforms to Mexico's system of general expenditure taxation proposed in 2009 (for implementation in 2010) represented an attempt to start broadening the expenditure tax base. As part of a wider package of revenue-raising tax measures,¹⁰ the Mexican government proposed the introduction of an expenditure tax of 2% on virtually all goods and services, including those subject to a zero rate of VAT, or exempt from VAT.¹¹ This tax was to be called the *Contribución para el Combate a la Pobreza* (CCP), and the revenues raised from it were to be used (notionally, at least) to increase government expenditure on social programmes aimed at alleviating poverty, including cash transfers, and health, education, and social services.

This initial proposal attracted significant opposition in both houses of the Mexican Congress, however. After several months of offer and counter-offer from the government and the legislature, the approved budget replaced the CCP with an increase in the standard rate of VAT

⁶ Exemption of many government services (which is a common feature of most VAT systems around the world) further reduces revenues from what would notionally be raised by a uniform system of VAT.

⁷ OECD (2014), *Consumption Tax Trends 2014*, Figure 3.1.

⁸ Case et al (2012).

⁹ Pecho Tuigeros et al (2012).

¹⁰ Table 2.1 of Abramovksy et al (2011) sets out the proposed and implemented reforms to income tax, excise duties, VAT and bank deposit tax.

¹¹ The only outlays on which this tax was not to be levied were donations to charity, and purchases of government licenses (such as driving licenses).

from 15% to 16% (with the VAT base being largely unchanged).¹² Opposition to the CCP centred on the argument that by levying tax on goods seen as necessities or otherwise socially desirable, the new tax would be 'regressive' and would hit poorer households harder. This reflects the fact that such goods – especially food –, make up a larger share of the budget of poorer households than richer households. Opponents argued it would be fairer to increase the standard rate of VAT, as doing so would not raise the price of food and other goods subject to a zero-rate of VAT. Analysis of the distributional effects of the initial proposals for indirect taxes (including the CCP) and the final plans (including the 1% increase in the standard rate of VAT) by the *Centro de Estudios de las Finanzas Públicas* (CEFP, a body similar to the US Congressional Budget Office) were understood by many as supporting this viewpoint. CEFP (2009) showed that households in the bottom tenth of the expenditure distribution gained the equivalent of 1.6% of their expenditure from the amendments to the initial proposals, whilst those in the highest tenth of the expenditure distribution gained the equivalent of just 1.3% of their expenditure. Thus, measuring indirect tax progressivity using taxes paid as a proportion of expenditure, the approved plans were more progressive than the initial proposals. But as we show in the next section, they were not a well targeted way of increasing Mexico's tax-benefit progressivity.

3. Assessing the distributional effects of the 2010 reforms

3.1 The MEXTAX micro-simulation model and data

We analyse the distributional and revenue effects of the proposed and implemented reforms to indirect taxes using the MEXTAX microsimulation model. MEXTAX is a Stata based model developed to analyse actual and counterfactual reforms to tax in Mexico, and uses the core architecture of the LATAX model, which also has versions for El Salvador and Colombia.¹³ It covers income tax (on employment income), VAT, excise duties and social security contributions.

The input data comes from the *Encuesta Nacional de Ingresos y Gastos* (ENIGH), a detailed survey of the demographic and socio-economic characteristics of a representative sample of Mexican households (approximately 29,000), undertaken every two years. ENIGH contains information regarding net income, expenditure, employment status, and government program participation (including social security coverage), allowing detailed modelling of the rules of each of the aforementioned taxes. In particular, information on expenditure is very disaggregated, allowing the identification of goods and services subject to the standard rate of VAT, the zero rate, and those that are exempt from VAT, as well as those subject to different excise duty regimes. In an effort to capture underlying consumption, rather than just a snapshot of expenditure, survey respondents are asked to report spending for different types of goods and services over different periods. They are asked to keep a diary of expenditure on food and public transport during the week of the survey; and to estimate spending on other items during either the past month (for instance, for cleaning products and personal goods); past three months (for instance, for clothes and cutlery, crockery and glassware); or past six months (for instance, for housing maintenance and renovations and electronic goods).

¹² Increases in excise duties and temporary increases in income tax on higher incomes were also scaled back.

¹³ More information on the structure of MEXTAX and LATAX can be found in Abramovsky et al (2011) and Abramovsky and Phillips (2013).

We do not observe directly whether the indirect tax due on a purchase is actually paid. Instead, we proxy this by distinguishing between formal transactions (on which tax is assumed paid) and informal transactions (on which tax is assumed unpaid) by using information about the type of vendor the good is acquired from (for instance, if vendor is a street market or a stall, or a supermarket). MEXTAX, by default, simulates VAT and duties only for those transactions identified as formal.¹⁴ This leads to an estimate of VAT evasion of around 8%, considerably lower than that reported in Pecho Tuigeros et al (2012), indicating that a significant proportion of that VAT that is evaded is evaded by larger vendors (like retail stores) rather than more easily identifiable 'informal' vendors; unfortunately, it is not easy to identify the transactions with retailers that appear more formal (according to our definition) are subject to tax evasion.¹⁵

MEXTAX calculates the taxes paid by each household under a baseline system, and under two reform systems (for instance, the proposed and implemented reforms). These household level measures are then aggregated, and 'grossed up' to nationally representative figures using household weights included in ENIGH. Summary statistics including estimated revenue, distributional, and (some dimensions of) behavioural effects of reforms are then outputted. Summary distributional statistics take the form of changes in tax payments (both measured in cash terms, and as a proportion of income and expenditure) for decile groups of the expenditure and net (post tax) income distributions. Households are grouped into decile groups according to their equivalised income and expenditure.¹⁶

In common with many household surveys, ENIGH suffers from significant under-reporting of income and expenditure. If this is not accounted for, the estimates of the revenue effects of reforms will be biased – as will, in general, estimates for the distributional effects be. A common solution to this problem is to multiply incomes and expenditures so that weighted aggregate income and expenditure match national accounts aggregates (the factors by which income and expenditure are multiplied are sometimes termed 'Altimir' factors, following the proposal of this method in Altimir (1987)). However this solution has problems. Multiplying all sources of income and all types of expenditure by the same factors means total income and expenditure match national accounts aggregates, and maintains the rank of each household in the income and expenditure distribution. But because under-reporting varies by income source and expenditure category, multiplication by a common factor will mean some categories of income and expenditure are over-estimated, whilst others are under-estimated. Thus revenue estimates from such an approach may be unreliable if taxes vary across income sources or by expenditure category (as they do, given varying rates of VAT and excise duties). This problem can be solved by using separate factors for different sources of income and different expenditure categories.

¹⁴ Similarly employment income is defined as formal or informal using information about workers' contributions to the social security system; income tax and social security due is only assumed to actually be paid by those defined as formally employed.

¹⁵ It is likely that such transactions would be in cash – cash transactions represent around 78.6% of transactions value in ENIGH 2008, substantially higher than estimates of VAT evasion.

¹⁶ Equivalisation is the process of adjusting income or expenditure for the size and composition of households. MEXTAX allows a number of different equivalence scales to be used. The default (used in the analysis in this paper) is that if the first adult in a household carries a weight of '100', additional adults and children aged 12 or over carry a weight of 80, and children aged 11 or under carry a weight of 50. This compares to relative weights under the modified-OECD scale used in EU poverty statistics of 100, 50 and 30, respectively. Higher relative weights for additional household members have been assumed for Mexico as the higher share of food and lower share of housing in overall expenditure, compared to Europe, is likely to mean there are fewer economies of scale in household expenditure in Mexico.

But, such an approach leads to re-ranking of households in the distributions of overall income and expenditure. This can have significant effects on distributional analyses. In what follows, the revenue effects of reforms are estimated using expenditures adjusted using category-specific Altimir factors, and distributional effects are estimated using unadjusted expenditures and incomes to preserve household rankings.

