The distributional impact of reforms to direct and indirect tax in Mexico

Analytical Report and Results

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March 2011

Abstract:

This is the final paper of a study aimed at building capacity for the distributional analysis of tax reforms in Mexico and other similar middle-income countries, characterised by the prevalence of tax avoidance and evasion in both the consumption and labor markets and a need to improve the quality of the micro-data suitable for this type of analysis. We develop a tax micro-simulation (MEXTAX) and method to analyse these types of tax reforms. Our methodology can quantify the revenue and distributional impact of tax reforms under both the assumption that individuals do not change their behavior as a consequence of changes in taxes, and the assumption that individuals react to these changes along specific margins. Particularly, we incorporate individuals' response to tax changes in their labor supply, changes in consumer spending as a result of changes in indirect taxes, and less-than-full pass-through of indirect tax changes to consumer prices by firms.

In 2010, the Mexican government implemented a fiscal tightening through an increase in VAT, the financial deposit tax, and a temporary increase to the top rate of income tax, after rejecting the original proposals of the Executive Power. We find that both the reform package initially proposed by the Executive Power and the reform package finally approved by the Congress are progressive if expenditure is used as a measure of living standards. The proposed reform would have raised more revenues than the approved reform.

The methodology adopted for this study makes heavy use of robustness analysis to test the sensitivity of results to different assumptions about informality, tax evasion, under-recording of income and expenditure in the survey data used and to behavioral response. We find that whilst the qualitative pattern of results in unaffected by the particular assumptions used, the quantitative results change significantly, particularly in terms of the amount of revenue raised from the different proposals.

This finding of quantitative sensitivity demonstrates that investment in improving the quality of data available for use in micro-simulation models – whether by improving the household survey (ENIGH) or the creation of tax-record micro-dataset, and by improving the information on informality – should be a priority for the Mexican authorities. The results also suggest that research on the responsiveness of taxable income to changes in tax rates with an emphasis on the incentives and incentives for informality would be useful, as would further studies on the extent to which changes in indirect taxes are passed through to changes in consumer prices. We also suggest expanding the micro-simulator coverage to include cash welfare transfers.

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The authors would also like to thank Héctor Villarreal and Ricardo Cantú of CIEP for their help in understanding the Mexican tax system and sharing their simulator codes with us; Samuel Freije Rodríguez and José Cuesta at the World Bank for their support and insightful remarks, and the participants at the World Bank seminar and at the presentations to the Secretaría de Hacienda y Crédito Público, in Mexico City in February 2011, for their helpful comments.

Executive summary

Introduction

In response to the short-run reduction in fiscal revenues, the Mexican government implemented a modest fiscal tightening in 2010 through:

- An increase in the rate of VAT (*Impuesto al Valor Agregado* (IVA)) of 1%.
- An increase in some duties (*Impuesto Especial sobre Produccion y Servicios* (IEPS)) of which some are temporary increases.
- An increase in the financial deposit tax from 2% to 3%.
- A temporary increase in the top rate of income tax (*Impuesto sobre la Renta* (ISR)) from 28% to 30% .

This paper analyse the distributional impact of some of the elements of both the approved 2010 Mexican tax reforms and the originally proposed by the Executive Power in 2009 but subsequently rejected by Congress. Its main data source is the *Encuesta Nacional de Ingresos y Gastos* (ENIGH) 2008.

It builds on previous efforts to assess the distributional impact of these reforms by CEFP and Absalón and Urzúa that have used the same data source; and it expands upon this existing work by considering:

- A more flexible simulator written in STATA (MEXTAX), which is designed to be a public tool for analyses of future reforms.
- A more complete documentation of assumptions.
- A battery of sensitivity analysis to shed light on the importance of dealing with formality in consumption and labor markets and with missing income in ENIGH 2008 when assessing the distributional and revenue impact of tax reforms.
- Different margins of behavioral response that affect the distributional and revenue impacts of the reforms: labor supply responses; the degree to which indirect taxes are passed on to consumers by producers (VAT pass-through); and consumers' responses to changes in prices induced by changes in taxes.
- A consideration of the efficiency implications of the proposed and approved reforms.

The tax reforms analysed in this paper

In this paper we simulate the initial proposals put to Congress by the Executive Power and the reforms finally implemented in the 2010 tax system. The set of proposals modelled is essentially the same as analysed by CEFP and Absalón and Urzúa.

For the proposed reforms by the Executive power we model the following:

- The introduction of a 2% expenditure tax (the *Contribución para el Combate a la Pobreza*) on all goods and services (with the exception of the purchase of government licenses and donations to charity).
- An increase in the tax rate on drinks with alcohol content greater than 20% by volume from a rate of 50% of the pre-tax price to a rate of 53% (the actual reform was for an increase of 3 pesos per litre but we have used the same approximation as used by CEPF for the purposes of this analysis).

- An increase in the tax on beer from 25% to 28%.
- An increase in the tax per cigarette (or 0.75 grams of snuff) from 160% to 164% (the actual reform was for an increase of 0.04 pesos per cigarette but we have used the same approximation as used by CEPF for the purposes of this analysis).
- An increase in the tax on lottery games from 20% to 30%.
- The introduction of a 4% tax on telecommunications services.
- An increase in the top rate of income tax from 28% to 30%, of the next highest rate from 21.95% to 23.52% and of the third highest rate from 19.94% to 21.36%. Only the part of tax paid on employment income is considered.

For the approved and implemented reforms we model the following:

- An increase in the rate of VAT from 15% to 16% (abstracting from the lower rate of 10% in border areas which was increased to 11%).
- An increase in the tax rate on drinks with alcohol content greater than 20% by volume from a rate of 50% of the pre-tax price to a rate of 53%.
- An increase in the tax on beer from 25% to 26.5%.
- An increase in the tax per cigarette (or 0.75 grams of snuff) from 160% to 164% (the actual reform was for an increase of 0.04 pesos per cigarette but we have used the same approximation as used by CEPF for the purposes of this analysis).
- An increase in the tax on lottery games from 20% to 30%.
- The introduction of a 3% tax on telecommunications services (abstracting from the exemption for public telephones and internet services).
- An increase in the top rate of income tax from 28% to 30%, of the next highest rate from 21.95% to 23.52% and of the third highest rate from 19.94% to 21.36%. Only the part of tax paid on employment income is considered.

This is not an exhaustive list of the full set of tax changes made in 2010. In particular we do not consider the impact of the increase in the ISR tax rates levied on non-employment and corporate income, nor the impact of the increase in the tax on cash deposits from 2.0% to 3.0% of the balance.

An analysis of tax policy alone cannot give a complete picture of the extent of redistribution – such an undertaking requires the modelling of spending on cash transfers and public services. This paper studies only the tax system for several reasons. First, the structure of the tax system can (and in general, should) be chosen without reference to the structure of spending making an analysis of the distributional impact of taxation alone interesting in its own right. Second, in Mexico, eligibility criteria for cash transfers are generally not simple incomes-based means tests but instead rely on complex formulae assessing a household's assets and living standards. Third, information on the use of public services across the income or expenditure distributions is not readily available.

The MEXTAX program and methodology

The MEXTAX simulator is a flexible simulator, which has been designed by IFS researchers to be a public tool for analyses of future tax reforms. The MEXTAX simulator:

- Builds on previous efforts to assess the distributional impact of these reforms by CEFP and Absalón and Urzúa that have used the same data source. It uses part of their codes as the basis for the MEXTAX program.
- Uses the 2008 ENIGH as the source of micro-data. This is a detailed survey of the demographic and socio-economic characteristics of Mexican households and covers, amongst other things, information regarding net income, expenditure, employment status, social security coverage and government programme participation.
- Is written in STATA code and is designed so that users do not need to edit the main simulation code but can instead make changes to an interface module (which defines input and output files and whether to run behavioral response modules) and system parameters modules (which define the basic structure and rates of the baseline and reform tax systems).

The following assumptions are maintained throughout this paper:

- Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program.
- Formal workers are assumed to comply with the tax law on all their income, including the (partial) exemptions for certain kinds of income (e.g. overtime). Deductions for certain expenses (e.g. funeral expenses) are not accounted for.
- Formal workers are assumed to be paid at least the minimum wage in the Federal District.
- Income tax is fully incident on the worker.

Several additional assumptions are made in the baseline analysis but are varied systematically in the sensitivity analyses conducted.

The presentation of the results is as follows:

- The estimated losses to households from the tax reforms are calculated relative to the status-quo in 2008 and presented both in cash terms (annual Mexican $ of 2008) and as a proportion of household (pre-reform) net income and household expenditure.
- We arrange the population from poorest to richest decile groups using net income and expenditure, both taking into account non-monetary income/expenditure and not taking such resources into account.
- Our preferred measured of living standards is total expenditure. This is because saving and dis-saving associated with a desire to smooth consumption in the face of volatile income mean that income may not be an appropriate measure of living standards on which to base distributional analysis of reforms that involve largely changes to indirect taxes.
- When deciding where households are in the income distribution, the standard approach of this paper is to use an equivalence scale to adjust incomes for family size because we consider there is some economies of scale (using a household consisting of a single individual as our reference point). We use a 100/80/50 scale: a household consisting of a single adult has an equivalence factor of 100%, with an additional factor of 80% to additional individuals aged 12 or over and 50% for those aged 11 or under. We also present results using per capita measures and an alternate equivalence scale of 100/50/30.

- A reform is considered progressive (regressive) when as a result of the tax reform the poorer households lose less (more) as a proportion of their income/expenditure than the richer households.
- We also present losses to household by classifying households in categories that take into account their demographic characteristics (e.g. couples with children, couples without children, etc.).
- Total changes in revenues are also estimated and a breakdown by type of tax (ISR, IVA and IEPS) is also presented when possible.

Baseline results

The baseline results show (see section 3 for more details):

- For the proposed reform, as a fraction of net income, poorer households lose more than richer ones, with a loss equivalent to 1.81% of net income for the poorest tenth of households, falling to 1.23% of net income for the richest tenth. Hence, the proposed reform looks regressive.
- For the approved reform, the poorest tenth of the population lose, on average 0.39% of their net income, whilst the richest tenth of the population lose 0.67% of their net income. The reform looks progressive.
- When total expenditure is used as a measure of living standards, losses due to the 2% expenditure tax (counted as IVA) are virtually uniform across the expenditure distribution as one would expect for a uniform expenditure tax. Combined with losses due to changes in income tax and IEPS that are a bigger proportion of expenditure for richer households, this means the overall pattern looks progressive. Households in the bottom 10% of the expenditure distribution lose an amount equivalent to 1.24% of their total expenditure, whilst the richest 10% lose an amount equivalent to 1.83% of their total expenditure.
- For the approved reforms, when total expenditure is used as a measure of living standards, cash losses for the poorest tenth of the population amount to 0.26% of their expenditure on average, and 0.94% for the richest tenth of the population.
- The choice of the equivalence scale has a negligible impact on the results of the distributional analysis of the approved reforms using expenditure as the measure of living standards.

In summary, our baseline results suggest the following:

- Progressivity of the approved reform overall and for each of the tax changes (IEPS, IVA and ISR), when living standards are measured either by total expenditure or income.
- Progressivity of the proposed reform overall and for each of the tax changes (IEPS, IVA and ISR), only when living standards are measured either by total expenditure.
- Revenues changes are under-estimated due to missing income and expenditure and the fact that we do not model taxation on non-labour income.

Sensitivity analyses

Because of significant problems in the underlying ENIGH survey data (for instance, missing income and expenditure), a number of fairly strong assumptions must be made in order to proceed with analysis.

We perform twelve sensitivity tests, one of which involves changing how we classify workers as formal or informal (scenario S1), another of which involves changing how we classify expenditure as formal or informal (scenario S2), and ten of which involve different ways of dealing with the under-recording of income and expenditure in ENIGH (see section 4 for more details), in particular:

- Using constant factors as is existing standard practise (scenarios S3 to S6).
- Using factors that vary (smoothly) across the income distribution to account for the concern that it is mainly towards the top of the income distribution that income is under-reported and households missing (scenarios S7 and S8).
- Using a regression-based approach to allocate missing earned and unearned income based on the characteristics of individuals and households, which allows for the complete omission of income sources by respondents (scenarios S9 to S12).

We use total expenditure as our measure of living standards and the 100/80/50 equivalence scale to perform the distributional analyses.

The different sensitivity analyses show that in general the distributional impact of both proposed and approved reforms is largely unchanged in qualitative terms. The reforms are still found to be progressive in most of the sensitivity analyses performed. However, the way missing income and expenditure are allocated can make important quantitative differences in the distributional analyses and estimates of revenue changes due to the tax reforms. In particular:

- When incomes are increased by fixed source-specific factors and expenditures correspondingly adjusted (scenario S4), losses increase most in cash terms for the top 10% of households but so do expenditures such that, as a proportion of expenditure, losses are higher than under the baseline for the poorest 90% of households but lower for the richest 10%.
- When expenditures are increased by category-specific factors and incomes are increased by constant Altimir factors (scenario S6), losses increase as a proportion of expenditure across the expenditure distribution, but more so for poorer households, making the reforms look a little less progressive than under the baseline.
- Increasing employment income only for richer households (scenarios S7 and S8) makes the reforms look a little more progressive than when incomes are adjusted by constant factors (scenario S4).
- Allowing for complete omission of income sources using a regression-based approach to allocating missing income (scenarios S9 to S12) shows that the exact specifications of such methods can have a sizeable quantitative impact on findings.

In general, we consider the sensitivity analyses an important and illuminating exercise which can guide policy makers in determining ways to improve data, for example by linking different survey data and accessing administrative data to get more accurate figures for income and by improving the way formal expenditure is defined. In particular, without such linking or an improvement in the quality of the ENIGH survey data, our analysis suggests that estimates of the impact of reforms on the income/expenditure distribution and tax revenues based on micro-simulation models must not be seen as providing 'exact' answers.

Allowing for behavioral response

We investigate how allowing for a number of dimensions of behavioral response can affect the amount of revenue raised by the 2010 reforms, and, where possible the impact of the reforms across the income / expenditure distribution (see section 5 for more details). We investigate different margins of behavioral:

- Labor supply responses. This exercise tests how different assumptions about taxable income elasticities (i.e. how responsive levels of taxable income are to tax rates) affect results.
- The degree to which indirect taxes are passed on to consumers by producers (VAT pass-through). This entails varying the assumptions about who bears the cost of increases in indirect taxes, allowing some of the cost to be borne by the workers or shareholders of formal companies as opposed to it being borne purely by consumers in the form of higher prices.
- Consumers' responses to changes in prices induced by changes in taxes. This goes beyond simple sensitivity analyses as the ones described above and estimate a model of consumer demand using ENIGH data and price data from the Bank of Mexico.