As with all tax microsimulation models, the distributional effects estimated by MEXTAX depend upon the assumptions about the economic incidence of taxes. MEXTAX allows these assumptions to be varied, but in what follows we assume that that expenditure taxes are fully incident on the purchaser, and income and social security taxes on the income-earner. Sensitivity analysis undertaken in the original World-Bank funded analysis of the distributional effects of the 2010 reforms suggest that the distributional conclusions drawn in this paper would be even stronger if capital or labour directly bore some of the burden of VAT in the form of lower factor payments.¹⁷

3.2 The distributional effects of the 2010 tax reforms

Figure 1 shows the distributional effects of the proposed 2% flat rate expenditure tax – the CCP. The change in expenditure tax payments (relative to the pre-reform system) are shown both as a proportion of net income, and as a proportion of expenditure, with households grouped into decile groups from poorest (1) to richest (10) based on their position in the household net income distribution.¹⁸ The Figure shows that the CCP would cost more, measured as a proportion of reported net income for lower income households than for higher income households. This would suggest that the legislative opponents of the CCP were right – it would have been a regressive tax that would have hit poorer households proportionately harder. However, the second set of bars shows that measured as a proportion of expenditure, the CCP would cost lower income households a very similar amount to higher income households. This would suggest that the CPP would have been distributionally neutral, in contrast to critics' complaints. Such a pattern follows from the fact that under the maintained incidence assumptions, a uniform 2% tax successfully levied on all expenditure would raise the price of all goods and services by the same amount, and therefore the price of all bundles of goods (whether those purchased by richer or poorer households) by 2%.

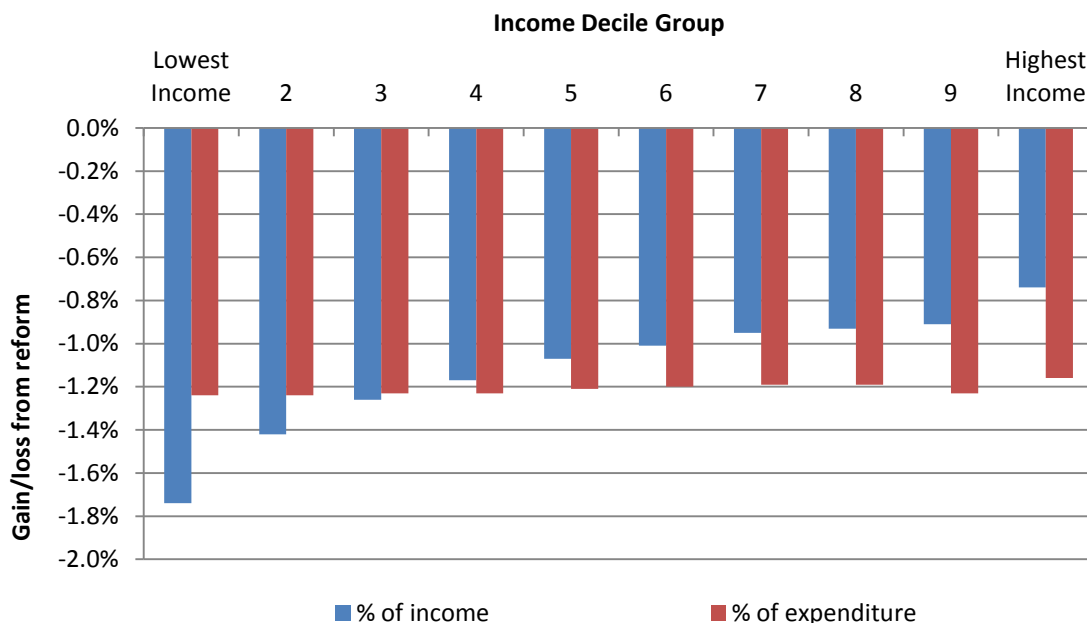
This might suggest it is unclear whether the CCP would have been regressive or progressive – the results depend on whether the additional tax due under the CCP is measured as a proportion of expenditure or income. But this would be a mistake. When assessing the distributional impact of indirect taxes, like the CCP, gains or losses from reforms should be expressed as a percentage of expenditure (IFS et al, 2011); which, in this case, would suggest the CCP would actually have been distributionally neutral. This is most easily seen from the perspective of consideration of the lifetime distributional incidence of taxation, but also applies to shorter-run perspectives of incidence too.

¹⁷ Abramovsky et al (2011) assesses the distributional effects of VAT under a number of different assumptions, including where labour and capital (as well as consumers) directly bear some of the burden of VAT in the form of lower factor returns. The analyses show that any form of VAT – including a uniform VAT like the CCP – appears more progressive if labour, and especially capital, share the burden of VAT with consumers.

¹⁸ Measures of income and expenditure both include non-monetary consumption, such as self-supplied goods and services (e.g. home grown foodstuffs).

So consider a CCP that is successfully imposed on all goods and services at 2% (as was the plan). Over a lifetime, if lifetime income and lifetime expenditure are equal, this can be clearly seen as distributionally neutral:¹⁹ as it is imposed on all goods and services at the same rate, it has the same proportional effect on the purchasing power of rich and poor households. CCP payments under such a system would be the same fraction of both lifetime income and lifetime expenditure for rich and poor households. But suppose, as in reality, we only have information on current income and spending. If CCP payments are presented as a fraction of current expenditure, this distributionally neutral pattern of payments would be found. However, because households with low current income tend to spend more than their income, and those with high current income tend to spend less, showing payments as a fraction of net income will make the uniform CCP look regressive if households are defined as rich or poor based on their current income. On the other hand, if households are defined as rich or poor based on their current expenditure, because households with the lowest spending tend to report incomes that

Figure 1. Distributional effects of the CPP, measured as a percentage of household net income and expenditure



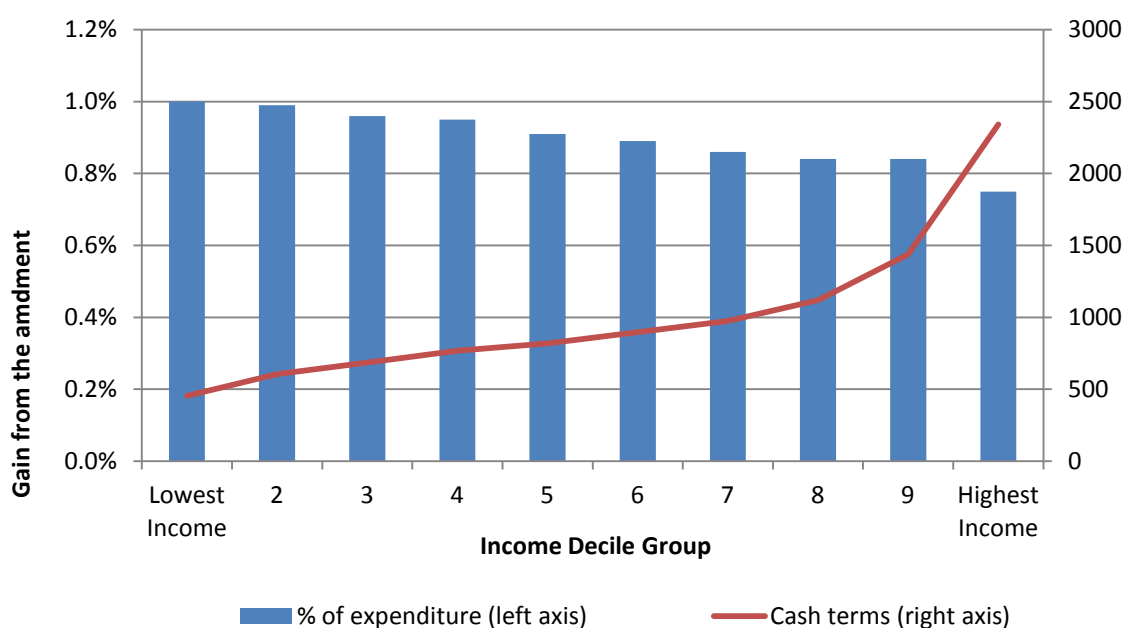
Source: Authors' calculations using ENIGH 2008 and MEXTAX

are higher than their spending, and those with high spending tend to report incomes that are lower than their spending, showing payments as a fraction of net income will make the uniform

¹⁹ The assumption that lifetime income and expenditure are equal means that we abstract from gifts and bequests. This is for ease of exposition only: the argument with bequests is more complicated but conclusions are unchanged. For example, when assessing the proportional impact of VAT on households that are recipients of gifts and bequests, it seems clear that we would want to take into account those gifts and bequests when measuring their lifetime resources. We would not, for instance, wish to say that a household with zero income but large expenditures funded by gifts and bequests is hit infinitely hard by VAT. Including bequests and gifts in the lifetime resources of the recipient makes subtracting them from the resources of the giver attractive to avoid the double counting of gifts and bequests. Adding and subtracting gifts and bequests when calculating lifetime resources in this manner means a uniform VAT would be found to be a constant fraction of both lifetime resources (income) and lifetime expenditure, i.e. it would be distributionally neutral as in the case with no gifts and bequests.

CCP look progressive. That is, a distributionally neutral uniform CCP can be misleadingly labelled progressive or regressive if payments are expressed as a proportion of net income. For this reason, analysis showing indirect tax payments as a proportion of household expenditure is much more informative about the distributional impact of reforms to indirect taxes, such as those proposed or implemented in Mexico in 2010; such analyses will thus be the focus of discussion in the remainder of paper.²⁰ Although this would suggest the legislative critics were wrong to argue that the CCP was regressive, Figure 2 shows that its replacement by a 1 percentage point increase in the standard rate of VAT did increase the progressivity of the tax reform. The bars show that measured as a proportion of expenditure, the gains from doing this were larger for poorer households than for richer ones. This reflects the fact that poorer households spend a larger proportion of their budgets on things such as food, on which the CCP would have been levied, but on which VAT is not levied. Households in the lowest decile group gained the equivalent of just under 1.0% of expenditure, whilst those in the highest decile group gained an amount equal to less than 0.8% of expenditure.

Figure 2. Gains from the replacement of the CCP with a VAT measured as a percentage of household expenditure and in cash terms (Pesos per annum)



Source: Authors' calculations using ENIGH 2008 and MEXTAX

The Figure also shows the cash-terms gains to households from replacing the CCP with the VAT rise. This shows a rather different picture. Households in the bottom decile group gained around 450 Mexican pesos (\$) per year, compared to gains of 2,350 Mexican pesos (\$) for those in the

²⁰ Note that while this exposition has focused on the role of borrowing and saving, it has not assumed that households are able to borrow freely to smooth consumption completely, nor that consumers are fully rational and 'forward looking': it applies to credit constrained and irrational consumers too. Measurement error in income and expenditure data also causes differences between reported income and expenditure, and provides a further reason to assess the distributional effects of indirect taxes by examining them as a share of expenditure rather than income (so that the same errors are in both the numerator and denominator).

top decile group. In other words, it was richer households that were by far the biggest gainers from the amendments to the Mexican government's initial proposals for the CCP (around 23% of the total cash gains went to households in the top decile group, compared to 4.5% in the bottom decile group, and 17% in the bottom three decile groups combined). Using the terminology of Lustig et al (2014), replacing the CCP with a VAT rise was therefore slightly progressive in relative (proportional) terms, but strongly regressive in absolute (cash) terms.

Replacing the CCP with a (smaller) 1% rise in VAT was also costly: our estimates suggest that the revenue foregone may have amounted to approximately 73 billion pesos per year, or around 0.6% of GDP. Our analysis suggests that little of this foregone revenue would have come from lower poorer households; much more would have come from richer households, with 23% (17 billion) coming from the top decile group alone. Replacing the CCP with a VAT rise, and forgoing this revenue, therefore represents a rather poorly targeted form of redistribution and 'protection' of poorer households.

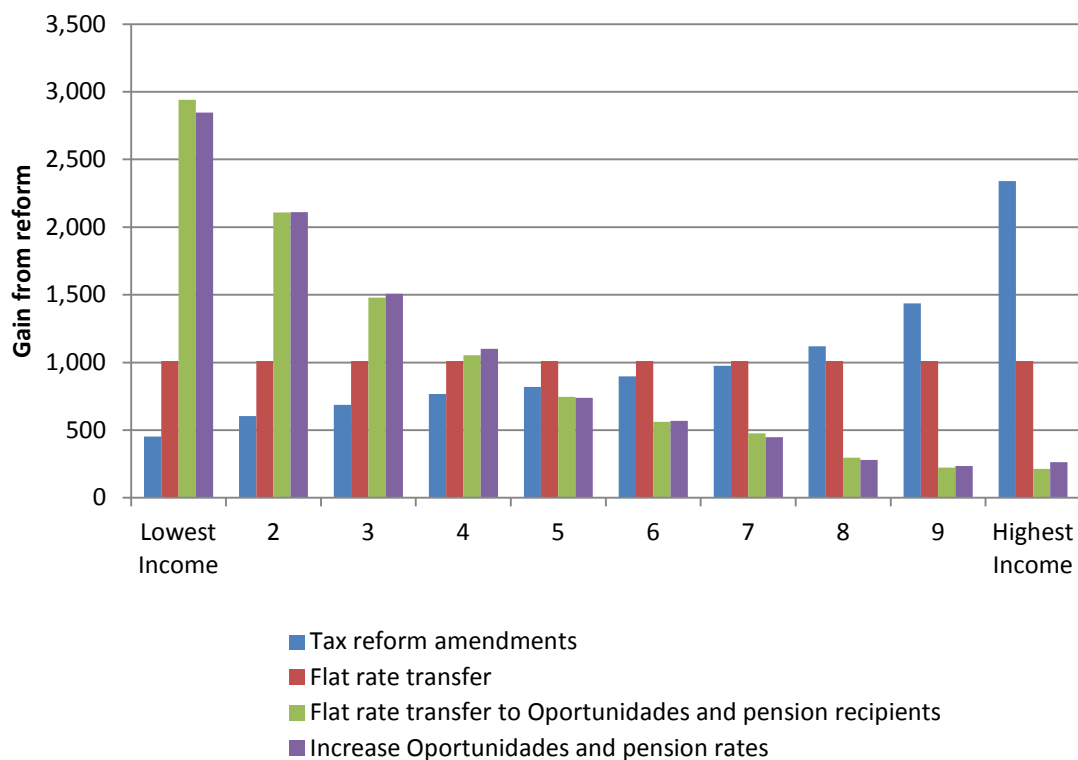
This does not necessarily mean these amendments to the plans were inappropriate though: a poorly targeted form of redistribution that is relatively but not absolutely progressive might be all that is feasible in countries with poor capacity to implement direct tax and transfer measures that can be better targeted. Bird and Zolt (2005) argue, for instance, that in many developing contexts, there are few alternative instruments for redistribution than the zero-rating of necessities such as basic foodstuffs. They argue that "although the poor may consume a relatively small amount of such basic food products, so that much of the benefit of exemptions goes to the non-poor, such exemptions may nonetheless still be warranted in developing countries".

However, in the context of Mexico at least, analysis of the concentration coefficient of the 'expenditure' associated with the foregone revenue by abandoning the CCP suggests other much better-targeted instruments are available for redistributive purposes. A concentration coefficient is a measure of the distributive properties of an expenditure item, bounded by -1 (a transfer goes entirely to the household with the lowest equivalised income) and +1 (a transfer goes entirely to the household with the highest income). A coefficient of 0 indicates that expenditure on that item is distributed equally in cash terms across the income distribution; a value less than 0 therefore means that an expenditure item is progressive in absolute terms, while a value greater than 0 means it is regressive in absolute terms. Relative progressivity is assessed by comparing the concentration coefficient to the Gini coefficient (0.50); if it is lower, then an item is relatively progressive, while if it is higher, it is relatively regressive.