We find that:

- Allowing for a change in labor supply is important, as once one does so the tax reforms raise lower revenues. For instance under the assumptions of a high degree of responsiveness, the proposed reforms raise 85% of the amount that they do under the assumption of no-behavioral response, and the approved reforms 78%.
- Allowing for less-than-full VAT pass-through makes an important quantitative difference to the distributional and revenue results. In particular, the pattern of losses looks more progressive, especially when that part of the burden not feeding through to higher prices is borne by the owners of capital.
- Allowing for changes in consumer demand patterns makes no measurable difference to estimated revenues from either the proposed or approved reforms, and substitution between goods is shown to make very little difference to the welfare costs of indirect taxation.

The efficiency of the tax reforms

We address in a qualitative manner the likely differences in the efficiency with which the proposed and approved reforms raise revenue, drawing on the optimal tax literature. We do not compare either set of reforms to a counterfactual "optimal" reform nor do we assess quantitatively the deadweight loss associated with the increases in tax rates (see section 6 for more details).

The reforms to ISR under the initial proposals and the approved plans are very similar and it is unlikely to be any great difference in the efficiency with which they raise revenue. However, a temporary increase in the top rates of ISR may not be a particularly efficient way to raise revenues, for a number of reasons.

- Firstly, the Mexican ISR introduces a number of distortions that are increased if ISR rates are increased: by taxing the normal return to capital (savings), it distorts decisions

about when to consume and how much to save and invest; and the system of exemptions under the ISR means that it taxes more heavily those jobs that do not involve an element of performance related pay than those who do. Hence an increase to ISR increases these distortions.

- Secondly, the deadweight cost of a tax increases more than proportionally with increases in the tax rate meaning that it is generally less economically costly to raise the same amount of revenue using a constant rate of tax over time, than rates that are low in some years and high in others. This means that unless the temporary deficit that Mexico hoped to address with a temporary tax increase would have not been financeable at a reasonable rate of interest, a small permanent increase in ISR would have been more economically efficient than a larger temporary increase.

Regarding the reforms to IVA and IEPS, the biggest difference between the proposed and approved reforms is the replacement of the 2% comprehensive spending tax with a (much smaller) 1% increase in the rate of IVA.

- The standard view is that uniformity is preferable (to avoid distortions to people's decisions about which goods to consume) in the presence of a non-linear income tax, unless some goods are complements for leisure and others substitutes. We find some evidence of non-separability but differentiation of VAT rates does not seem to reflect this (instead it seems to largely reflect distributional concerns).
- Consideration of administrative burden and compliance issues is thought to reinforce the case for uniformity.
- This suggests that the initial proposals would be a more economically efficient way of raising a given amount of revenue than (a suitably scaled up version of) the approved reforms.
- However, differences in the ease of evasion across goods mean it is likely that the elasticity of demand for formal expenditure with respect to the rate of IVA will differ across goods. Models of optimal commodity taxation need to be further developed to determine whether this could provide a justification for non-uniformity of rates.

Future research

This paper shows us that the way missing income and expenditure are allocated can make important quantitative differences in the distributional analyses and estimates of revenue changes due to the fiscal reforms. In addition, it shows us that behavioral response can significantly reduce the amount of additional revenue raised from tax increases, and can alter the distributional pattern of welfare losses. We discuss four main areas where we feel future research effort would be most productively spent in light of these findings (see section 7 for more details). We wish for future research to be a collaborative effort involving researchers at the IFS, the World Bank, and in Mexico and other developing countries.

First, we examine the ways in which one may improve the modelling of labor supply, in particular:

- How (exogenous) changes in incentives individuals face to work in the informal sector affect whether workers are formally employed or not.

- The estimation of taxable income elasticities for Mexico and the theoretical development of the approach to allow for different elasticities for the various types of response that may entail different revenue effects.
- An exploration of how changes in indirect taxes affect labor supply decisions

Second, we argue that it is important to explore further the incidence of indirect taxes, specifically:

- How the part of the increase in indirect taxes borne by producers is distributed between capital owners and workers.
- How the degree of pass-through and how the part borne by producers is distributed is determined in specific markets, using a more structural analysis, in which both supply and demand of a specific good is considered, and information about labor and capital markets are incorporated in the analysis.

Thirdly, we stress, as many other researchers in Mexico have done already, that there is a need to improve the quality of micro-data, particularly:

- Additional effort should be placed on improving coverage of high income households that are currently under-represented in the survey, and in improving the sampling weights as far as possible.
- The government should also link the survey data with administrative data.

Finally, we discuss how MEXTAX could be expanded to include cash transfers (welfare/benefits) in addition to taxes. We highlight the main challenges in doing this and suggest improvements to the ENIGH survey that may need to be made to allow more comprehensive analysis of cash transfers.

Contents

1. Introduction

In 2009 the Mexican government debt to gross domestic product (GDP) ratio stood at 35.6%, while the government deficit was 2.32% of GDP. Although these figures are low relative to the position of most developed countries, they hide a substantial imbalance: government revenues from general taxation account for only 9.5% of GDP, while expenditure stands at 26.1% of GDP.[1] The difference between these figures is mainly covered by oil revenues, which therefore play an important role in guaranteeing the long-term solvency of the Mexican government. However, given the volatility of oil prices and the fact that proven reserves of Mexican oil are expected to last less than 10 years, there is an urgent need to consolidate government finances, both in terms of expenditure and in terms of revenue.

In 2009, in response to the short-run reduction in fiscal revenues[2], the Mexican government approved a modest fiscal tightening starting in 2010 (from now on referred to as the 2010 tax reforms) through an increase in the rate of VAT of 1%[3], an increase in some duties, an increase in the financial deposit tax from 2% to 3%, and a temporary increase in the top rate of income tax from 28% to 30%. The Mexican Congress rejected more radical proposals for larger increases in duty rates, the introduction of a comprehensive 2% VAT on all goods (including those currently not covered), and increases in regulated prices. When assessing fiscal reforms such as these, an important element of the appraisal is to ascertain the distributional impact of the reforms.

This paper is the second in a series of papers that analyse the distributional impact of the 2010 tax reforms, applying the methodology described and explained in the first paper, "Methodological Issues and Approach" (Abramovsky et al (2010)). We first present the results of the distributional and revenue analysis for our baseline data and assumptions. We then present a number of sensitivity analyses where we vary the following assumptions:

- The definition of formality in both the labor and goods markets, and;
- The type of correction to be applied to account for missing income and expenditure.

A full description of the baseline assumptions and the alternative assumptions used as robustness checks for the main results can be found in the relevant sections of this paper. It should be noted at the outset that we do not claim to have found the correct set of assumptions needed to accurately model the impact of tax reforms in Mexico. Instead we believe that the sensitivity analyses provide information about how important issues such as the under-recording of incomes in household surveys are, and that they demonstrate how different methods for addressing such issues can impact on the results of tax policy analysis.

We then look at how allowing for behavioral response may change results. For labor supply and the shifting of the burden of increases in indirect taxes onto workers and shareholders in the form of lower wages and dividends, this again takes the form of sensitivity analysis. However, we have the necessary data to estimate a consumer demand model. This model is used to look at

[1] Bank of Mexico, Annual Report 2009 (see Cuadros 6, 7 and 18).
[2] There has been, as yet, less focus on the longer-term need to consolidate the budget in the face of the increasing cost of welfare and social security programmes and a projected decline in oil revenues.
[3] The main VAT rate increased from 15% to 16%, and the rate at which transactions subject to VAT are taxed in areas bordering the United States increased from 10% to 11%.

how consumer welfare and expenditure patterns are affected by tax reforms, and to estimate the impact of any substitution on the revenues from tax reforms.

We also address in a qualitative manner the likely differences in the efficiency with which the proposed and approved reforms raise revenue, drawing on the optimal tax literature.

At this stage it is worth noting that an analysis of tax policy alone cannot give a complete picture of the extent of redistribution – such an undertaking requires the modelling of spending on cash transfers and public services. This paper studies only the tax system for several reasons. First, the structure of the tax system can (and in general, should) be chosen without reference to the structure of spending making an analysis of the distributional impact of taxation alone interesting and important in its own right. Second, in Mexico, eligibility criteria for cash transfers are generally not simple incomes-based means tests but instead rely on complex formulae assessing a household's assets and living standards which makes modelling the programs more difficult. Third, information on benefit receipt and the use of public services across the income or expenditure distributions is not readily available.

The rest of this paper proceeds as follows. Section 2 describes the tax reforms considered in this analysis, summarises the distributional analysis presented in previous work by other authors, and presents the methodology employed in this paper. In section 3 we present our baseline results and show how the choice of using expenditure or income as our measure of living standards significantly affects whether the reforms are considered regressive or progressive. We also demonstrate that the choice of equivalence scale is second order when analysing the 2010 tax reforms. Section 4 describes and explains the numerous sensitivity analyses we conduct, whilst section 5 presents our analysis when we allow for behavioral response. In section 6 we assess qualitatively the efficiency implications of the tax reforms. In section 7 we discuss what we consider to be the most important avenues for future research and provide some tentative ideas about how such research could be conducted. Section 8 concludes.

We include three written appendices. Appendix A describes the processes and programs used to create the data used in the baseline analysis and the various sensitivity analyses. Appendix B describes the structure and workings of our tax simulator. Appendix C provides additional details on our consumer demand system, the Quadratic Almost Ideal Demand System (QuAIDS). We also include our full tables of results in an attached Microsoft Excel file (results.xls). Whilst we include tables that show the main results in the main body of the paper, we do reference the spreadsheet as well, in some instances. Documented code for the tax simulator will be provided following the completion of the paper.

2. Analysing the 2010 Mexican tax reforms

In section 2.1 we detail the reforms that were proposed and, following negotiations, approved. In section 2.2, we discuss the results of previous published analyses of the distributional impact of the proposed and implemented 2010 tax reforms, carefully noting the assumptions underlying these results and the reforms modelled. In section 2.3 we detail the reforms that are modelled in this paper, and provide details on the assumptions, methods and data employed in our analysis. A key part of our research involves varying the assumptions made in order to test the sensitivity of results. These alternative assumptions are discussed in the relevant parts of section 4.

2.1 The 2010 tax reforms

Table 2.1 shows the main reforms proposed by the Executive power and approved by the Congress and implemented. It is clear from the table (and will be confirmed in the quantitative analysis in this paper) that the proposed tax reforms were significantly larger than those ultimately approved by the Mexican Congress.

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Table 2.1 A description of the 2010 tax reforms

Item	**Status-quo**	**2010 tax reform *proposed* by the Executive power**	**2010 tax reform *approved* by the Congress and implemented**
1. Income tax: both personal and corporate (Impuesto sobre la Renta – ISR).	Top three marginal rates are 19.94%, 21.95% and 28%.	-Top three marginal rates increase to 21.36%, 23.52% and 30% in 2010, 2011, 2012, with a phased reduction to 28% in 2014. -Individuals earning up to 4 minimum wages are not affected. -The annual upper threshold of income band 3 (lower threshold of income band 4) decreases from 88,793.04 $ (mex) to 79,964.16.	-Top three marginal rates increase to 21.36%, 23.52% and 30% in 2010, 2011, 2012, with a phased reduction to 28% in 2014. -Individuals earning up to 6 minimum wages are not affected.
2. VAT (Impuesto al Valor Agregado - IVA)	General rate of 15%, and 10% in border areas	--	General rate of 16%, and 11% in border areas
3. Excise duties (Impuesto especial sobre la producción y servicios – IEPS)			
3.a. Tobacco	160% rate	Additional flat-rate of 0.04 for each cigarette or 0.75 grams of snuff; to be increased to 0.10 by 2014.	Additional flat-rate of 0.04 for each cigarette or 0.75 grams of snuff; to be increased to 0.10 by 2014.
3.b. Beer	25% rate	28% rate	26.5% rate (temporary)
3.c. Lottery	20% rate	30% rate	30% rate
3.d. Drinks with alcohol content greater than 20% by volume	50% rate	Additional minimum charge per litre of 3 pesos	53% rate
3.e. Telecommunications	None	4% rate	3% rate, except for Internet connexions
4. New expenditure tax (*Contribucion para el Combate a la Pobreza*)	--	Introduction of a 2% expenditure tax on all goods and services (with the exception of the purchase of government licenses and donations to charity)	Rejected
5. Tax on cash deposits	2% rate of balance	3% rate of balance	3% rate of balance

Source: CEFP (2009f)

2.2 Previous distributional and revenue analysis

Two groups have published distributional analysis of the impact of the 2010 tax reforms: the *Centro de Estudios de las Finanzas Públicas* (CEFP) - a quasi-autonomous research group formerly led by Héctor Villarreal and that reports to the Mexican Congress -; and Carlos Absalón and Carlos Urzúa – funded by the United Nations Development Programme (UNDP). These two efforts use broadly the same methodology and model broadly the same set of reforms in the same manner.

CEFP analysis

CEFP is a branch of the General Secretariat of the Congress of the United States of Mexico and is tasked with undertaking research relating to the economy and public finances. As part of this, it undertakes analyses of tax reforms presented to, debated in and legislated for by Congress. This analysis is made available to the public with the aim of promoting public debate and understanding of policy proposals. Between February 2008 and March 2010, Héctor Villarreal was director of CEFP and during this time significant effort was invested in developing tax micro-simulation models for the analysis of policy measures.

CEFP has developed micro-simulation models for value added tax (IVA), certain excise duties (IEPS) and personal income tax (ISR) levied on employment income. In their distributional analysis of the 2010 fiscal reforms they model the following:

- Reform to ISR (see table 2.1., item 1). Only the part of tax paid on employment income is considered.
- Introduction of expenditure tax (table 2.1. item 4) and reforms to VAT/IVA (item 2 of table 2.1., abstracting from the lower rate of 10% in border areas which was increased to 11% by the reforms).
- Reforms to IEPS (table 2.1, items 3.a. to 3.e.). The increase in the tax per cigarette (or 0.75 grams of snuff) is modelled as an increase in the ad-valorem rate of 4% from 160% to 164%. The proposed increase in the tax on drinks with alcohol content greater than 20% by volume is modelled as an increase from a rate of 50% of the pre-tax price to a rate of 53%.

CEFP analysed not only the implemented reforms and the initial proposals put to Congress but also the intermediate proposals resulting from the debates of the Upper and Lower Houses of the Mexican Congress. We do not discuss these intermediate proposals in this paper.

In order to model these reforms, the following assumptions are made[4]:

- Workers are considered to be employed in the formal sector if they are covered by an ISSSTE, ISSSTE, PEMEX or military social security program.
- Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program.
- If a person states membership of both IMSS and an ISSSTE scheme it is assumed that they face the ISSSTE social security contributions schedule.

[4] See CEFP (2009a, 2009b, 2009c) for more details.

- Formal workers are assumed to comply with the tax law on all their income, including the (partial) exemptions for certain kinds of income (e.g. overtime). Deductions for certain expenses (e.g. funeral expenses) are not accounted for.
- Formal workers are assumed to be paid at least the minimum wage in the Federal District.
- Income tax is fully incident on the worker.
- Under-reporting of employment income is proportional to reported employment income so that incomes can be adjusted by increasing gross employment income by a constant factor (the Altimir factor[5]). The corresponding increase to net household income (used to define people as rich or poor) is not made.
- No adjustment is made for under-reporting of consumer expenditure.
- IVA and IEPS are fully incident on the consumer.

CEFP study the distribution of tax burdens under both the existing, proposed and approved tax systems, as well as estimating the change in income tax revenues as a proportion of net income by income decile group and in expenditure tax revenues as a proportion of expenditure by expenditure decile group. When looking at the overall impact they use net income per capita decile groups.

Cuadro 2 of CEFP (2009e) shows the losses under the approved tax reforms as a percentage of net household income. This shows the pattern to be broadly progressive (except at the very bottom of the income distribution) with losses equivalent to 0.5% of net income for the poorest tenth of households, 0.4% for households in the middle of the income distribution, and 0.9% for the richest tenth of households. They find the progressive pattern to be due solely to the reforms to ISR, with the increase in the rate of IVA found to be regressive. We will argue later that this is a potentially misleading artefact of using income as one's measure of living standards rather than expenditure.

CEFP has not provided a similar analysis of the burden of the full set of initial proposals. However, it has produced an analysis of how the losses due to the indirect tax change as a percentage of total expenditure are reduced under the approved plans relative to the initial proposals. Cuadro 4 of CEFP (2009d) shows losses were lower to the tune of 1.6% of expenditure for the poorest tenth of households (based on their position in the expenditure distribution) and 1.3% for the richest tenth of households under the approved reforms compared to the initial proposals. That is, the amendments to the initial proposals were progressive meaning that the initial proposals were less progressive than those finally approved. We come to similar conclusions. The amendments to the proposed reforms of ISR are much smaller than the amendments to the reforms of IVA and IEPS and are unlikely to alter this conclusion.

CEFP uses a STATA-based simulator that is designed so that changes can be made to tax rates and thresholds by changing scalars that are defined at the start of programs. This makes it relatively easy to perform simple changes to the tax system. However, it is not possible to easily change more complicated features of the tax system such as the amounts of various income sources that are exempt from tax or the types of goods on which IVA and IEPS are levied on.

[5] CEFP use a factor of 1.40 for employment income. The factor was calculated by comparing the National Accounts figure for "remuneration to employees", which was assumed to be gross remunerations, to the total gross employment income from ENIGH 2008.

This means that the programs are perfectly suitable for simulating the impact of the proposed and implemented reforms in 2010 but are not flexible enough to be used to simulate more complicated counterfactual reforms. The data source is the 2008 *Encuesta Nacional de Ingresos y Gastos de los Hogares* (ENIGH) and files based on this created by *Consejo Nacional de Evaluación de la Política de Desarrollo Social* (CONEVAL), a federal research institute that, amongst other things, calculates the official measures of poverty. A key part of the simulator is the "reverse engineering" of gross income from net income using the 2008 income tax and social security system structure

Héctor Villarreal has founded a new research institute called the *Centro de Investigación Económica y Presupuestia* (CIEP)[6], which is further developing the programs developed at CEPF and integrating them with an online interface so that members of the public can look at the revenue and distributional impacts of simple reforms of the ISR, IVA and IEPS systems. This is a very important project that will help Mexican citizens understand policy and gain the knowledge necessary to hold their government to account.

The analysis of Absalón and Urzúa

Absalón and Urzúa were commissioned by the UNDP to develop a model that could be used to undertake distributional analyses of tax reforms in Mexico and to apply this model in an assessment of the impact of the proposed and approved 2010 tax reform packages. This is part of an ongoing project in Latin America known as "Fiscal Systems for Inclusive Development" (FSID) that is designed to improve tax and benefit policy through theoretical and empirical research, including the development of tax-benefit microsimulation models.[7]

Ultimately, Absalón and Urzúa plan to eventually model not only IVA, IEPS, and ISR levied on employment income, but also other personal income tax payments, car ownership tax, the IMSS and ISSSTE social security systems, and a number of welfare benefits including Oportunidades, Procampo and social security pensions (Absalón and Urzúa (2009a)). For the purposes of their analysis of the 2010 fiscal reforms, however, they modelled the following reforms (Absalón and Urzúa (2010)):

- Reform to ISR (see table 2.1., item 1). Only the part of tax paid on employment income is considered.
- Introduction of expenditure tax (table 2.1. item 4) and reforms to VAT/IVA (item 2 of table 2.1., abstracting from the lower rate of 10% in border areas which was increased to 11% by the reforms).
- Reforms to IEPS (table 2.1, items 3.a. to 3.e.).

In order to model these reforms, the following assumptions are made:

- Workers are considered to be employed in the formal sector if they are covered by an IMSS, ISSSTE, PEMEX or military social security program through their own work.
- Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program.

[6] For more information visit http://www.ciep.mx/
[7] For more details, see:
http://economiccluster-lac.org/index.php?option=com_content&view=article&id=73&Itemid=29&lang=en

- Formal workers are assumed to comply with the tax law on all their income, including the (partial) exemptions for certain kinds of income (e.g. overtime). Deductions for certain expenses (e.g. funeral expenses) are not accounted for.
- Formal workers are assumed to be paid at least the minimum wage in the Federal District.
- Income tax is fully incident on the worker.
- Under-reporting of employment income is proportional to reported employment income so that incomes can be adjusted by increasing gross employment income by a constant factor (the Altimir factor[8]).
- No adjustment is made for under-reporting of consumer expenditure.
- IVA and IEPS are fully incident on the consumer.

Absalón and Urzúa plan to study the impact of the modelled tax reforms on a number of summary distributional measures including Lorenz curves, and the Gini coefficient which will not be analysed in our paper. However, like us, they also look at the burden of taxes by income decile group (although it is unclear what measure of income is used to assign households to decile groups).

The increases in income tax are found to be strongly progressive whilst the increases in expenditure taxes are found to be regressive for the proposed reform but progressive for the approved reform (see table 17 and table 18 in Absalón and Urzúa (2010)). In our methodological paper we argued that using income as the denominator and welfare measure by which to categorise households as rich or poor may lead to a bias towards regressivity for expenditure tax due to consumption smoothing. Unfortunately, the paper does not present expenditure decile groups (as far as we can tell).

The version of Absalón and Urzúa's paper that we have is a conference draft. Whilst the policy context, policy changes and methodology are explained very clearly and in great detail, important information required to properly interpret the results is omitted. For instance, it is not clear what measure of income is used to assign households to decile groups; whether expenditure is used to assign households to decile groups for expenditure taxes; what the denominator is for the "Incidencia del impuesto" columns of table 14 or table 16; or why there are changes in social security revenues from the change in income tax rates. This sometimes makes comparing the results of this analysis to other studies such as our own results a little difficult. We think that the more information that is provided in the final draft, the better.

Absalón and Urzúa's model is Microsoft Excel-based, allowing a user to easily change tax rates and thresholds to simulate actual and counterfactual reforms using an interface page. The simulator uses the ENIGH 2008 dataset as its micro-data. As with the CEFP model, a key part of the simulator is the "reverse engineering" of gross income from net income using the 2008 income tax and social security system structure.

2.3 Data, methods and assumptions

In this paper we simulate the initial proposals put to Congress and the final proposals passed and implemented in the 2010 tax system. The set of proposals modelled is essentially the same

[8] Absalón and Urzúa use a factor of 1.133575 for employment income that they calculate by comparing earnings aggregates in ENIGH 2008 survey and the system of National Accounts (Absalón and Urzúa (2009b)).

as analysed by previous researchers. For the **initial proposals** and **the implemented reforms** we model the following:

- Reform to ISR (see table 2.1., item 1). Only the part of tax paid on employment income is considered.
- The proposed introduction of the expenditure tax (table 2.1. item 4) and the approved reforms to VAT/IVA (item 2 of table 2.1., abstracting from the lower rate of 10% in border areas which was increased to 11% by the reforms).
- Reforms to IEPS (table 2.1, items 3.a. to 3.e.). We have used the same approximation as used by CEPF for the purposes of this analysis: the increase in the tax per cigarette (or 0.75 grams of snuff) is modelled as an increase of 4% from 160% to 164%; and the proposed increase in the tax on drinks with alcohol content greater than 20% by volume is modelled as an increase from a rate of 50% of the pre-tax price to a rate of 53%. In the case of the approved reforms, we abstract from the exemption for public telephones and internet services.

This is not an exhaustive list of the full set of tax changes made in 2010. In particular, we do not consider the impact of the increase in the ISR tax rates levied on non-employment and corporate income, nor the impact of the increase in the tax on cash deposits from 2.0% to 3.0% of the balance. We were unable to model these tax changes due to the poor quality of data for non-employment income and for cash deposits in the ENIGH surveys used in this analysis and the fact that ENIGH does not measure corporate income (except to the extent that it is distributed to households). Furthermore there are special regimes for certain forms of income that add complexity that is beyond the scope of this project. In restricting our attention to a subset of the tax reforms we are also in-line with past analyses.

As highlighted earlier, we do not model spending on cash transfers (except the earned-income ISR subsidy) or on public services. It is important to bear this in mind because the initial proposals put forward by the Finance Secretary proposed using some of the revenues from the 2% general expenditure tax (table 2.1, item 4) to fund expansions of anti-poverty programs such as O*portunidades* (indeed the tax was referred to as *Contribución para el Combate a la Pobreza* or the Contribution to the Combat against Poverty). This means that the complete set of initial proposals (both tax and spending) are likely to be more progressive than the aspects of the reforms (the tax component) discussed in this paper. However given that increases in spending on anti-poverty programs can be made irrespective of the particular tax-mix chosen, we believe it is worthwhile assessing the distributional impact of the tax reforms alone.

The simulator and analysis discussed in this paper use the 2008 ENIGH as the source of micro-data. This is a detailed survey of the demographic and socio-economic characteristics of Mexican households and covers, amongst other things, information regarding net income, expenditure, employment status, and government program participation (including social security coverage). The survey is conducted every 2 years (and is released for public use in July of the following year), with the 2008 sample consisting of 29,468 households of which 29,429 include responses to all the questions necessary for our model.

The survey data consists of several separate datasets. Our model uses variables from all of the datasets except the files 'noagro', 'erogaciones', and 'gastotarjetas'. We use these data, together with a number of assumptions about how the raw variables translate into the variables

necessary for our simulator (such as formality status, and gross incomes) to create three model input datasets: a household file, an expenditure file and an individual file (that includes income and social security status). Testing the sensitivity of results to changes in assumptions about what income and expenditure is 'formal' and how to account for the discrepancy between total income and expenditure as measured in the ENIGH and in national accounts is done through adjusting the input files. Full details of this process, the files and the programs used to create them can be found in appendix A.

The simulator program is written in STATA code and is designed so that users do not need to edit the main simulation code but can instead make changes to an interface module (which defines input and output files and whether to run behavioral response modules) and system parameters modules (which define the basic structure and rates of the baseline and reform tax systems). Based on the data and the user-defined tax parameters, separate modules then calculate indirect tax payments, the direct tax base, and direct tax payments before calculating the revenue effects of the reforms and the impact of the tax changes across the income / expenditure distributions and by household types. Separate modules can then be turned on and off according to need to allow for less-than-full pass-through of changes in indirect taxes to changes in consumer prices, as well as to model labor supply (or more correctly, taxable income) and consumer demand responses to tax changes. It has been designed in this way so that users do not have to edit the main program code even if they wish to make fairly major changes to the tax system (e.g. introducing additional tax rates) or the input data (such as additional sources of income or expenditure categories). Full details of the simulator program can be found in appendix B, with economic aspects of the modelling discussed in the relevant sub-sections.

The following assumptions are maintained throughout this paper including the sensitivity analysis conducted in section 4:

- Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program.
- Formal workers are assumed to comply with the tax law on all their income, including the (partial) exemptions for certain kinds of income (e.g. overtime). Deductions for certain expenses (e.g. funeral expenses) are not accounted for.
- Formal workers are assumed to be paid at least the minimum wage in the Federal District.
- Income tax is fully incident on the worker.

In addition, the following assumptions are made in the baseline analysis discussed in this section but are varied assumption-by-assumption in the sensitivity analysis conducted in section 4:

- Workers are considered to be employed in the formal sector if they are covered by an IMSS, ISSSTE, PEMEX or military social security program through their own work.
- Expenditure is considered to be subject to IVA and IEPS unless the type of vendor is a street market or a stall[9]. Expenditure on petrol and telecoms, which is subject to IVA, is always considered to be formal.

[9] ENIGH variable lug_com equals to 1, 2, or 3.

- No adjustment is made for under-reporting of consumer expenditure or for the under-reporting of incomes.
- IVA and IEPS are fully incident on the consumer.

Table 2.2 provides a comparison of our baseline assumptions to those of CEFP and Absalón and Urzúa.

We present the losses to households from the tax reforms both in cash terms and as a proportion of household net income and household expenditure, and arrange the population from poorest to richest decile groups using net income and expenditure. We do this both taking into account non-monetary income/expenditure and not taking such resources into account. We also present the percentage of total revenue change born by each decile for the baseline assumptions.

When deciding where households are in the income/expenditure distribution, the standard approach of this paper is to use an equivalence scale to adjust incomes/expenditures for family size (using a household consisting of a single individual as our reference point). Hence a household consisting of a single adult has an equivalence factor of 100%, with an additional factor of 80% for additional individuals aged 12 or over and 50% for those aged 11 or under. This means that, for example, a household consisting of two adults and two children aged 11 or under would have their income divided by 2.8 to find the equivalent amount for a single adult. Our particular scale is arbitrary but considered; we have chosen it to be roughly mid-way between the scales used in the UK (with weights of 50% for second and subsequent adults and 30% for children) and a per-capita scale (weights of 100% for all individuals). This is because it is generally felt that whilst household economies of scale do exist, they are likely to be of less importance in developing countries (like Mexico) than in developed countries (like the UK) as food (for which economies of scale are minor) is a bigger fraction of household expenditure, and housing (for which economies of scale are bigger) is a smaller fraction. Nevertheless, in the baseline analysis we show results for each of the aforementioned equivalence scales (this is not repeated when testing the sensitivity of results to changes in more substantive assumptions in section 4).