We estimate that the concentration coefficient for the revenue foregone by failing to implement the CCP is 0.26. That is, it is relatively progressive, but strongly absolutely regressive as shown in Figure 2. Scott (2014) calculates concentration coefficients for Mexico's cash transfers, benefits-in-kind and public services. He finds that expenditure on Oportunidades, Mexico's main conditional cash transfer programme has a concentration coefficient of -0.54; means-tested pensions for the over-70s has a coefficient of - 0.20; and the concentration coefficient for overall expenditure on direct cash transfers is -0.30. These programmes are therefore strongly redistributive in absolute terms and targets resources much more closely at poorer households than does the replacement of the CCP by a VAT rise.

It is therefore worthwhile comparing the replacement of the CCP with a VAT rise with alternative ways of spending the revenue thus foregone. Figures 3 and 4 compare the cash gains from the amendments to the 2010 indirect tax reforms, with three alternative policies that are each estimated to cost the same using ENIGH: an increase in Oportunidades and non-contributory pensions of 66%; an additional flat-rate transfer of approximately 5,300 pesos per year to all households containing someone reporting receipt of either of these two programmes; and a flat-rate transfer of 1,000 pesos to all households.²¹ Figure 3 shows results across the income distribution; Figure 4 for different household types. Whilst the choice of the alternative policies is somewhat arbitrary, they are still informative of the type of options available that were available to Mexico. For instance, when proposed, the CCP was envisaged as funding increases in the generosity of and expansion of existing cash transfers aimed at poorer households like Oportunidades, as well as new pro-poor transfers and services (hence, the name of the proposed tax). And a flat-rate transfer to all households or individuals (sometimes called a demogrant) involves little in the way of formal targeting (although it does require an accurate register of households) and is clearly a relevant benchmark against which to assess any redistributive policy.

Figure 3. Cash gains from alternative ways of spending the revenue foregone through the amendments to the 2010 tax reforms (replacing the CCP with the VAT rise), across the income distribution



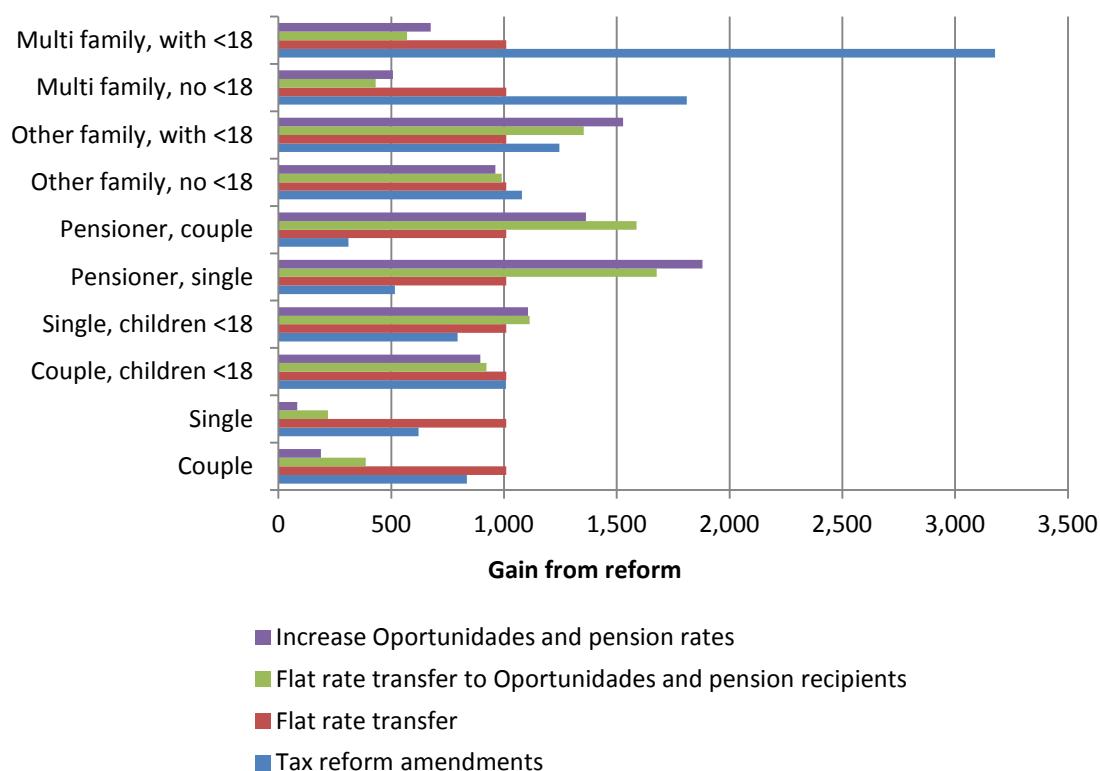
Source: Authors' calculations using ENIGH 2008 and MEXTAX.

Figure 3 shows that expansion of existing cash transfer programmes would redistribute substantially more to poorer households than the amendments to Mexico's 2010 indirect tax reforms. For instance households in the decile groups 1, 2 and 3 would gain around six, four

²¹

and two times as much as under the indirect tax changes, on average, under a flat rate payment to all Oportunidades and non-contributory pension recipients.

Figure 4. Cash gains from alternative ways of spending the revenue foregone through the amendments to the 2010 tax reforms (replacing the CCP with the VAT rise), by household type



Source: Authors' calculations using ENIGH 2008 and MEXTAX.

Of course, Oportunidades and non-contributory pensions do not reach all poorer households: only around 55% in the lowest income decile group, and around a third in the poorest half of households report receiving at least one of these transfers. In particular, households where children no longer attend school (which may be among the poorest), and non-pensioner households without children, are entitled to neither of these transfers.²² The latter can be clearly seen in Figure 4: working age households without children would very rarely gain from such increased funding for these policies, and therefore even the poorest such households gained more under the 'poorly targeted' amendments to the indirect tax reforms. New cash transfers would therefore be needed to reach the broader population of poor households, including those not targeted by existing programmes. Doing this need not be overly bureaucratic nor involve complex targeting mechanisms though. Figure 3 shows that even a flat-rate transfer per household would be substantially more redistributive than the tax amendments. For instance, the lowest income tenth of households would gain more than twice as much from a uniform transfer than they did under the amendments to the 2010 tax reforms;

²² Although some such households do report receipt of these benefits.

and households in each of the poorest seven decile groups gain more, on average, under such a flat-rate transfer.

The equity case for replacing the CCP with the smaller 1% increase in VAT thus appears weak: Mexico has the ability to target existing cash transfers much better at poorer households; and even using the revenue from the CCP for a flat-rate transfer would have been much more progressive. More generally, this would suggest that the case for applying zero or reduced rates to broad categories of goods like food and public transport on distributional grounds is relatively poor in Mexico. As emphasised in the Mirrlees et al (2011), what matters is not the distributive properties of a specific tax, but of the tax-and-transfer system as a whole; if other instruments allow for better targeting of resources for redistribution.

Such findings echo the conclusions of a number of qualitative studies of tax policy from the perspective of middle income countries like Mexico (see for instance Ebrill et al (2001) and Abramovsky et al (2013)). Both recommend that countries should aim for a broad-based VAT charged at a single rate in order to raise revenues in an efficient manner, and to use other instruments to achieve redistributive goals. While the analysis presented so far suggests such a strategy makes sense from a purely distributive sense – the revenue foregone from zero rating could be spent in a much more targeted way via cash transfer policies –, how does the efficiency argument for such a uniform system of taxation stack up?

4. The efficiency implications of Mexico's VAT structure

There are two broad arguments for the efficiency of broader, more uniform rates of VAT.

The first is focused on administrative and enforcement efficiency. For instance, Ebrill et al (2001) argues that having multiple rates of VAT complicates the accounting, invoicing and tax-filing requirements of businesses, makes auditing of VAT returns more difficult, and leads to more outright “refunds” (where the input VAT deducted exceeds the output VAT charged), which are particularly prone to fraud. It can also lead to costly litigation and enforcement difficulties around boundaries between goods subject to different rates of VAT. Furthermore, the presence of reduced rates for some goods may lead to lobbying for the extension of such preferential treatment to other goods (the “me too” effect), potentially resulting in a proliferation of reduced rates that severely limits the ability of VAT to raise revenues (IFS et al, 2011).