Table 2.2. Assumptions in MEXTAX, CEFP and Absalon and Urzua

Type of assumptions	MEXTAX assumptions	CEFP	Absalón and Urzúa
Informal consumption	Informal consumption if purchased from informal vendors, defined as ENIGH variable lug_com equal to 1, 2, or 3 (B)	The same as MEXTAX	The same as MEXTAX
Formal workers	Formal worker if social security coverage through their own work (B) Formal workers are assumed to comply with the tax law on all their income, including the (partial) exemptions for certain kinds of income (e.g. overtime). Deductions for certain expenses (e.g. funeral expenses) are not accounted for Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program Formal workers are assumed to be paid at least the minimum wage in the Federal District	Formal worker if social security through their household (not necessarily through own work). If a person states coverage by both IMSS and ISSSTE, it is assumed that the face the contributions schedule of the latter. The rest is as MEXTAX	The same as MEXTAX
Missing income	No correction for missing income (B)	Gross employment income only is adjusted by a constant factor of 1.40. The corresponding increase to net household income (used to define people as rich or poor) is not made.	Incomes are adjusted by increasing gross employment and non-employment income by constant factors (1.13 for employment)
Missing expenditure	No correction for missing expenditure (B)	The same as MEXTAX	The same as MEXTAX
Incidence of income tax levied on employment income	Income tax is fully incident on the worker	The same as MEXTAX	The same as MEXTAX
Incidence of indirect taxes	IVA and IEPS are fully incident on the consumer (B)	The same as MEXTAX	The same as MEXTAX

Notes: (B) means that they are only maintained in our baseline analysis but are changed in our sensitivity analyses or when we incorporate behavioral response.

3. Baseline results

In this section we present and describe the key findings of our analysis of the distributional impact of the tax reforms using our baseline assumptions. Full tables of results for our baseline analysis can be found in sheets A3.1a and A3.1b in the attached excel spreadsheet (results.xlsx), although key tables can also be found in the main body of the paper (tables 3.1 to 3.5).

The first panel of table 3.1a shows the cash and proportional losses by income decile group for the tax reforms initially proposed by the executive, whilst the second panel shows the losses from the proposals approved and implemented. Column (1) shows the average total income for each decile group and column (2) shows the proportion of total income in the Mexican economy accounted for by each decile group. Columns (3), (4), and (5) show the loss/gain (in 2008 Mexican pesos per annum) due to changes in the amount of ISR, IVA and IEPS paid, respectively, with column (6) showing the total loss/gain. Column (7) shows the overall change as a percentage of household total net income (this measure includes both monetary and non-monetary sources of income) and column (8) shows the percentage of total revenue change borne by each income decile group.

Looking first at the proposed reforms, it is easily seen that average cash losses increase as one moves up the income distribution for each of the taxes. This is particularly the case for income tax (ISR) given that most households towards the bottom part of the income distribution have incomes too low to be affected by the changes in income tax (the few poorer households that are affected are ones containing many individuals where one individual has a relatively high income). The imposition of a 2% tax on all goods (included within IVA here) is a bigger hit in cash terms for richer households than poorer ones but, as a proportion of income, it hits poorer households harder. This may seem odd given that the tax is a uniform tax on all expenditure. It comes about because households towards the bottom of the income distribution report spending an amount that exceeds their monetary income (although not their total income), whilst those towards the top of the income distribution generally report spending significantly less than their income. This might reflect expenditure smoothing in response to income shocks or lifecycle changes in needs or earning capacity. For instance, those with low incomes may have only temporarily low incomes or may be towards the start or end of their life and fund higher expenditure by borrowing or dis-saving, whilst those with high incomes may have only temporarily high income (e.g. because of a bonus) and therefore save a large fraction of it. The impact of the comprehensive expenditure tax means that as a fraction of net income, poorer households lose more than richer ones, with an estimated loss equivalent to 1.81% of net income for the poorest tenth of households, falling to 1.23% of net income for the richest tenth.

Looking at the approved and implemented reforms, cash losses are lower across the income distribution for all taxes considered. This is particularly the case for IVA; an increase of 1 percentage point in the standard rate of IVA raises much less money than the introduction of a comprehensive 2% expenditure tax and therefore costs households less. The poorest tenth of the population lose, on average, 124 pesos per year (equivalent to 0.39% of their net income), whilst the richest tenth of the population lose, on average, 3,282 pesos per year (equivalent to 0.67% of their net income).

Table 3.1b shows the gains from the amendments made between the initial proposals and the approved proposals. In cash terms, the biggest gains go to the richest households, with low

income households hardly gaining from changes to the income tax proposals. Column (6) shows that poorer households got only 4% of the gain whereas richest households got around 24%. However, driven by the shift from the 2% expenditure tax to a 1% increase in IVA, column (5) shows that the gains are a significantly larger fraction of net income for households towards the bottom of the income distribution than they are for those towards the top of the income distribution.

Hence, if one uses income as the measure of living standards, whilst the approved and implemented reforms look progressive, as do the amendments made to the initial proposals, the same cannot be said for the plans as initially proposed.[10]

[10] We feel we cannot describe the initial proposals as regressive under this measure as we are unable to model the part of the increase in ISR rates that is incident on self-employment, corporate and other capital income. This omitted component is likely to be progressive in both the proposed and reform systems.

Table 3.1a. Average gains and losses due to reforms by total income decile group

Reform	Average income (1)	% of total income accounted for by each decile (2)	*$ (mex) cash loss or gain due to reforms* ISR (3)	IVA (4)	IEPS (5)	Total (6)	Change as a % of net income (7) = (6)/(1)	% of total revenue change born by each decile (8)
Proposed								
Poorest Decile	32,225	2.2%	0	-561	-23	-584	-1.81%	3.09%
Decile Group 2	53,417	3.6%	-1	-759	-43	-803	-1.50%	4.24%
Decile Group 3	69,460	4.6%	-3	-880	-66	-949	-1.37%	5.01%
Decile Group 4	85,026	5.7%	-13	-995	-81	-1,089	-1.28%	5.75%
Decile Group 5	101,256	6.8%	-32	-1,092	-112	-1,235	-1.22%	6.52%
Decile Group 6	119,905	8.0%	-74	-1,221	-131	-1,426	-1.19%	7.53%
Decile Group 7	142,190	9.5%	-148	-1,358	-160	-1,666	-1.17%	8.79%
Decile Group 8	170,910	11.4%	-292	-1,600	-211	-2,102	-1.23%	11.10%
Decile Group 9	231,407	15.5%	-645	-2,122	-275	-3,042	-1.31%	16.06%
Richest Decile	490,625	32.8%	-1,966	-3,657	-427	-6,050	-1.23%	31.93%
Approved								
Poorest Decile	32,225	2.2%	0	-107	-18	-124	-0.39%	1.66%
Decile Group 2	53,417	3.6%	0	-153	-33	-185	-0.35%	2.48%
Decile Group 3	69,460	4.6%	0	-191	-50	-241	-0.35%	3.22%
Decile Group 4	85,026	5.7%	0	-223	-61	-284	-0.33%	3.80%
Decile Group 5	101,256	6.8%	-3	-268	-84	-354	-0.35%	4.74%
Decile Group 6	119,905	8.0%	-12	-319	-98	-430	-0.36%	5.76%
Decile Group 7	142,190	9.5%	-49	-376	-120	-544	-0.38%	7.28%
Decile Group 8	170,910	11.4%	-131	-472	-159	-762	-0.45%	10.20%
Decile Group 9	231,407	15.5%	-384	-673	-206	-1,263	-0.55%	16.91%
Richest Decile	490,625	32.8%	-1,664	-1,297	-321	-3,282	-0.67%	43.94%

Notes: 100/80/50 equivalence scale, total income includes monetary and non monetary resources. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 3.1b. Average gains and losses due to amendments to reforms by total income decile group

Reform	*$ (mex) cash loss or gain due to reforms*				Change as a % of net income (5)	% of total revenue change born by each decile (6)
	ISR (1)	IVA (2)	IEPS (3)	Total (4)		
(Approved) – (Proposed)						
Poorest Decile	0	454	5	460	1.42%	4.01%
Decile Group 2	1	606	10	618	1.15%	5.38%
Decile Group 3	3	689	16	708	1.02%	6.17%
Decile Group 4	13	772	20	805	0.95%	7.01%
Decile Group 5	29	824	28	881	0.87%	7.68%
Decile Group 6	62	902	33	996	0.83%	8.68%
Decile Group 7	99	982	40	1,122	0.79%	9.78%
Decile Group 8	161	1,128	52	1,340	0.78%	11.68%
Decile Group 9	261	1,449	69	1,779	0.76%	15.50%
Richest Decile	302	2,360	106	2,768	0.56%	24.12%

Notes: 100/80/50 equivalence scale, total income includes monetary and non monetary resources. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Tables 3.2a and 3.2b repeat the analysis of tables 3.1, but rather than determine whether a household is rich or poor based on their net income, we instead use their total expenditure (again, including both monetary and non-monetary sources). This may be a better measure of the living standards of the households (particularly in the long run) if they are able to borrow and save (either formally or informally).

Looking at the proposed reforms, cash losses increase with total expenditure, particularly for income tax (as was the case for table 3.1a). As a share of total expenditure, losses due to the 2% expenditure tax (counted as IVA) are virtually uniform across the expenditure distribution as one would expect for a uniform expenditure tax. Combined with losses due to changes in income tax and IEPS that are a bigger proportion of expenditure for richer households, this means the overall pattern looks progressive. Households in the bottom 10% of the expenditure distribution lose an amount equivalent to 1.24% of their total expenditure, whilst the richest 10% (on this measure) lose an amount equivalent to 1.83% of their net expenditure.

Of course, the approved and implemented reforms still entail lower revenue than those initially proposed. These amount to additional taxes of 96 pesos per year, on average, for the poorest tenth of the population (or 0.26% of their expenditure) and additional taxes of 3,179 pesos per annum, on average, for the richest tenth of the population (or 0.94% of their expenditure). Interestingly, Table 3.2b shows that the amendments made to the initial proposals now look to have been broadly neutral in a distributional sense; they have led to households across the expenditure distribution gaining the equivalent of about 1% of net expenditure relative to the initial proposals for reform. This is in contrast to the analysis of table 3.1b which found the amendments to have been progressive. It is driven by the fact that expenditure is a little higher than income for poorer households and significantly lower than income for richer households so that a given cash change becomes smaller proportionally for poor households, and larger proportionally for rich households when moving from using income to using expenditure as one's measure of living standards.

Tables 3.1a, 3.1b, 3.2a and 3.2b consider monetary and non-monetary resources to measure living standards. When only monetary resources are taken into account, the qualitative results for the proposed and the approved reforms remain the same. The proposed reform looks progressive only when expenditure is used to measure living standards, but not when income is used. The approved reform looks progressive when using monetary expenditure or income.

Table 3.2a. Average gains and losses due to reforms by total expenditure decile group

Reform	Average expenditure (1)	% of total expenditure accounted for by each decile (2)	*$ (mex) cash loss or gain due to reforms* ISR (3)	IVA (4)	IEPS (5)	Total (6)	Change as a % of net expenditure (7) = (6)/(1)	% of total revenue change born by each decile (8)
Proposed								
Poorest Decile	36,972	3.1%	-3	-439	-18	-460	-1.24%	2.43%
Decile Group 2	55,521	4.7%	-21	-682	-41	-744	-1.34%	3.93%
Decile Group 3	66,631	5.6%	-29	-813	-60	-901	-1.35%	4.76%
Decile Group 4	76,688	6.5%	-46	-932	-82	-1,061	-1.38%	5.60%
Decile Group 5	88,227	7.5%	-89	-1,078	-110	-1,277	-1.45%	6.74%
Decile Group 6	100,380	8.5%	-154	-1,215	-140	-1,509	-1.50%	7.96%
Decile Group 7	114,438	9.7%	-199	-1,377	-160	-1,735	-1.52%	9.16%
Decile Group 8	133,211	11.3%	-317	-1,607	-203	-2,127	-1.60%	11.23%
Decile Group 9	172,542	14.6%	-607	-2,105	-269	-2,981	-1.73%	15.73%
Richest Decile	336,677	28.5%	-1,709	-3,995	-447	-6,151	-1.83%	32.47%
Approved								
Poorest Decile	36,972	3.1%	-1	-82	-13	-96	-0.26%	1.29%
Decile Group 2	55,521	4.7%	-8	-139	-30	-177	-0.32%	2.37%
Decile Group 3	66,631	5.6%	-8	-172	-45	-225	-0.34%	3.02%
Decile Group 4	76,688	6.5%	-13	-214	-61	-289	-0.38%	3.86%
Decile Group 5	88,227	7.5%	-30	-264	-83	-376	-0.43%	5.04%
Decile Group 6	100,380	8.5%	-64	-315	-105	-483	-0.48%	6.47%
Decile Group 7	114,438	9.7%	-100	-370	-120	-591	-0.52%	7.91%
Decile Group 8	133,211	11.3%	-175	-464	-152	-791	-0.59%	10.59%
Decile Group 9	172,542	14.6%	-397	-662	-202	-1,262	-0.73%	16.89%
Richest Decile	336,677	28.5%	-1,447	-1,396	-336	-3,179	-0.94%	42.56%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 3.2b. Average gains and losses due to amendments to reforms by total expenditure decile group

Reform	*$ (mex) cash loss or gain due to reforms*					
	ISR (1)	**IVA (2)**	**IEPS (3)**	**Total (4)**	**Change as a % of net expenditure (5)**	**% of total revenue change born by each decile (6)**
(Approved) – (Proposed)						
Poorest Decile	2	357	5	364	0.98%	3.17%
Decile Group 2	13	543	11	567	1.02%	4.94%
Decile Group 3	21	641	15	676	1.01%	5.89%
Decile Group 4	33	718	21	772	1.00%	6.73%
Decile Group 5	59	814	27	901	1.02%	7.85%
Decile Group 6	90	900	35	1,026	1.02%	8.94%
Decile Group 7	99	1,007	40	1,144	1.00%	9.97%
Decile Group 8	142	1,143	51	1,336	1.01%	11.64%
Decile Group 9	210	1,443	67	1,719	1.00%	14.98%
Richest Decile	262	2,599	111	2,972	0.89%	25.90%

Notes: 100/80/50 equivalence scale, total income includes monetary and non monetary resources. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 3.3 shows that the choice of equivalence scale has a negligible impact on the results of the distributional analysis of the approved reforms using expenditure as the measure of living standards. This is because changing equivalence scales involves moving households with different numbers of people to different parts of the income distribution. Where policies explicitly target larger households (e.g. containing children) or smaller ones (e.g. pensioners) the choice of equivalence scale would matter but the effect is generally less significant where policy changes apply to all types of households, such as the 2010 tax reforms. Full results in tables A3.1a and A3.1b confirm that the choice of equivalence scale has little impact on the analysis of the proposed reforms and when using income as the measure of living standards.

Table 3.3 The impact of equivalence scale choice

Reform	**Change as a % of expenditure**		
	100/80/50 Scale	**Per Capita Scale**	**100/50/30 Scale**
Approved			
Poorest Decile	-0.26%	-0.26%	-0.25%
Decile Group 2	-0.32%	-0.32%	-0.31%
Decile Group 3	-0.34%	-0.35%	-0.33%
Decile Group 4	-0.38%	-0.38%	-0.37%
Decile Group 5	-0.43%	-0.43%	-0.41%
Decile Group 6	-0.48%	-0.48%	-0.47%
Decile Group 7	-0.52%	-0.54%	-0.51%
Decile Group 8	-0.59%	-0.62%	-0.57%
Decile Group 9	-0.73%	-0.76%	-0.72%
Richest Decile	-0.94%	-0.93%	-0.95%

Notes: Total expenditure includes monetary and non monetary consumption.
Source: ENIGH 2008 and authors' calculations using MEXTAX

As well as being concerned about the impact of policy over the income or expenditure distribution, it is also often informative to study how the impact of a policy change varies by the demographic characteristics of households. This is particularly the case for policies explicitly targeted at certain kinds of households, but even when this is not the case, differences in income or spending patterns may mean a set of reforms impacts some kinds of households more than others. Table 3.4 shows such an analysis for the proposed and approved reforms using expenditure as our measure of living standards.[11]

This shows that in both cash and proportional terms, the biggest losers from both the proposed and approved reforms are households that consist of individuals from multiple families, where at least one of the families has children. This is mainly because this type of household contains a high fraction of high earners (who have live-in servants) who are harder hit by the increases in the top rates of income tax than other groups; the impact of the changes to expenditure taxes do not affect this group especially hard (in proportional terms). Households headed by an adult aged over 65 (termed pensioner households) are found to be hit less hard by the reforms than other household types (partly because a large fraction of their expenditure is non-monetary, and partly because we do not model income tax liable on pensions income).

[11] Again full results are in tables A3.1a and A3.1b of results.xls.

Table 3.4. Average gains and losses due to reforms by household type

Reform	Average expenditure	Average income	*$ (mex) cash loss or gain due to reforms*				Change as a % of expenditure
			ISR (1)	IVA (2)	IEPS (3)	Total (4)	
Proposed							
Couple	110,948	146,365	-412	-1,283	-150	-1,845	-1.66%
Single	95,335	133,540	-358	-982	-131	-1,472	-1.54%
Couple with children	111,540	129,242	-343	-1,411	-124	-1,878	-1.68%
Single with children	92,616	92,239	-143	-1,086	-107	-1,335	-1.44%
Couple, Pensioner	80,902	94,823	-11	-738	-84	-833	-1.03%
Single, Pensioner	59,761	69,057	-23	-451	-58	-532	-0.89%
Other family, no children	128,975	178,761	-326	-1,538	-195	-2,060	-1.60%
Other family, with children	133,337	164,519	-311	-1,690	-171	-2,172	-1.63%
Multiple families, no children	236,334	337,680	-511	-2,666	-301	-3,478	-1.47%
Multiple families, with children	345,147	509,391	-3,153	-4,598	-369	-8,120	-2.35%
Approved							
Couple	110,948	146,365	-311	-441	-113	-864	-0.78%
Single	95,335	133,540	-285	-355	-98	-737	-0.77%
Couple with children	111,540	129,242	-241	-396	-93	-730	-0.65%
Single with children	92,616	92,239	-97	-286	-80	-463	-0.50%
Couple, Pensioner	80,902	94,823	-7	-218	-63	-288	-0.36%
Single, Pensioner	59,761	69,057	-19	-137	-44	-201	-0.34%
Other family, no children	128,975	178,761	-218	-451	-147	-815	-0.63%
Other family, with children	133,337	164,519	-214	-437	-128	-780	-0.58%
Multiple families, no children	236,334	337,680	-352	-843	-228	-1,424	-0.60%
Multiple families, with children	345,147	509,391	-2,926	-1,406	-276	-4,608	-1.34%

Notes: Total expenditure and income includes monetary and non monetary resources. Expenditure and income displayed are averages across households within each category. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 3.5 shows the estimated revenue from our baseline model and compares it to the estimates produced by CEFP using national accounts data.

Table 3.5. Revenue raised from the reforms

Reform	Annual Revenue ($ millions Mex)	
	MEXTAX Estimate	CEFP Estimate
Proposed		
ISR	8,470	72,990
IVA	38,000	74,520
IEPS	4,080	18,930
Total	50,550	166,440
Approved		
ISR	5,990	62,780
IVA	10,900	33,550
IEPS	3,060	13,810
Total	19,950	110,140

Source: ENIGH 2008 and authors' calculations using MEXTAX

Using the baseline data and assumptions, MEXTAX significantly under-estimates the revenues obtained from the reforms. This discrepancy is largest for ISR, which is not surprising given that we only model that part of the tax which falls on employment income, and the ENIGH survey is widely believed to suffer from both under-recording and omission at the upper end of the income distribution (those most affected by the ISR reforms). The fact that MEXTAX under-estimates the approved 1% increase in IVA by a greater proportion than the proposed 2% expenditure tax reflects the fact that food expenditure (which is mostly not subject to IVA) is relatively well accounted for in ENIGH, whereas non-food items (many of which are subject to standard IVA) is poorly accounted for.

As detailed in section 2.2, previous micro-simulation models have addressed the problem of under-reporting incomes in the ENIGH by adjusting employment incomes using a fixed factor. We do this in section 4 but also test the sensitivity of results to a number of alternative assumptions about missing income and expenditure, as well as about informality.

4. Sensitivity analyses - data

In this section we present the results of a number of sensitivity analyses we have conducted to see how these alter the estimated revenues and the distributional impact of the reforms. In section 4.1 we describe our approach to sensitivity analysis and discuss the value we think it adds to the evaluation of tax proposals in the context of poor quality data. Section 4.2 shows how changing assumptions about what income or expenditure is formal or informal affects results. Section 4.3 accounts for missing income using a constant factor for each type of income, while section 4.4 accounts for missing expenditure using a constant factor for each type of good and constant factors for each income source. In Section 4.5 we apply a factor to employment incomes that increases with the level of incomes to account for the fact that missing income is believed to be a bigger problem for households with higher incomes. In section 4.6 we randomly

allocate missing income based on observable characteristics so that we can account for omission of income sources as well as under-reporting.[12]

4.1 Our approach to sensitivity analysis

Because of significant problems in the underlying ENIGH survey data (for instance, missing income and expenditure), a number of fairly strong assumptions must be made in order to proceed with the analysis. Section 2.3 set out the assumptions we made for our baseline analysis, but we now vary these assumptions to show how important such assumptions are to the results we obtain, both in terms of the revenue raised and in terms of the distributional impact of the reforms.[13] In this section we perform twelve sensitivity tests, one of which involves changing how we classify workers as formal or informal, another of which involves changing how we classify expenditure as formal or informal, and ten of which involve different ways of dealing with the under-recording of income and expenditure in ENIGH. Table 4.1 provides a summary of each of the different tests (with full details in the relevant sub-section). The sheets referred to in the table are the sheets of the attached Excel file (results.xls).

Whilst when varying assumptions we do so to improve upon perceived shortcomings of the baseline assumptions, the alternate assumptions made remain largely arbitrary. For instance, when we correct for missing employment income by applying a factor that increases with the amount of employment income reported, the rate at which this factor increases is exogenously determined (and varied) by the authors rather than estimated using external data. This is generally because of an absence of external data (such as tax records) that is suitable for use in a more refined method. This means that in conducting these sensitivity analyses, we are not attempting to provide a definitive answer for how these issues such as varying definitions of informality or alternative methods for accounting for missing income should be applied. Instead, we wish to show how the results of tax reforms change when different plausible assumptions are made. This will help guide future research by indicating how important it is to improve the quality of the underlying ENIGH data or improve the methods for dealing with these problems (for instance, by linking survey data with administrative or census data). The results of the sensitivity analyses should be seen as providing formal bounds on the distributional or revenue, impacts, however.

In this section we present results using total expenditure as our measure of living standards and the 100/80/50 equivalence scale. Results when using monetary expenditure, total income and monetary income as measures of living standards can be found in results.xls.

[12] In our earlier methodological paper we planned further sensitivity checks that have proven not necessary or infeasible. First, we had planned to randomly allocate workers to the informal sector to match other estimates of the rate of informality; this proved to be unnecessary as the rate observed in our data is close to other estimates. Second we had planned to allow for evasion to differ across income sources but as we have not extended the model to cover non-employment income, this has not proved feasible.

[13] In section 3, we have already tested how sensitive our results are to the choice of equivalence scale (finding this is not particularly important in this instant) and the choice of whether to measure living standards by income or expenditure (finding that this does have more of an impact).

Table 4.1. Taxonomy of the sensitivity analysis performed in this section

Type of assumptions	**Formality**		**Missing income**	**Missing expenditure**
	Workers	**Consumption**		
Baseline assumptions	Formal worker if social security coverage through their own work	Informal consumption if purchased from informal vendors (defined as variable lug_com equal to 1, 2, or 3)	No correction for missing income	No correction for missing expenditure
Sensitivity analysis				
(S1) Worker formality definition Sheets A4.1a and A4.1b Section 4.2	Formal worker if social security coverage through household	As baseline	As baseline	As baseline
(S2) Expenditure formality definition Sheets A4.2a and A4.2b Section 4.2	As baseline	As baseline plus randomly reallocating cash spending from the formal to informal sector to match estimated evasion rates of 20%	As baseline	As baseline
(S3) Missing income – fixed factors Sheets A4.3a and A4.3b Section 4.3	As baseline	As baseline	Uprate net income by constant Altimir factors, which vary by income source.	As baseline
(S4) Missing income – fixed factors Sheets A4.4a and A4.4b Section 4.3	As baseline	As baseline	As S3	Increase each household's expenditure by the same factor as its income is increased
(S5) Missing income – fixed factors Sheets A4.6a and A4.6b Section 4.4	As baseline	As baseline	As baseline	Increase each expenditure category by a constant factor to match national accounts for that category

(S6) Missing income – fixed factors Sheets A4.6a and A4.6b Section 4.4	As baseline	As baseline	As S3	Uprate each expenditure category by a constant factor to match national accounts
(S7) Missing income – increasing factors Sheets A4.7a and A4.7b Section 4.5	As baseline	As baseline	Increase employment income by a sliding scale that rises with employment income. Increase other income sources by constant Altimir factors	Increase each household's expenditure by the same factor as its income is increased
(S8) Missing income – increasing factors Sheets A4.8a and A4.8b Section 4.5	As baseline	As baseline	As S7, except that missing income more concentrated in top 10% of wage earners	Increase each household's expenditure by the same factor as its income is increased
(S9) Missing income – random allocation Sheets A4.9a and A4.9b Section 4.6	As baseline	As baseline	Regression-based technique to predict (with error) if and how much of an income source an individual has. Amount adjusted by a constant factor to ensure total matches National Accounts.	Increase each household's expenditure by the same factor as its income is increased
(S10) Missing income – random allocation Sheets A4.10a and A4.10b Section 4.6	As baseline	As baseline	As S9, but an alternative draw from the prediction error distribution	Increase each household's expenditure by the same factor as its income is increased

(S11) Missing income – random allocation Sheets A4.11a and A4.11b Section 4.6	As baseline	As baseline	As S9, but a smaller amount of additional income is allocated to more people.	Increase each household's expenditure by the same factor as its income is increased
(S12) Missing income – random allocation Sheets A4.12a and A4.12b Section 4.6	As baseline	As baseline	As S9, but a larger amount of additional income is allocated to fewer people	Increase each household's expenditure by the same factor as its income is increased

4.2 The definition of informality

In this section we present and describe the key findings of our analysis of the distributional impact of the tax reforms using alternative assumptions about what employment income (scenario S1) or expenditure (scenario S2) is formal or informal.

In our baseline assumptions we define an individual earning employment income as formal if they are covered by the social security healthcare system through their own work, and where they report coverage under more than one scheme (e.g. both IMSS and ISSSTE) because of coverage due to both one's own work and one's spouse's work, we use information on whether their main employer is a private or public institution to allocate them to a IMSS or ISSSTE schemes, respectively. Members of State ISSSTE, PEMEX or military social security schemes are assumed to face the same rate schedule as contributors to the national ISSSTE program. The work of CEPF/CIEP seems to condition only upon whether an individual is covered by a social security system, and where they are covered by both IMSS and ISSSTE, the assumption is that it is ISSSTE contribution that is paid. In this section we test how important these differences in assumptions are for the distributional analysis and revenue changes (scenario S1; full results in Excel tables A4.1a and A4.1b).[14]

We also test our results to redefining informal expenditure. In our baseline results we define expenditure as formal or informal based upon the type of store the good or service was purchased from. This leads to an estimate of VAT evasion of around 8%; considerably lower than the 20% estimated by Mexican researchers.[15] We test the sensitivity of results to randomly reallocating spending from the formal to informal sector to match the government estimate of the evasion rate. In order to do this we reallocate expenditure entries from the informal to the formal sector only if the payment method has been exclusively cash, because VAT evasion is unlikely in expenditures paid by credit card or trade credit (as both of these involve the creation of written or electronic records). We do this for each expenditure category for which we consider it possible to escape VAT; hence, we do not apply this method to expenditure on the lottery, insurance fees or telecoms. We assign a random number drawn from a uniform distribution to each entry paid by cash in ENIGH 2008; and if the number is less or equal than a threshold 0.2, we reallocate this spending from the formal to informal sector. This gives an aggregate evasion rate of 20% using ENIGH 2008 data (scenario S2; full results in excel tables A4.2a and A4.2b). It is likely that expenditure on certain goods (e.g. utilities) is unlikely to escape VAT whilst others (e.g. household maintenance) are more likely to escape VAT. However, we have not obtained information on evasion by type of good and service and so have not been able to apply different thresholds by good. Furthermore, the rate of evasion may differ by demographic group and by position in the income/expenditure distribution. Except to the extent that payment by cash is more or less common over these dimensions, our modelling does not allow for this.

The first panel of table 4.2 shows the average cash and proportional losses per household by expenditure decile group for all the tax reforms (ISR, IVA and IEPS) initially proposed by the executive and the second panel shows the same for the approved and implemented reforms.

[14] The methodological paper states that we will randomly allocate workers to the formal or informal sectors to match estimates of the size of the informal economy but we have not done this. This is because the implied informality rate under our assumptions is close to the estimated rates.
[15] See Cuadro III, page 40 of Samaniego (2006).

Columns (1), (2) and (3) show the cash losses (in Mexican 2008 pesos per annum) due to changes in the amount of ISR, IVA and IEPS paid under the baseline assumptions, the alternative assumption about formal workers (S1) and the alternative assumption about formal expenditure (S2), respectively. Columns (4), (5) and (6) show the overall losses as a percentage of household total expenditure for the baseline and the two alternative scenarios.

Using the broader classification of formal workers (scenario S1) has a negligible impact on the distributional impact of either the proposed or approved reforms (using expenditure as the measure of living standards). It slightly increases the losses due to changes in ISR for households in the top 50% of the expenditure distribution. This is because there is only a small increase in the number of formal workers with incomes high enough to be affected by the tax reforms as a consequence of using household social security healthcare coverage as opposed to coverage through work. Many of the individuals with social security healthcare coverage only through the household are not in employment, and many of those in work have only low incomes.