The second argument is focused on economic efficiency. Under a set of assumptions including separability of goods demand with leisure (Corlett and Hague (1953), Atkinson and Stiglitz (1976)), equal substitutability with non-taxed forms of procurement such as home-production and informal or underground market transactions across different goods and services (Sandmo (1990), Piggott and Whalley (1998) and Kleven et al (2000)), and tastes being uncorrelated with underlying earnings capability (Saez (2002)), then it can be shown that a uniform rate of VAT minimises the efficiency of revenue raising. This is because doing so does not distort the relative prices of goods, and therefore does not distort consumption decisions; such distortions would reduce efficiency and welfare under the aforementioned assumptions. If, on the other hand, any of these conditions are violated, deviations from uniformity actually improve

efficiency and welfare by offsetting the disincentives to work or to engage in formal transactions that taxation more generally creates.

While in practice such assumptions are unlikely to completely hold, the idea that deviations from uniformity are distortionary is well established and has informed proposals for VAT base broadening in both the developed (Mirrlees et al (2011)) and developing world (Ebrill et al). Thus policymakers often view uniform VAT as an efficient form of taxation, albeit one that would be less progressive than systems with reduced rates for necessities such as food. In what follows we first assess the potential efficiency gains from a move towards a uniform VAT based on standard consumer demand modelling assumptions, using the demand system incorporated in MEXTAX. We then explore what effect violation of these conditions would have, focusing on the role tax evasion and economic informality, which is likely to be of particular relevance for developing countries like Mexico.

4.1 The MEXTAX QUAIDS model

The demand system incorporated in MEXTAX is of the non-linear QUAIDS form, developed in Banks, Blundell and Lewbel (1996,1997). It is a generalisation of the Almost Ideal Demand System (AIDS) model that allows for quadratic Engel curves, so that goods can be necessities at one level of income and luxuries at another (higher or lower) level of income. The model is a 'standard' consumer demand model in the sense that it: it is based on the unitary model of household decision making; assumes that consumption and leisure decisions are separable; and does not account for positive or negative externalities from expenditure on certain goods (for instance fuel, alcohol and tobacco). The QUAIDS model is integrable, meaning that it is not simply a set of price and income elasticities; it is derivable from an indirect utility function and an associated expenditure function.

As with the main MEXTAX model, household expenditure and demographic data for the QUAIDS model comes from the ENIGH (the model is estimated using the 2008 version). In order to ensure that the model can be feasibly estimated it is necessary to aggregate the very detailed expenditure categories in ENIGH into a significantly smaller number of aggregate commodity groups. These are designed to ensure both that the groups make sense as functional product groups but also to allow for substitution between goods treated differently by the indirect tax system. The 12 categories chosen are:

- Food on which no VAT is levied
- Food on which VAT is levied and meals out
- Alcoholic drinks and tobacco (VAT and duties levied)
- Clothing and footwear (VAT levied)
- Household goods, services and communications (VAT levied, duties sometimes levied)
- Household goods, services and communications (no VAT levied)
- Transport and vehicle fuels (VAT levied, duties sometimes levied but not modelled)
- Public Transport and other transport on which no VAT levied
- Health and Education goods (no VAT levied)
- Health and personal goods and services (VAT levied)
- Leisure and hotel services (VAT sometimes levied)
- Other services

By aggregating goods in such a way, the demand model is suitable for modelling the welfare impacts of changing the rate of VAT and imposing VAT on additional classes of goods (such as would occur if a uniform VAT were introduced). Indeed, it is the first model covering all categories of expenditure estimated for the purposes of tax policy simulation in Latin America.²³

In addition to information on expenditures, estimation of a consumer demand system requires information on (and variation in) prices. ENIGH does not contain information on prices,²⁴ and so instead we make use of price data used to construct Mexico's official inflation statistics. These data are available at a level much more disaggregated than the 12 categories in the demand system: the prices (and associated expenditure weights) of the disaggregated goods have therefore been used to calculate prices of the 12 aggregate commodities.²⁵ Variation is provided by making use of differences in prices both over time and geography. In particular we make use of price data provided by the *Banco de Mexico* for 46 city-regions for every month for which we have expenditure information in the 2008 ENIGH.²⁶ This is the first time this data has been used for modelling consumer demand.

In addition to prices, and a quadratic term for total expenditure, the model allows demand behaviour to vary with family size, family composition, and geographic region, as well as the education, sex and labour-market status of the head of a household. As it is standard in this literature, because total expenditure may be endogenous, we instrument for it using monetary income and a control function approach (see Banks, Blundell and Lewbel (1997)). This is a valid instrument under the assumption that consumption is not affected by labour supply decisions. The three main theoretical constraints on demand system parameters (additivity, homogeneity, and symmetry) are imposed, and negativity of the matrix of compensated elasticities is tested and confirmed. Standard errors are calculated using a clustered bootstrap procedure with 500 iterations and clusters defined by city-regions, the level at which we observe prices.

Full details on the elasticities estimated using the model can be found in Appendix B. In general patterns of demand are plausible. Food on which VAT is not levied is most inelastic; whilst

²³ No similar model has been estimated for Mexico; instead, most Mexican models make use of unit value data in ENIGH and focus on food demand (del Campo and Paez (2008), Attanasio et al (2013)). Asano and Fiúza (2003) estimate a model for a similarly broad group of expenditure categories in Brazil, but do not align categories with indirect tax status, nor apply it to the analysis of indirect tax policy.

²⁴ Information on quantities as well as expenditures is available for some goods (such as food), allowing the construction of *unit values*, which are sometimes used as proxies for underlying prices. However, unit values cannot be constructed for all goods, and can capture variation in quality rather than variation in price, whereas the prices sampled in the *Banco* price data are meant to be for equivalent products.

²⁵ The prices of the aggregated commodities are calculated as weighted arithmetic averages of the prices of the individual goods making up the commodity. This assumes there is no within-group substitution when relative prices of the goods making up a commodity change. There is not a particular set of preferences which corresponds to the weighted arithmetic average but it is consistent with how price changes are modelled in the static analysis using MEXTAX only. This implies that the only behavioural response we allow when integrating the QUAIDS to MEXTAX is the one estimated by the demand system between groups. In this way, we avoid assuming a degree of behavioural response within-groups which would be implied by, for instance, a geometric mean (which assume within-group own price elasticities of -1 and cross price elasticities of 0, i.e. Cobb-Douglas preferences).

²⁶ The *Banco* provided information on which city region a municipality (municipality identifiers are available in ENIGH) is associated with for all municipalities with a population of greater than 15,000. These linkages are determined by distance, population size, and other characteristics (such as economic structure). Links between city-regions and municipalities of less than 15,000 people are not provided by the *Banco*, and are therefore constructed by ourselves using distance (measured using travel time according to Google maps), to ensure the estimated demand system is representative of all of Mexico. Estimated coefficients are highly robust to the exclusion of municipalities of less than 15,000 people, however.

public transport is most elastically demanded. Food on which VAT is not levied is also a necessity whilst food on which VAT is levied and meals out are a luxury. The other strong necessity is public transport, whilst private transport, leisure goods and services and other services are strong luxuries.

4.2 Assessing the behavioural and efficiency effects of a uniform VAT rate using the MEXTAX QUAIDS model

In order to assess the efficiency effects of Mexico's existing VAT rate structure – with broad zero rating – we simulate the effects of a revenue-neutral reform replacing it with a uniform rate of VAT on all goods and services.²⁷ Table 1 shows that such a reform would lead to modest changes in expenditure patterns, and the volume of different goods and services: the distortions to relative prices under the existing differentiated VAT system do seem to have notable, although not particularly large effects on consumer spending patterns.