Using the alternate broader classification of expenditure as informal (scenario S2) has a more notable impact on the results. Firstly, the loss of net income due to increase in indirect taxes (mostly IVA) is smaller for both the proposed and approved reforms, although the reduction in the size of the loss is greater for the proposed reform since it involves a bigger change (the universal 2% tax to be levied on all goods and services). Losses fall more as a proportion of expenditure for poorer households meaning that using the alternative definition of informal expenditure makes both the proposed and approved reforms look slightly more progressive. This is consistent with poorer households paying for a higher proportion of their transactions in cash and hence probably purchasing more of their goods and services in the informal sector.

We also assess the revenue impacts of redefining informality. Table 4.3 shows that revenue increases slightly as a result of redefining formal workers (S1), due to higher income tax revenues compared to under the baseline assumptions. Total revenue decreases as a bigger number of transactions are classified as informal to match the estimated evasion rate of 20% (S2).

Table 4.2 Total average gains and losses due to reforms by total expenditure decile group

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	Baseline (1)	S1 (2)	S2 (3)	Baseline (4)	S1 (5)	S2 (6)
Proposed						
Poorest Decile	-460	-460	-436	-1.24%	-1.24%	-1.18%
Decile Group 2	-744	-744	-706	-1.34%	-1.34%	-1.27%
Decile Group 3	-901	-902	-856	-1.35%	-1.35%	-1.29%
Decile Group 4	-1,061	-1,061	-1,004	-1.38%	-1.38%	-1.31%
Decile Group 5	-1,277	-1,278	-1,211	-1.45%	-1.45%	-1.37%
Decile Group 6	-1,509	-1,513	-1,427	-1.50%	-1.51%	-1.42%
Decile Group 7	-1,735	-1,740	-1,639	-1.52%	-1.52%	-1.43%
Decile Group 8	-2,127	-2,135	-2,003	-1.60%	-1.60%	-1.50%
Decile Group 9	-2,981	-2,997	-2,811	-1.73%	-1.74%	-1.63%
Richest Decile	-6,151	-6,220	-5,822	-1.83%	-1.85%	-1.73%
Approved						
Poorest Decile	-96	-96	-84	-0.26%	-0.26%	-0.23%
Decile Group 2	-177	-177	-158	-0.32%	-0.32%	-0.28%
Decile Group 3	-225	-226	-203	-0.34%	-0.34%	-0.30%
Decile Group 4	-289	-289	-260	-0.38%	-0.38%	-0.34%
Decile Group 5	-376	-377	-344	-0.43%	-0.43%	-0.39%
Decile Group 6	-483	-484	-442	-0.48%	-0.48%	-0.44%
Decile Group 7	-591	-593	-543	-0.52%	-0.52%	-0.47%
Decile Group 8	-791	-793	-728	-0.59%	-0.60%	-0.55%
Decile Group 9	-1,262	-1,272	-1,176	-0.73%	-0.74%	-0.68%
Richest Decile	-3,179	-3,235	-3,013	-0.94%	-0.96%	-0.90%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 4.3 Revenue Raised due to reforms, alternative assumptions about formality

Reform	Annual Revenue ($ millions Mex)		
	Baseline	S1	S2
Proposed			
ISR	8,470	8,750	8,470
IVA	38,000	38,000	35,300
IEPS	4,080	4,080	4,050
Total	50,550	50,830	47,820
Approved			
ISR	5,990	6,180	5,990
IVA	10,900	10,900	9,530
IEPS	3,060	3,060	3,040
Total	19,950	20,140	18,560

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

4.3 Dealing with missing income – fixed income-based factors

An important and worrying feature of surveys such as ENIGH is the significant extent to which recorded aggregate income (grossed-up using sample weights) is significantly lower than national accounts aggregates. In this section we test the sensitivity of our results to allocating missing incomes by increasing income by a set of constant factors so that aggregate incomes in ENIGH match administrative (National Accounts) aggregates. This is a standard practise, although we have argued that this not an entirely satisfactory way in which to correct for the under-reporting of income when analysing tax reforms. The linearity of expenditure taxation, the presentation of analysis at the group level (e.g. income decile group), and the use of proportional (as opposed to cash) changes in tax payments means that constant factors are suitable for indirect taxes. However, non-linearities of the direct tax system mean that the use of constant factors can severely bias results. We test different methods of accounting for missing income in sections 4.5 and 4.6 and show that these can have a significant impact on results.

In this section we take information from a presentation by Gerardo Leyva Parra from INEGI (2001)[16] that uses ENIGH 1998 to calculate adjustment factors for each source of income –we have not been able to find or calculate separate factors for separate sources of income from more recent waves of the survey. In particular, it suggests using a factor of 1.6173 for monetary employment income; a factor of 2.5191 for monetary income from own-business; a factor of 26.0441 for monetary capital income; and a factor of 1.2948 for transfer income. These factors are calculated for gross incomes so we reduce each factor by 10% as an approximate way to account for taxes (10% being, roughly, the mean combined ISR and social security rate on employment income according to our simulator). Scenario S3 applies these factors to each income source reported in ENIGH 2008 by each of the members of a household (full results in excel tables A4.3a and A4.3b).[17] This implies an adjustment factor for total income that varies at the household level according to the importance of each source in the composition of the household income. Scenario S4 (full results in excel tables A4.4a and A4.4b) uses the implied household level factor to adjust each household's expenditures, maintaining each household's savings ratio and expenditure shares.

Table 4.4 shows that when we increase income sources by source-specific constant factors (scenario S3), the losses due to the reforms increase for households across the expenditure distribution: higher income yields additional revenue from the higher rates of ISR. The increase is larger in both cash and proportional terms for richer households. This is because individuals in such households are more likely to be paying the top three ISR rates that have been increased in the reforms. The results are very similar for the proposed and approved reform, except that the increases in losses look larger relative to the losses under the baseline for the approved reform, particularly for the richest 70% of households. This is unsurprising because ISR (the only tax whose yield is affected by the assumptions of scenario S3) represents a higher proportion of the overall tax reform in the approved reform than in the proposed reform (under which changes in indirect taxation were more important). When looking at losses as a

[16] http://www.eclac.cl/povertystatistcs/documentos/leyvappt.pdf Last accessed 18 January 2011. See table in slide 7. SHCP (2010) provides Altimir factors for employment (1.1914) and non-employment (13.65) income but does not provide a breakdown of non-employment income.

[17] See Appendix A for a description of how we assign each of the income sources in ENIGH to these broad income sources.

percentage of total expenditure, both proposed and approved reforms appear to be slightly more progressive under S3 than they were under the baseline assumptions.

When we also increase expenditure by the implied household-level factors (scenario S4) cash losses increase substantially, as higher expenditure means a greater yield from the IVA and IEPS reforms. Again the increase is proportionally bigger for richer households. In this case, this is because richer households are more likely to report income sources such as capital and own business income for which under-reporting is more acute than for employment income. As a result, these sources are adjusted by a higher Altimir factor; resulting in a higher constant factor for households with a positive income from capital or own businesses. For the proposed reform, the poorest household experiences on average a 47% increase in total cash losses due to mainly increases in indirect taxes paid, relative to the baseline. The richest tenth of household sees an increase of over 300% in their cash losses relative to the baseline, on average (again mostly due to higher payments of indirect taxes). The pattern for the approved reforms is similar. However, the pattern of adjustment to household expenditure is even more skewed towards richer households than the adjustments to tax payments. This means that the top tenth of households look to be less hard hit by the tax reforms when measured as a proportion of expenditure than do households in the eighth and ninth decile groups (who are also harder hit than under the baseline assumptions).

Table 4.5 shows that total revenue increases only as a result of ISR tax receipts under scenario S3, increasing by a factor of about 2 compared to the baseline results. This is greater than the increase in labor incomes reflecting the progressive nature of the increase in the higher rates of ISR. Under scenario S4, in which also expenditure is increased by the implied household-level factor, revenues are significantly greater as a result of increasing IVA and IEPS receipts. Under scenario S4, the yield from the increase in IVA is a little under that estimated by CEFP for the approved reforms and somewhat greater than that estimated by CEFP for the proposed reforms (see table 3.5).

Table 4.4 Total average gains and losses due to reforms by total expenditure decile group

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	Baseline (1)	S3 (2)	S4 (3)	Baseline (4)	S3 (5)	S4 (6)
Proposed						
Poorest Decile	-460	-474	-678	-1.24%	-1.28%	-1.34%
Decile Group 2	-744	-790	-1,111	-1.34%	-1.42%	-1.46%
Decile Group 3	-901	-963	-1,382	-1.35%	-1.45%	-1.49%
Decile Group 4	-1,061	-1,160	-1,698	-1.38%	-1.51%	-1.55%
Decile Group 5	-1,277	-1,426	-2,090	-1.45%	-1.62%	-1.64%
Decile Group 6	-1,509	-1,735	-2,469	-1.50%	-1.73%	-1.71%
Decile Group 7	-1,735	-2,005	-2,860	-1.52%	-1.75%	-1.74%
Decile Group 8	-2,127	-2,509	-4,047	-1.60%	-1.88%	-1.92%
Decile Group 9	-2,981	-3,603	-5,984	-1.73%	-2.09%	-2.02%
Richest Decile	-6,151	-7,469	-25,081	-1.83%	-2.22%	-1.82%
Approved						
Poorest Decile	-96	-99	-139	-0.26%	-0.27%	-0.27%
Decile Group 2	-177	-196	-268	-0.32%	-0.35%	-0.35%
Decile Group 3	-225	-253	-356	-0.34%	-0.38%	-0.38%
Decile Group 4	-289	-335	-472	-0.38%	-0.44%	-0.43%
Decile Group 5	-376	-465	-661	-0.43%	-0.53%	-0.52%
Decile Group 6	-483	-634	-848	-0.48%	-0.63%	-0.59%
Decile Group 7	-591	-781	-1,070	-0.52%	-0.68%	-0.65%
Decile Group 8	-791	-1,096	-1,708	-0.59%	-0.82%	-0.81%
Decile Group 9	-1,262	-1,814	-2,838	-0.73%	-1.05%	-0.96%
Richest Decile	-3,179	-4,466	-10,971	-0.94%	-1.33%	-0.80%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 4.5 Revenue Raised from the Reforms, constant income-derived factors

Reform	Annual Revenue ($ millions Mex)		
	Baseline	S3	S4
Proposed			
ISR	8,470	17,000	17,000
IVA	38,000	38,000	98,500
IEPS	4,080	4,080	11,000
Total	50,550	59,080	126,500
Approved			
ISR	5,990	13,100	13,100
IVA	10,900	10,900	30,200
IEPS	3,060	3,060	8,260
Total	19,950	27,060	51,560

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

4.4 Dealing with missing spending – fixed expenditure-based factors

In this section we describe an alternatative method foraccounting for missing expenditure. We increase expenditures in ENIGH so that they aggregate spending matches National Accounts aggregates. This involves matching expenditure categories in ENIGH to the categories in the National Accounts and comparing aggregate expenditures.[18,19] We then calculate and apply an adjustment factor for each category which if multiplied by the expenditure in ENIGH 2008 would replicate the figures from the National Accounts. Scenario S5 applies these category-specific factors to each expenditure entry reported in ENIGH 2008 by each household (full results in Excel tables A4.5a and A4.5b). This implies an adjustment factor for total expenditure that varies at the household level according to their expenditure composition. Scenario S6 (full results in Excel tables A4.6a and A4.6b) also adjusts household incomes using the method of section 4.3 (i.e. constant income source-specific adjustment factors).

Table 4.5 shows that increasing expenditure by a category-varying factor holding income unchanged (scenario S5), leads to an increase in cash losses for all households stemming from an increase in indirect tax payments. When looking at the changes as a proportion of expenditure, both the proposed and the approved reforms appear to be less progressive under this scenario, likely reflecting poorer households spending a greater share of their resources on goods and services for which ENIGH suffers from greater under-reporting under scenario S5 than it does under the baseline assumptions.

Under scenario S6 both expenditure and income are increased to account for under-reporting. As expected, cash losses increase more than under scenario S5 relative to the baseline, since now ISR tax payments increase as well. For both reforms, cash losses as a share of expenditure increases for all households, though more for households towards the bottom of the expenditure distribution. Both the proposed and approved reforms look a little less progressive under scenario S6 than under the baseline assumption.

[18] We use ten broad categories: 1. Alimentos, bebidas y tabaco, 2. Vestido y calzado, 3. Vivienda, electricidad, gas, agua y otros combustibles, 4. Mobiliario, equipos y enseres domésticos, 5. Sanidad, 6. Transporte, 7. Esparcimiento y cultura, 8. Educación, 9. Hoteles, cafeterías y restaurants, and 10. Bienes y servicios diversos. We use information from INEGI (2010), "Sistemas de Cuentas Nacionales de Mexico. Cuentas de bienes y servicios 2005-2009. Año base 2003. Primera version", Cuadro 26 for the year 2008. http://www.inegi.org.mx/sistemas/biblioteca/detalleSCNM.aspx?c=16867&upc=0&s=est&tg=49&f=2&pf=Cue Last accessed 18 January 2011.

[19] See Appendix A for more details or program create_processed_data_v6_s5

Table 4.6 Total average gains and losses due to reforms by total expenditure decile group

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	Baseline (1)	S5 (2)	S6 (3)	Baseline (4)	S5 (5)	S6 (6)
Proposed						
Poorest Decile	-460	-1,368	-1,378	-1.24%	-1.46%	-1.48%
Decile Group 2	-744	-2,282	-2,320	-1.34%	-1.54%	-1.57%
Decile Group 3	-901	-2,820	-2,881	-1.35%	-1.57%	-1.60%
Decile Group 4	-1,061	-3,451	-3,544	-1.38%	-1.62%	-1.67%
Decile Group 5	-1,277	-4,068	-4,230	-1.45%	-1.65%	-1.72%
Decile Group 6	-1,509	-4,684	-4,886	-1.50%	-1.67%	-1.75%
Decile Group 7	-1,735	-5,345	-5,619	-1.52%	-1.70%	-1.79%
Decile Group 8	-2,127	-6,529	-6,930	-1.60%	-1.72%	-1.83%
Decile Group 9	-2,981	-8,728	-9,344	-1.73%	-1.81%	-1.94%
Richest Decile	-6,151	-16,645	-17,977	-1.83%	-1.82%	-1.96%
Approved						
Poorest Decile	-96	-317	-319	-0.26%	-0.34%	-0.34%
Decile Group 2	-177	-593	-605	-0.32%	-0.40%	-0.41%
Decile Group 3	-225	-808	-838	-0.34%	-0.45%	-0.47%
Decile Group 4	-289	-1,041	-1,087	-0.38%	-0.49%	-0.51%
Decile Group 5	-376	-1,307	-1,404	-0.43%	-0.53%	-0.57%
Decile Group 6	-483	-1,595	-1,721	-0.48%	-0.57%	-0.61%
Decile Group 7	-591	-1,932	-2,137	-0.52%	-0.62%	-0.68%
Decile Group 8	-791	-2,471	-2,789	-0.59%	-0.65%	-0.74%
Decile Group 9	-1,262	-3,613	-4,152	-0.73%	-0.75%	-0.86%
Richest Decile	-3,179	-7,761	-9,057	-0.94%	-0.85%	-0.99%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

According to National Accounts, expenditure is under-reported by a greater amount than income, so when one corrects for under-reporting through an adjustment on the expenditure side rather than the income side, the additional revenues from the reforms are larger, as shown in table 4.7. Under scenario S5, estimated revenues from the increases in IVA and IEPS are significantly higher than the estimates of CEFP (which are also derived from National Accounts), probably reflecting the fact that our standard definition of informal expenditure is not broad enough and significantly under-estimates the extent of indirect tax evasion. Under scenario S6, where income as well as expenditure are increased, the estimated yield from the reforms to the ISR is around twice than that under the baseline assumptions.

Table 4.7 Revenue Raised from the Reforms, expenditure-derived factors

Reform	Annual Revenue ($ millions Mex)		
	Baseline	**S5**	**S6**
Proposed			
ISR	8,470	8,470	17,000
IVA	38,000	125,000	125,000
IEPS	4,080	15,800	15,800
Total	50,550	149,270	157,800
Approved			
ISR	5,990	5,990	13,100
IVA	10,900	39,300	39,300
IEPS	3,060	11,900	11,900
Total	19,950	57,200	64,300

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

4.5 Increasing income by a variable factor

In section 4.3 we used the standard 'Altimir method' to correct for missing income by increasing the amounts reported for each source by a source-specific constant factor. However, it is perceived that the problem of missing income mainly relates to under-reporting of income and complete non-response to the survey by higher income households (see, for instance, López-Calva et al (2007, 2008)). Therefore, in this section we test how results are affected if all under-reporting of employment income is accounted for by individuals who are in the top 50% of the earnings distribution. That is the employment incomes of individuals in the bottom half of the earnings distribution are assumed to be reported accurately and are not adjusted but those in the top half of the earning distribution are assumed to be under-reported. The factor by which they are increased to 'correct' for this under-reporting is increasing with income. In scenario S7,[20] the ratio increases smoothly over the top 50% of the earnings distribution from a factor 1.014 for those in the 50th percentile to a factor of 1.914 for those in the 100th percentile (i.e. an increase of 0.014 for every percentile one moves up the employment income distribution until the 90th percentile from which the increase is 0.034 for every percentile). In scenario S8,[21] the ratio increases by a factor of 0.005 for every percentile one moves up the earned-income distribution from the 50th to the 90th percentile, and then increases more rapidly at a rate of 0.1259 for every percentile for the 91st to the 100th percentile to a maximum of 2.464. These two scenarios have been chosen to represent arbitrarily "low" and "high" concentrations of missing income in the top tenth of the income distribution (as opposed to the top half, more generally). Household expenditures are adjusted using the household-level factor by which income is increased, maintaining budget shares and each household's savings rate. Future work should seek to use other surveys (such as ENOE) and taxpayer records to make an adjustment that is more evidenced-based (and that can therefore be seen as a 'correction' as opposed to a 'sensitivity check').

[20] Full results for which can be found in excel tables A4.7a and A4.7b.
[21] Full results for which can be found in excel tables A4.8a and A4.8b.

Table 4.8 shows that when we increase employment incomes (and hence total income and total expenditure) by a greater factor for higher income individuals, the cash losses from the tax reforms fall for lower expenditure households (who are now assumed to earn and spend less) and rise for richer households (who now assumed to earn and spend more). Compared to scenario S4 (income-based constant factors), under the initial proposals, the average cash losses fall for the poorest 70% of households under scenario S7 ("low" concentration) and rise for the richest 30% of households. Under scenario S8 ("high concentration), cash losses fall for the poorest 80% of households and rise even more for the richest 20% of households. The picture is very similar for the approved reforms. For households towards the bottom of the expenditure distribution, most of this change is due to indirect taxes: lower assumed income is accompanied by lower assumed spending and hence reduced yield from changes in IVA and IEPS. The change in income itself is of less importance as many households in this part of the income distribution do not contain an individual earning enough to be affected by the reforms to ISR under any of the assumptions considered. Towards the top of the expenditure distribution, however, the change is largely driven by the higher assumed income, meaning additional revenues from the increase in income tax.

When considering the increase in tax payments as a proportion of expenditure, we find a similar effect: assuming missing income is more concentrated in higher income households makes the proportional losses unchanged or smaller for poorer and middle-expenditure households and larger for households towards the top of the expenditure distribution. That is both the proposed and approved reforms look a little more progressive than they do when we apply a constant factor to account for missing employment income. For instance, under the approved reforms, the poorest tenth of the population see additional tax payments equivalent to 0.27% of household expenditure under scenarios S4 and S8, whilst the equivalent figures for the richest tenth of households are 0.8% and 0.96%, respectively.

Table 4.8 Impact of reforms by total expenditure decile group: allowing missing income to be concentrated amongst higher-earners

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	S4	S7	S8	S4	S7	S8
	(1)	(2)	(3)	(4)	(5)	(6)
Proposed						
Poorest Decile	-678	-573	-568	-1.34%	-1.31%	-1.30%
Decile Group 2	-1,111	-874	-861	-1.46%	-1.37%	-1.37%
Decile Group 3	-1,382	-1,156	-1,117	-1.49%	-1.44%	-1.43%
Decile Group 4	-1,698	-1,424	-1,343	-1.55%	-1.48%	-1.45%
Decile Group 5	-2,090	-1,763	-1,595	-1.64%	-1.55%	-1.50%
Decile Group 6	-2,469	-2,141	-1,945	-1.71%	-1.65%	-1.58%
Decile Group 7	-2,860	-2,759	-2,442	-1.74%	-1.76%	-1.66%
Decile Group 8	-4,047	-4,051	-3,451	-1.92%	-1.97%	-1.83%
Decile Group 9	-5,984	-6,674	-6,731	-2.02%	-2.16%	-2.20%
Richest Decile	-25,081	-27,046	-28,981	-1.82%	-1.91%	-1.99%
Approved						
Poorest Decile	-139	-118	-116	-0.27%	-0.27%	-0.27%
Decile Group 2	-268	-201	-199	-0.35%	-0.31%	-0.32%
Decile Group 3	-356	-298	-283	-0.38%	-0.37%	-0.36%
Decile Group 4	-472	-408	-372	-0.43%	-0.42%	-0.40%
Decile Group 5	-661	-540	-469	-0.52%	-0.48%	-0.44%
Decile Group 6	-848	-730	-642	-0.59%	-0.56%	-0.52%
Decile Group 7	-1,070	-1,076	-901	-0.65%	-0.69%	-0.61%
Decile Group 8	-1,708	-1,807	-1,461	-0.81%	-0.88%	-0.77%
Decile Group 9	-2,838	-3,386	-3,526	-0.96%	-1.09%	-1.15%
Richest Decile	-10,971	-12,488	-14,028	-0.80%	-0.88%	-0.96%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 4.9 shows how the estimated revenue from the tax reforms changes under scenarios S7 and S8, relative to scenario S4. Total revenue increases as one increases the extent to which missing employment income is concentrated amongst high earners (i.e. moving from S4 to S7 and then S8). This is driven (more than) entirely by an increase in the amount of revenue raised from ISR on employment earnings and reflects the fact that the majority of this revenue comes from an increase in the top three tax rates. Revenue from the indirect tax changes falls slightly. This is because the schedule of factors in S7 and S8 are designed so that aggregate gross income matches gross income in S4 (and hence national accounts), without affecting each household's savings rate. Because the savings rates of richer households are higher, the assumed reduction in expenditure by lower and middle income households more than offsets the assumed increase in expenditure by richer households meaning lower revenue from expenditure taxes.

Table 4.9 Revenue Raised from the Reforms, increasing employment income factor

Reform	Annual Revenue ($ millions Mex)		
	S4	S7	S8
Proposed			
ISR	17,000	21,200	23,400
IVA	98,500	97,200	96,600
IEPS	11,000	10,900	10,900
Total	126,500	129,300	130,900
Approved			
ISR	13,100	17,800	20,400
IVA	30,200	30,200	30,100
IEPS	8,260	8,210	8,150
Total	51,560	56,200	58,650

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

4.6 Randomly allocating missing income to households

The accompanying methodology paper (see page 14, Abramovsky et al (2010)) highlighted two potential causes for the under-recording of income in the ENIGH relative to Mexican National Accounts data. The first is a downward bias in amounts reported for different sources of income by those who report a positive amount. Sections 4.3, 4.4 and 4.5 involved testing the sensitivity of our results to different assumptions about the patterns of such bias. However, it seems more likely that, particularly for non-labor income, a large fraction of the under-reporting relates to individuals omitting sources of income completely.[22] Unfortunately, without access to administrative data, there is no clear method to identify those who completely omit an income source that they receive, although regression-based techniques can be used to assign this income based on the characteristics of those reporting a particular income source in the first place. This is what is done in this section. The procedure is as follows.

The first stage of the imputation procedure involves predicting whether or not each individual has *under-reported* a particular source of income (and from now on under-reporting means both the complete omission of a source or reporting a lower amount than the true amount). The first part of this is to decide how many individuals we assume are under-reporting their income from a particular source, relative to the number reporting a positive amount in the raw unadjusted data. We have no *a priori* evidence to guide us on this, so again we test how sensitive our results are to a number of different assumptions. In our first assessment (scenario S9) we assume the following "under-reporting factors":

- The number of households under-reporting employment income is 50% of the number reporting an amount.
- The number of households under-reporting self-employment income is 100% of the number reporting an amount.

[22] A third reason which is not explicitly addressed in this paper is if higher-income households are under-represented in the survey sample due to non-response. One way to address this concern would be to re-weight the data so that richer households are given higher sample weights but this is difficult to do, whilst at the same time maintaining the representativeness of the sample along other dimensions (e.g. age and family structure).

- The number of households under-reporting capital income is 400% of the number reporting an amount.
- The number of households under-reporting transfer income is 50% of the number reporting an amount.
- No households under-report the other sources of income they have.

Scenario S10 uses the same assumptions as scenario S9 but draws from a different set of random error terms. In scenario S11 each of these factors is halved (so that, for example, the 50% for employment income becomes 25%) and in scenario S12 each of these factors is doubled (so that, for example, the 50% for employment income becomes 100%). Compared to scenario S9, scenario S11 involves a smaller number of households each under-reporting to a larger extent, and vice versa for scenario S12. Those assumed to be under-reporting under this method will include both those who do report an amount for a particular source and those who do not report an amount.

We then need to decide which specific households are under-reporting their income. To do this, zero-one variables are set up indicating whether an individual has a *reported* positive value or not for each income source. These indicator variables are then regressed upon a set of explanatory variables using a linear probability model (LPM). The sources of income considered are employment, self-employment, transfer, capital, and other income.

The following are used as explanatory variables in the regressions for each source:

- Indicators and amounts for the other sources of income
- A cubic term in age, and a sex dummy
- Indicators for membership of a social security program
- Education attainment and literacy dummies
- Indicators of occupation and industrial sector
- Indicators of type of employer in main job (including self-employment)
- Indicators of household amenities such as owning a TV, a car and having internet access

Following this, we:

- Calculate (using the raw, unadjusted data) the proportion of individuals that report receipt of each income source.
- Multiply this proportion by the under-reporting factor for that source for that sensitivity scenario. For instance, under scenario S9, multiply the proportion for earned income by 0.5, and the proportion for capital income by 4.0. Call this the "adjusted proportion".
- Predict an index value (plus an error term drawn randomly from the error distribution[23]) for each income source for each individual in the sample.
- For each income source calculate the index value (or propensity score) which if we allocated everyone with a value higher than this a "1" and everyone with a value lower than this a "0", we would obtain the adjusted proportion. Call this index value the "cut-off point".

[23] We add a random error draw to the predicted value to account for the fact that our equations are not perfect predictors of whether one has a certain income source or not. Indeed, if they were perfect this method would not work.

- Those individuals with an index value for a particular income source that is greater than that income source's cut-off point are deemed to have under-reported that income source.

Once we know which individuals have under-reported an income source (by either under-reporting the amount or complete omission of the source), the second stage of the imputation procedure involves predicting a figure for the amount by which that source is under-reported. This procedure works as follows:

- We use ordinary least squares (OLS) regression to predict a central-estimate for the amount for each individual for which a positive value has been assigned in the first stage of the procedure.
- We then draw from the error distribution of these predictions and add this random component to the central-estimate to reflect our inability to perfectly predict the amount of income one would have.
- Next, we split these error-adjusted predicted values into percentiles.
- Then for each individual we record the amount of income for that source that corresponds to the average reported value for the same percentile of the distribution of the *reported* values for that source. This is used rather than the predicted value (with error) because the predicted value (with error) is based on the assumption that the prediction errors are normally distributed which does not hold in practise .
- The amount of income under-reported by an individual for a particular source is then obtained by multiplying this amount by a factor so that aggregate income for this source matches national accounts (and scenario S4).
- Household expenditure is then adjusted so that each household's expenditure patterns and savings ratio remains unchanged.

Whilst we feel this rather involved procedure represents an improvement on adjusting all incomes by a constant factor (because it allows for complete omission of income sources) it should be remembered that the resulting values for the amount of under-reporting by each household is arbitrary.

Table 4.10 shows that, qualitatively, the distributional pattern remains the same under S9 and S10; using expenditure as our measure of living standards, both policies look progressive. In cash terms, moving to the regression-based framework (scenarios S9 and S10) mean significantly higher losses for households in the top half of the income distribution under both the proposed reforms and the approved reforms. However, the assumed expenditure of households in these decile groups is also higher under these scenarios, on average, meaning that the losses are roughly the same (or a little lower) as a proportion of household expenditure. The results are very similar for scenarios S9 and S10 which use the same set of assumptions about how missing income and expenditure is distributed, but which are based on different random draws from the error distribution.