Table 1. Effect of VAT rate structure on expenditure patterns

Expenditure category	<i>Share of good in total expenditure</i>	
	2008 VAT rate structure	Uniform 7.86% VAT rate
1) Food on which no VAT is levied	26.9%	28.3%
2) Food on which VAT is levied and meals out	12.9%	12.7%
3) Alcoholic Drinks and Tobacco (VAT and duties levied)	0.6%	0.5%
4) Clothing and footwear (VAT levied)	7.2%	7.0%
5) Household goods, services and communications (VAT levied, duties sometimes levied)	21.6%	21.4%
6) Household goods, services and communications (no VAT levied)	1.6%	1.6%
7) Transport and vehicle fuels (VAT levied, duties sometimes levied but not modelled)	7.3%	7.1%
8) Public Transport and other transport on which no VAT levied	6.3%	6.2%
9) Health and Education goods (no VAT levied)	3.2%	3.2%
10) Health and personal goods and services (VAT levied)	7.6%	7.4%
11) Leisure and hotel services (VAT sometimes levied)	4.1%	4.0%
12) Other services	0.6%	0.6%

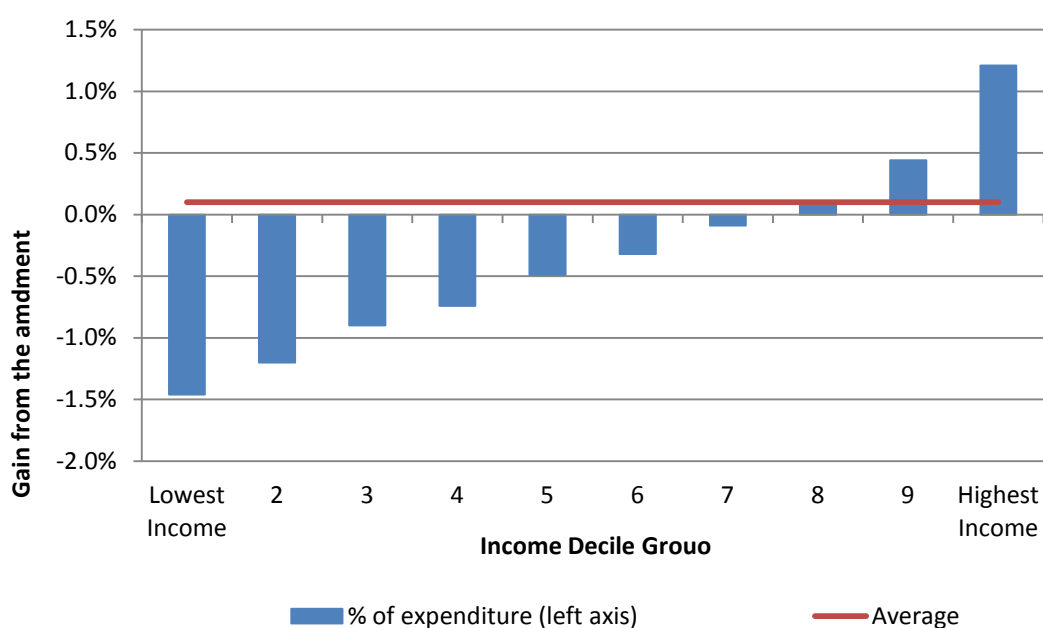
Notes: Reported shares are shares of aggregate household expenditure.

Source: ENIGH 2008 and authors' calculations using Bank of Mexico price indices and MEXTAX

²⁷ Given that the 2008 version of the ENIGH was used, and at that time the rate was 15%, we assess revenue neutrality against a 15% rate; we find that a rate of 7.86% would be required.

However, these modest distortions to expenditure patterns do not in fact translate into significant losses in economic efficiency. We can see this by aggregating across households a money-metric measure of the household-level welfare effects of a move to a uniform rate of VAT. The money-metric measure we use is the compensating variation (CV): the change in income a household would require in order to make them indifferent between the existing VAT rate structure (and their current levels of income) and the simulated uniform rate of VAT. Figure 5 shows that, on average, unsurprisingly, lower income households would lose from such a uniform rate of VAT (because the extra VAT they would pay on food would exceed the reduction in VAT on other goods), while higher income households would gain (for the converse reason). But as theory would suggest, the aggregated value of gains to ‘winners’ from the reforms exceed the aggregate value of losses to ‘losers’. This means that, in principle, it would be possible to redistribute the gains from the ‘winners’ to fully compensate the ‘losers’ and still leave winners better off than under the existing VAT system. This implies that a uniform rate of VAT would be more economically efficient, and welfare-improving.

Figure 5. Gains/losses across the income distribution under a revenue neutral uniform VAT, measured as a percentage of expenditure



Source: Authors' calculations using ENIGH 2008 and MEXTAX

Only just though; the estimated aggregate gain in welfare equates to 0.1% of overall household expenditure. This would suggest that while – under the assumptions underlying the standard consumer demand models like QUAIDS – the existing system of VAT in Mexico does entail some loss of economic efficiency by distorting relative prices and expenditure patterns, the loss is only small. Similar results have been found for deviations from uniformity in the UK and Belgium (an efficiency cost also equivalent to around 0.1-0.2% of consumer expenditure).²⁸

²⁸ IFS et al (2011).

The potential gains in economic efficiency from uniformity therefore do not seem to be as great an impetus towards VAT reform as is sometimes suggested (Mirrlees et al (2011)). Even the small gains estimated rest upon the maintained assumptions of standard consumer demand models. In the following sub-section we examine how violation of these may affect the optimal structure of VAT rates in Mexico and other developing countries.

4.3 Informality and tax evasion and optimal VAT rate structure

As already mentioned, uniform rates of VAT are only optimal under a particular set of restrictions on demand behaviour. The most well known is the separability of demand behaviour from labour supply and leisure decisions. Browning and Meghir (1991) show that leisure-consumption separability can be tested relatively easily in demand systems like the QUAIDS by including hours of work or the employment status in the demand system share equations. Goods for which the coefficients on the chosen work variable are positive are complements for work, and goods for which the coefficient on this is negative are complements for leisure. However, the way tax rates would optimally differ across goods reflects not only the complementarity status of a particular good, but also cross-price effects on the demand for other goods, and the complementarity or substitutability of these other goods with work. Hence, a complement to work need not be taxed less heavily than a substitute to work if the complement is strongly complementary to other goods that are substitutes to work. This problem has yet to be overcome empirically, and remains the subject of ongoing research.²⁹

Of particular relevance to developing countries though is the effect informality has on optimal VAT rate structure (and, indeed, tax design more general). Let us define an informally procured good as one in which any tax that would normally be levied from a legal market transaction is avoided. This includes home-produced goods such as home-grown food, and goods purchased from the 'informal' market on which tax was not paid. The effects of such informality on optimal rate structure will depend upon the extent to which substitutability between formal and informal procurement of a good varies across types of goods.

Kleven et al (2000) analyse how home production (one of the forms of informality described) affects optimal indirect taxation. They find that when different market purchased goods differ in their degree of substitutability or complementarity with home produced goods, optimal indirect tax rates will differ across goods. In particular they find that it would be optimal to charge lower rates of tax on goods that are particularly substitutable with home produced goods or services; and higher tax rates on complements to such goods and services. Their analysis is in the context of developed countries and they argue this suggests lower rates of tax should be imposed on consumer services (such as decorating, gardening, childcare, cleaning, minor repairs etc). Such arguments have influenced thinking on VAT in the European Union.³⁰

²⁹ A promising approach is to examine this problem from the labour supply side (rather than the consumer demand side). For instance, if the relative prices of different goods and services are included as right-hand side variables in a labour supply model, this should incorporate not only own-price effects, but also cross-price effects on the supply of labour.

³⁰ The EU has allowed trials of reduced rates of VAT on 'labour intensive services', which have some degree of overlap with the type of consumer services that might be considered to be substitutable for home produced services.

Table 2 shows that the extent of informality does appear to vary significantly across goods and services in Mexico. For instance 24% of expenditure on food on which VAT is not currently levied and 23% on clothing takes place at ‘informal establishments’, compared to 14% of expenditure on VATable food, and 4% on household goods and services. Similarly, while 98% of expenditure on VAT-free food is recorded as being in cash, the same is true of only 89% of VATable food, 61% household goods and services, and 54% of transport. Of course, goods and services where the level of informal procurement is high are not necessarily the same as those where the *elasticity* of informality with respect to tax rates is high. However, that a substantial fraction of food is purchased from informal traders (or home produced)³¹ even when tax is not levied on such goods is indicative that they are particularly amenable to informality.

Table 2. Share of expenditure on different goods that takes place in ‘informal establishments’ or is in cash

Expenditure category	% of expenditure in ‘informal establishments’	% of expenditure in cash
Food on which no VAT is levied	24%	98%
Food on which VAT is levied and meals out	14%	89%
Alcoholic Drinks and Tobacco	2%	98%
Clothing and footwear	23%	87%
Household goods, services and communications	4%	61%
Transport	0%	54%
Health and education goods and services	5%	93%
Leisure and hotels	6%	57%

Notes: Reported shares are shares of aggregate household expenditure.

Source: ENIGH 2008 and authors’ calculations using Bank of Mexico price indices and MEXTAX

If this variation in the prevalence of informality is indicative of variation in how responsive informality would be to changes in tax rates, it would suggest there may be an efficiency argument to set a lower rate of VAT on food (or at least those types of food most prone to informal production and transactions) than other goods and services. It may also provide a justification for higher rates of tax imposed on certain utilities and services provided overwhelmingly via large formal providers – like telecommunications services, which is subject to a 3% surcharge in Mexico – where the scope for informal provision seems limited.

How important these considerations are for practical VAT policy depends upon the differences in the relative elasticities of informality. If these differences are small, then optimal VAT rates would likely differ only a little, and the associated gains in efficiency over a uniform rate of VAT would likewise be small. In such circumstances, such gains may not be great enough to justify the loss of administrative and enforcement efficiency that deviations from uniformity entail. If, on the other hand, the differences in relative elasticities of informality are large, then there may be real gains to be had by imposing lower rates on those goods with higher elasticities, and vice versa, which outweigh the administration issues thus raised.

A general equilibrium analysis of indirect tax base broadening in Canada, where informality is less of an issue than Mexico, suggests such factors can be important: Piggott and Whalley (2001)

³¹ Insert detail

find that the base broadening was efficiency-reducing, and led to increases in home production and tax evasion. Note that in some ways, this finding is driven by the assumptions of their modelling rather than actual data on the relative propensity for tax evasion and self-supply of different goods.³² Estimating the elasticity of informality with respect to the tax rate for different goods requires variation in the tax rates faced by each category of goods so that the relative informality response can be estimated. Unfortunately Mexico's national system of indirect taxes precludes such an analysis. But countries like Brazil and India have sub-national indirect tax systems with substantial cross-country variation in tax rates for the same good. Analysis of how differences in tax rates affect home production and informal market transactions differently for different goods in these countries is therefore a potentially promising avenue for future research.

5. Conclusion

This paper has utilised a new tax microsimulation model for Mexico, MEXTAX, and an associated consumer demand model, to analyse indirect tax policy. In doing so, we have found results which turn the usual arguments about VAT rate structure on their head. In particular, whilst the application of zero or reduced rates of VAT on food is often justified on distributional grounds, we argue that in the context of Mexico – and by implication, other developing countries building the capacity to redistribute in a more effective and more targeted manner via cash transfers – such a rationale is weak; from a distributional perspective alone, it would be better to raise additional revenue by broadening the VAT base and then redistribute it. Instead revenue and economic efficiency considerations – usually seen as favouring a uniform VAT rate – may provide a stronger rationale for the application of reduced rates to food, and other goods more prone to substitution between formal provision, and informal provision or home production.

Further empirical research is needed to confirm this. In particular, the data available for Mexico does not allow us to estimate a demand system that incorporates substitution between the informal and formal market sectors to determine how quantitatively important these theoretical considerations may be. In order to do this, data with plausibly exogenous variation in the spread of prices between the formal and informal sectors is required. One possibility for this is Brazil, or India, countries where the rates of indirect tax vary substantially across states. If this variation in tax rates leads to variation in prices between the formal and informal sectors that differs for different goods, the relative 'elasticities' of tax evasion/informality with respect to price can potentially be estimated.

The policy implications of the analysis in this paper are potentially highly significant for Mexico and for tax policy in developing countries more generally. In the narrowest sense, the distributional analysis of the amendments to the 2010 Mexican tax reforms – abandoning the planned CCP and instead increasing the standard VAT rate by 1% – suggest they were misplaced. If the motivation for this amendment was to help poorer Mexicans – as appears to be the case – then it provided only poorly targeted help. The additional revenue raised by the CCP could have been targeted much more effectively at the poor through cash transfers (even a universal flat-rate transfer to every household). This has implications for other developing

³² They assume, for instance, that the goods subject to the former tax (largely manufactured goods) were not subject to self-supply or tax evasion; and use information on the share of food expenditure spent on 'meals out' (newly taxed under the broader tax) to infer self supply responses for all goods.

countries wishing to raise revenue to fund the expansion of nascent cash transfer or social programmes: use the tax system to raise revenues in an efficient way, and use the cash transfer programmes for redistribution, including the compensation of poorer households for the additional tax they have to pay.

More broadly, it suggests that optimal VAT rate structure may indeed differ for countries at different development levels, as suggested by Richard Bird and others, but for rather different reasons. When countries face significant problems with VAT evasion and economic informality, lower tax rates may be warranted for those goods and services particularly susceptible to informal transactions – such as food. This minimises the excess burden associated with raising tax, by minimising the shifts from formal to informal transactions. As countries develop and enforcement of tax on goods like food improves, the case for lower VAT rates on such goods would decline. In this way, the application of a uniform rate of VAT may become more attractive as countries develop – for primarily efficiency rather than equity reasons.

Two potential caveats apply though, and mean further research is warranted. First, as already mentioned, the quantitative importance of variations in propensity for evasion/informality is not known. Second, the administrative efficiency associated with a uniform rate of VAT may be even more important for developing countries – countervailing the ‘economic efficiency’ argument associated with evasion/informality propensity. Alternatively, the greater ease of evasion for certain goods (like food) may mean it is more administratively efficient to concentrate administrative and enforcement efforts on easier-to-tax sectors. Additional research on tax administration and tax evasion in the context of VAT in developing countries is therefore clearly needed.

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Appendix A. The QUAIDS model

The QUAIDS model is based on the following indirect utility function:

$$\ln V = \left\{ \left[\frac{\ln x - \ln a(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1} \quad (\text{A})$$

Where x is expenditure, $a(p)$, $b(p)$ and $\lambda(p)$ are defined as:

$$\ln a(p) = \alpha_0 + \sum_i \alpha_i \ln(p_i) + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln(p_i) \ln(p_j) \quad (\text{B})$$

$$b(p) = \prod_{i=1}^n p_i^{\beta_i} \quad (\text{C})$$

$$\ln \lambda(p) = \sum_{i=1}^n \lambda_i \ln(p_i) \quad (\text{D})$$

where ($i=1, \dots, n$ denotes a good). Applying Roy's identity to equation (A) gives the following equation for w_i , the share of expenditure on good i in total expenditure is, for each household:

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{x}{a(p)}\right) + \frac{\lambda_i}{b(p)} \left(\ln\left(\frac{x}{a(p)}\right) \right)^2 \quad (\text{E})$$

For the resulting demands to be consistent with utility maximisation, the demand system must satisfy four key properties: adding-up; homogeneity; symmetry; and negativity (negative semi-definiteness). The first three can be imposed using linear restrictions on the parameters of the model:

(adding up)

$$\sum_{i=1}^n \alpha_i = 1; \quad \sum_{i=1}^n \beta_i = 0; \quad \sum_{i=1}^n \gamma_{ij} = 0 \quad \forall j \quad \sum_{i=1}^n \lambda_i = 0$$

(homogeneity)

$$\sum_{j=1}^n \gamma_{ij} = 0 \quad \forall i$$

(symmetry)

$$\gamma_{ij} = \gamma_{ji}$$

Negativity cannot be imposed in such a manner but the estimated Slutsky matrix can be tested to see if it satisfies this criterion.

This paper allows for household demographics to affect demands in a fully theoretically consistent manner. Demographics (denoted $k = 1, \dots, K$) enter as taste-shifters in the share equations, and to maintain integrability are therefore part of α_i terms in $\ln a(p)$:

$$\ln a(p) = \alpha_0 + \sum_i \left\{ \alpha_i + \sum_{k=1}^K \alpha_{ik} z_k \right\} \ln(p_i) + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln(p_i) \ln(p_j) \quad (F)$$

$$w_i = \alpha_i + \sum_{k=1}^K \alpha_{ik} z_k + \sum_{j=1}^n \gamma_{ij} \ln(p_j) + \beta_i \ln\left(\frac{x}{a(p)}\right) + \frac{\lambda_i}{b(p)} \left(\ln\left(\frac{x}{a(p)}\right) \right)^2 \quad (G)$$

Which gives us the following new adding-up conditions that supersede $\sum_{i=1}^n \alpha_i = 1$:

$$\sum_{i=1}^n \alpha_i = 1; \quad \sum_{i=1}^n \alpha_{ik} = 0;$$

Having estimated a fully specified demand system, one can estimate the impact of price changes on consumer welfare using the associated expenditure functions. An attractive measure of the welfare impact is the compensating variation (CV): the change in income a household would require in order to make them indifferent between the original price vector (with the original income) and the new price vector. This is calculated as:

$$CV = E(u^*, p^1) - E(u^*, p^0) \quad (H)$$

where u^* is the original value of the utility index, p^0 is the initial price vector, p^1 is the new price vector and $E(u^*, p^y)$ ($y=0,1$) is:

$$E(u^*, p^y) = e^{\ln a(p^y) + b(p^y) \left\{ \frac{1}{\ln u^*} - \lambda(p^y) \right\}^{-1}} \quad (I)$$

and where $\ln u^*$ can be calculated using the indirect utility function. Price and total expenditure elasticities are derived and presented in Banks et al (1997).

Our model is estimated using a 2-step procedure. Before estimation of equation (F), $a(p)$ and $b(p)$ are unknown. For this reason, $\ln a(p)$ is approximated using the Stone price index

$$\ln p^* \approx \sum_i w_i \ln p_i \quad (J)$$

and $b(p)$ is approximated as 1. Conditional upon the price indices, QUAIDS is linear in parameters. Hence, a linear Seemingly Unrelated Regression (SURE) framework is used to estimate the model. Adding up is imposed by excluding the equation for the n th good from the estimated system of equations; parameters for this equation are calculated using the parameters from the other $(n-1)$ equations and the adding up restrictions. Homogeneity and symmetry are imposed using linear restrictions on parameters.

The parameters estimated in the first stage are then used to calculate values for $a(p)$ and $b(p)$. The model is then re-estimated using the same specification as the first stage except that p^* is replaced with $a(p)$ and λ_i by $\frac{\lambda_i}{b(p)}$. The new parameter values are used to update $a(p)$ and $b(p)$, and the model is then re-estimated for a third time. This updating of price indices and re-

estimation is iterated 12 times, by which point the parameter values have converged to 5 decimal places.

Because total expenditure may be endogenous, we instrument for it using monetary income. This is a valid instrument under the assumption that consumption is not affected by labour supply decisions. This is done using a control function approach. That is we regress $\ln x$ and $(\ln x)^2$ on the prices and demographic variables included in our demand system and on the log of household monetary income and the square of the log of household monetary income and include cubic terms of the residuals from these regressions in our demand system equations.

Standard errors are calculated using bootstrapping with 500 iterations. We take into account that we use variation in prices across city-regions clusters and draw, with replacement, from within clusters.

Appendix B. Estimated elasticities from the QUAIDS model

The elasticities reported below are calculated at mean values for prices, expenditures, and demographic variables.

Table B1 Income (total expenditure) elasticities

Good	Income Elasticity
(1) Food on which no VAT is levied	0.52
(2) Food on which VAT is levied and meals out	1.34
(3) Alcoholic Drinks and Tobacco (VAT and duties levied)	1.16
(4) Clothing and footwear (VAT levied)	1.20
(5) Household goods, services and communications (VAT levied, duties sometimes levied)	1.20
(6) Household goods, services and communications (no VAT levied)	0.84
(7) Transport and vehicle fuels (VAT levied, duties sometimes levied but not modelled)	2.06
(8) Public Transport and other transport on which no VAT levied	0.66
(9) Health and Education goods (no VAT levied)	1.12
(10) Health and personal goods and services (VAT levied)	0.98
(11) Leisure and hotel services (VAT sometimes levied)	2.09
(12) Other services	1.69

Notes: Standard errors are calculated using a 500-repetition bootstrap. Statistical significance here means significantly different from 1 (or unit elasticity). Elasticities highlighted with light grey are statistically significant at the 10% level, whilst those highlighted with dark grey are statistically significant at the 5% level. Elasticities are estimated using mean prices and expenditures and for a household with 2 adults and 2 children, where the head is male, has low levels of education, is employed and lives in the DF.

Source: Authors' calculations using MEXTAX, Bank of Mexico price data and ENIGH 2008.

Table B2 Hicksian (compensated) price elasticities

Good	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Food on which no VAT is levied	-0.229	0.039	-0.040	0.051	0.087	-0.002	-0.013	0.069	0.015	0.041	-0.010	-0.009
(2) Food on which VAT is levied and meals out	0.077	-0.847	0.072	0.010	0.255	0.041	0.068	0.122	0.043	0.137	0.011	0.011
(3) Alcoholic Drinks and Tobacco (VAT and duties levied)	-1.762	1.390	-0.744	-0.370	-0.410	0.210	0.343	0.325	0.205	0.172	0.416	0.225
(4) Clothing and footwear (VAT levied)	0.181	0.043	-0.044	-1.049	0.530	0.070	0.125	0.026	0.018	0.063	0.052	-0.014
(5) Household goods, services and communications (VAT levied, duties sometimes levied)	0.199	0.191	-0.018	0.183	-0.886	0.006	0.027	0.083	0.029	0.108	0.059	0.020
(6) Household goods, services and communications (no VAT levied)	0.035	0.254	0.073	0.207	0.031	-1.050	0.065	0.312	-0.004	-0.043	0.168	-0.049
(7) Transport and vehicle fuels (VAT levied, duties sometimes levied but not modelled)	-0.180	0.246	0.058	0.166	0.184	0.041	-0.841	0.051	0.069	0.048	0.154	0.004
(8) Public Transport and other transport on which no VAT levied	0.364	0.286	0.041	0.037	0.223	0.108	0.041	-1.217	0.050	0.112	-0.036	-0.009
(9) Health and Education goods (no VAT levied)	0.204	0.189	0.050	0.030	0.166	-0.001	0.079	0.106	-0.954	0.012	0.085	0.034
(10) Health and personal goods and services (VAT levied)	0.177	0.276	0.018	0.058	0.269	-0.014	0.031	0.094	0.005	-0.934	0.019	0.001
(11) Leisure and hotel services (VAT sometimes levied)	-0.107	0.047	0.108	0.087	0.428	0.140	0.206	-0.075	0.102	0.046	-1.038	0.057
(12) Other services	-0.697	0.360	0.374	-0.214	0.821	-0.231	0.044	-0.133	0.238	0.005	0.366	-0.932

Notes: Standard errors are calculated using a 500-repetition bootstrap. Statistical significance here means significantly different from 0 (or complete inelasticity). Elasticities highlighted with light grey are statistically significant at the 10% level, whilst those highlighted with dark grey are statistically significant at the 5% level. Elasticities are estimated using mean prices and expenditures and for a household with 2 adults and 2 children, where the head is male, has low levels of education, is employed and lives in the DF.

Source: Authors' calculations using MEXTAX, Bank of Mexico price data and ENIGH 2008.