Table 4.10 Impact of reforms by total expenditure decile group: allocating missing income using a regression-based technique

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	S4	S9	S10	S4	S9	S10
	(1)	(2)	(3)	(4)	(5)	(6)
Proposed						
Poorest Decile	-678	-635	-641	-1.34%	-1.33%	-1.33%
Decile Group 2	-1,111	-1,023	-1,017	-1.46%	-1.42%	-1.41%
Decile Group 3	-1,382	-1,319	-1,332	-1.49%	-1.47%	-1.46%
Decile Group 4	-1,698	-1,708	-1,739	-1.55%	-1.53%	-1.56%
Decile Group 5	-2,090	-2,099	-2,053	-1.64%	-1.61%	-1.60%
Decile Group 6	-2,469	-2,655	-2,640	-1.71%	-1.68%	-1.68%
Decile Group 7	-2,860	-3,374	-3,501	-1.74%	-1.73%	-1.76%
Decile Group 8	-4,047	-5,169	-5,013	-1.92%	-1.88%	-1.85%
Decile Group 9	-5,984	-8,494	-8,634	-2.02%	-1.91%	-1.90%
Richest Decile	-25,081	-31,324	-31,384	-1.82%	-1.86%	-1.92%
Approved						
Poorest Decile	-139	-136	-138	-0.27%	-0.28%	-0.29%
Decile Group 2	-268	-251	-249	-0.35%	-0.35%	-0.35%
Decile Group 3	-356	-353	-367	-0.38%	-0.39%	-0.40%
Decile Group 4	-472	-495	-511	-0.43%	-0.44%	-0.46%
Decile Group 5	-661	-666	-640	-0.52%	-0.51%	-0.50%
Decile Group 6	-848	-905	-890	-0.59%	-0.57%	-0.57%
Decile Group 7	-1,070	-1,210	-1,266	-0.65%	-0.62%	-0.64%
Decile Group 8	-1,708	-2,102	-2,004	-0.81%	-0.76%	-0.74%
Decile Group 9	-2,838	-3,517	-3,488	-0.96%	-0.79%	-0.77%
Richest Decile	-10,971	-11,430	-11,738	-0.80%	-0.68%	-0.72%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 4.11 shows that Qualitatively, the distributional pattern remains the same under S11 and S12 as under S4; both policies look progressive. In cash terms, losses are smaller for the poorest nine-tenths of households, on average, when the under-reporting is assumed to be more concentrated (S11) than under scenario S9, and larger for the richest tenth. When under-reporting is assumed to be less concentrated (S12) than under scenario S9, losses are higher, on average, for the poorest nine-tenths, and lower for the richest tenth of the population. These differences reflect changes in the incomes at different parts of the expenditure distribution under the alternative scenarios. Proportionate losses are less affected because the changes in income (and hence expenditure) generally go in the same direction as the changes in the estimated cost of the tax reforms.

Table 4.11 Impact of reforms by total expenditure decile group: allocating missing income using a regression-based technique

Reform	*$ (mex) cash loss or gain due to reforms*			Change as a % of expenditure		
	S9	S11	S12	S9	S11	S12
	(1)	(2)	(3)	(4)	(5)	(6)
Proposed						
Poorest Decile	-635	-554	-713	-1.33%	-1.30%	-1.35%
Decile Group 2	-1,023	-872	-1,128	-1.42%	-1.37%	-1.42%
Decile Group 3	-1,319	-1,101	-1,505	-1.47%	-1.39%	-1.50%
Decile Group 4	-1,708	-1,442	-1,961	-1.53%	-1.50%	-1.57%
Decile Group 5	-2,099	-1,831	-2,389	-1.61%	-1.59%	-1.60%
Decile Group 6	-2,655	-2,207	-3,095	-1.68%	-1.62%	-1.68%
Decile Group 7	-3,374	-2,979	-6,341	-1.73%	-1.75%	-2.61%
Decile Group 8	-5,169	-4,240	-5,901	-1.88%	-1.85%	-1.80%
Decile Group 9	-8,494	-7,249	-9,418	-1.91%	-1.96%	-1.85%
Richest Decile	-31,324	-35,402	-26,773	-1.86%	-1.94%	-1.90%
Approved						
Poorest Decile	-136	-118	-154	-0.28%	-0.28%	-0.29%
Decile Group 2	-251	-211	-282	-0.35%	-0.33%	-0.36%
Decile Group 3	-353	-291	-411	-0.39%	-0.37%	-0.41%
Decile Group 4	-495	-427	-581	-0.44%	-0.45%	-0.47%
Decile Group 5	-666	-587	-744	-0.51%	-0.51%	-0.50%
Decile Group 6	-905	-736	-1,021	-0.57%	-0.54%	-0.55%
Decile Group 7	-1,210	-1,110	-2,264	-0.62%	-0.65%	-0.93%
Decile Group 8	-2,102	-1,718	-2,179	-0.76%	-0.75%	-0.67%
Decile Group 9	-3,517	-3,195	-3,584	-0.79%	-0.86%	-0.70%
Richest Decile	-11,430	-13,612	-9,878	-0.68%	-0.75%	-0.70%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 4.12 shows how these different assumptions affect MEXTAX's estimates of the revenues obtained from the reforms. Under scenarios S9, S10, and S12 the amount of revenue from the income tax changes is less than under scenario S4 (where a set of constant factors is used to account for under-reporting of income). This reflects the fact that under S9, S10 and S12 some of the missing employment income is being allocated to households with no observed employment income. This means that more of the missing income is being allocated to people unaffected by the reforms to ISR (which only affect higher earners), thereby meaning the reforms are estimated to raise less. Under scenario S11, the concentration of missing employment income amongst a smaller fraction of the population than under S4 pushes more people into the higher tax-bands affected by the reforms ensuring that the reforms are estimated to raise more.

The increase in yield under scenarios S9 to S12 from the reforms to IVA and IEPS happens because we increase expenditure in such a way that each household's savings rate remains unchanged following adjustments to its income. Some households report very low incomes that are increased substantially in the adjustment process. The expenditure of these households is therefore adjusted by a large factor, and given that these low-income households typically

report spending significantly more than their incomes, this leads to large monetary increases in estimated spending. Hence, the allocation of the (fixed aggregate level of) missing income leads to a larger amount of assumed missing expenditure under scenarios S9 to S12 than under scenario S4, and, hence a higher yield from changes in indirect taxes. The yields from the approved reforms to IVA and IEPS under scenarios S9 to S12 are quite similar to the CEFP estimates shown in table 3.5. Estimates for the initial proposals for indirect taxes are significantly greater than CEFP's estimates, possibly reflecting a greater degree of informality and/or a lower degree of under-reporting for goods currently not subject to IVA than we assume.

Table 4.12. Revenue Raised from the Reforms

Reform	Annual Revenue ($ millions Mex)				
	S4	**S9**	**S10**	**S11**	**S12**
Proposed					
ISR	17,000	15,900	15,900	17,500	14,200
IVA	98,500	125,000	125,000	124,000	130,000
IEPS	11,000	13,100	13,400	13,400	14,100
Total	126,500	154,000	154,300	154,900	158,000
Approved					
ISR	13,100	12,100	12,100	14,000	10,300
IVA	30,200	34,200	34,600	34,600	35,400
IEPS	8,260	9,890	10,100	10,200	10,600
Total	51,560	56,190	56,800	58,800	56,300

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

4.7 Summary

In this section we performed twelve sensitivity tests, one of which involves changing how we classify workers as formal or informal, another of which involves changing how we classify expenditure as formal or informal, and ten of which involve different ways of dealing with the under-recording of income and expenditure in ENIGH.

The different sensitivity analyses show that in general the distributional impact of both proposed and approved reforms is largely unchanged in qualitative terms. The reforms are still found to be progressive when expenditure is considered as the measure of living standards in most of the sensitivity analyses performed. However, the way missing income and expenditure are allocated can make important quantitative differences in the distributional analyses and estimates of revenue changes due to the fiscal reforms. In particular:

- When incomes are increased by fixed source-specific factors and expenditures correspondingly adjusted (scenario S4), losses increase most in cash terms for the top 10% of households but so do incomes such that, as a proportion of expenditure, losses are higher than under the baseline for the poorest 90% of households but lower for the richest 10%.
- When expenditures are increased by category-specific factors and incomes adjusted using the fixed source-specific factors (scenario S6), losses increases as a proportion of

expenditure across the expenditure distribution, but more so for poorer households, making the reforms look a little less progressive than under the baseline.

- Increasing employment income only for richer households (scenarios S7 and S8) makes the reforms look a little more progressive than when incomes are adjusted by constant factors (scenario S4).
- Allowing for complete omission of income sources using a regression-based approach to allocating missing income (scenarios S9 to S12) shows that the exact specifications of such methods can have a sizeable impact on quantitative findings.

In general, we consider the sensitivity analyses an important and illuminating exercise which can guide policy makers in determining ways to improve data, for example by linking different survey data and accessing administrative data to get more accurate figures for income and by improving the way formal expenditure is defined. In particular, without such linking or an improvement in the quality of the ENIGH survey data, our analysis suggests that estimates of the impact of reforms on the income/expenditure distribution and tax revenues based on micro-simulation models must not be seen as providing 'exact' answers.

5. Allowing for behavioral response

In this section we show how allowing for a number behavioral responses can affect the amount of revenue raised by the 2010 reforms, as well as the impact of the reforms across the income / expenditure distribution. In two instances, this involves performing a sensitivity analysis whereby assumptions about the degree of behavioral response are varied. First, in section 5.1 we test how different assumptions about taxable income elasticities (i.e. how responsive levels of taxable income are to tax rates) affect results. In section 5.2 we vary assumptions about who bears the cost of increases in indirect taxes, allowing some of the cost to be borne by formal workers (as a proxy for the workers of companies affected by changes in indirect taxes) and those in receipt of capital income (as a proxy for shareholdings in companies affected by changes in indirect taxes) as opposed to it being borne purely by consumers in the form of higher prices.

In section 5.3 we are able to go beyond simple sensitivity analyses and estimate a model of consumer demand. This allows us to account for the fact that households can substitute between goods when prices change, allowing them to reduce the welfare cost of the tax changes to less than what it would be under the assumption of no behavioral response.

5.1 Labor Supply

Our earlier methodological paper (Abramovsky et al (2010)) explained that with the resources available for this project (both in terms of time and data), that it is infeasible to attempt to estimate a structural model of labor supply (and the formality decision) for this paper.[24] In this section, instead, we use a reduced-form model of responses at the intensive and extensive margins that is closely related to the methods employed by the Institute for Fiscal Studies in the Mirlees Review (Mirrlees et al (forthcoming)) and in work that looks at the trade-off between redistribution and efficiency in the tax system (Adam (2005)). It also bears some resemblance to the models of taxable income elasticities that have been used to estimate the impact of

[24] See section 7.1 for a discussion of research planned for the future in this area.

changes in tax rates on the reported incomes of high earners in the US (Feldstein (1995), Gruber and Saez (2002)) and the UK (Brewer et al (2010)).

This method considers the effect of the tax reforms separately for two types of behavioral change: the decision whether to work formally or not (the extensive margin) which is affected by the proportion of earnings one loses to taxes when one enters work (termed the participation tax rate or PTR); and the decision whether to change the amount of formal income earned at the margin (the intensive margin), which is affected by the marginal effective tax rate (METR). In order to implement this method we therefore need to estimate or assume the following parameters:

- The PTR and METR faced by individuals in the pre- and post-reform tax systems.
- The extensive margin elasticity of formal labor income
- The intensive margin elasticity of formal labor income

In this paper, we are able to calculate the tax rates (under some fairly stringent assumptions) but must make assumptions about the elasticities due to a paucity of evidence about how responsiveness varies across demographic groups in Mexico and insufficient resources to conduct such analysis for this paper.

We think it is important to include indirect taxes in our modelling of labor supply. In developed countries, such as the UK, politicians sometimes claim that increasing indirect taxes such as VAT and duties (IVA and IEPS in the Mexican context) is less economically costly than increasing direct taxes such as income tax (ISR) because the former taxes do not reduce work incentives.[25] This is clearly untrue unless individuals suffer from complete money-illusion; what matters for their work decisions is the real purchasing power of a unit of effort (or time) and this is affected by both increases in prices (through increases in indirect taxes) or reductions in the net wage (through an increase in direct taxes). This means our PTRs and METRs need to take into account the IVA and IEPS paid on the additional goods and services one purchases when one enters work or earns a little more. Ideally, we would like to measure the tax rate that applies to spending out of extra income earned at the margin by the individual in question (for the METR) or out of the additional income when the individual in question enters work (for the PTR). Unfortunately such data is not available, so instead we use the average (indirect) tax rate that applies to each household's total spending (taking into account their purchases from non-formal vendors). This is not perfect but is clearly better than using the national average consumption tax rate as used by Mendoza et al (1994) and Browning (1995).

The other aspect of METRs and PTRs that one should consider is the direct taxation of earnings. In principle, as well as accounting for tax and social security payments, one would also account for the loss of welfare payments when someone enters work or increases their income at the margin. This is the practise for the UK where the amount of benefits income is a well-defined function of demographic characteristics, current income and housing costs, and where benefits

[25] For instance, in defending the UK Government's decision to increase VAT from January 2011, the Chief Secretary to the Treasury, Danny Alexander claimed that "Raising income tax would reduce the rewards for work at a time when hard work and endeavour will lead the recovery", implying that increasing VAT would not have this effect. See http://www.guardian.co.uk/politics/2010/jun/27/danny-alexander-defends-2010-budget.

are smoothly withdrawn as income rises.[26] In the Mexican context, this might not be completely straightforward. Mexico, similar to many other developing countries, has a welfare system that determines eligibility using a broader set of indicators such as location of residence, housing quality, and durable goods ownership in the case of Oportunidades (the exact targeting formula is secret to prevent gaming). Furthermore, income assessments are not conducted continuously for many programs meaning that entering or exiting work would not lead to immediate changes in benefit entitlement. For instance, Oportunidades eligibility is reassessed every three years. Clearly such complicated means-tests cannot be easily integrated into standard METRs and PTRs. In this paper, we abstract from the welfare system when calculating METRs and PTRs. Section 7.4 provides some further discussion on the issue.

Individuals can respond to a tax change in two distinct ways. First, they can change the amount of effort supplied to the market reducing their total earnings, which we call the *real* response. Secondly, they can change the extent to which they avoid or evade their taxes, for instance by shifting between the formal and informal sectors of the economy. We call this the *shifting* response. Feldstein has shown that one does not need to distinguish between the two from a welfare point of view, because a utility-maximising individual would respond such that the marginal cost of further response along either of these dimensions is equal (Feldstein (1995)). However, the revenue impacts of the two types of responses differ in the presence of indirect taxation. A real response reduces total income and is therefore likely to reduce consumer expenditure so one would want to take into account reductions in indirect taxes. On the other hand, a shifting response changes the composition but not the level of income, and therefore consumer expenditure and indirect tax revenues may not fall. This means that ideally we would have separate elasticities for real and shifting responses, and separate PTRs and METRs that include and do not include indirect taxes. In this paper we abstract from these issues and use a single set of elasticities and tax rates, in common with other papers in the literature. Section 7.1 provides more discussion about issues involved in implementing such a method in future work.

We calculate METRs and PTRs as follows:

$$METR = \frac{ISR_{Rate} + SocSec_{Rate} + AvIndirectTax_{rate}}{1 + AvIndirectTax_{rate}}$$

$$PTR = (\frac{ISR_{Amt} + SocSec_{Amt}}{GrossInc} + AvIndirectTax_{rate})/(1 + AvIndirectTax_{rate})$$

The next step is to calculate the proportional change in the net marginal and net participation wage following a tax change, and then calculate the new value of gross formal earnings following the reforms. The following formula is used to do this procedure:

$$Gross_{new} = Gross_{old} * \left(\frac{1 - METR_{new}}{1 - METR_{old}}\right)^{IntElast} * \left(\frac{1 - PTR_{new}}{1 - PTR_{old}}\right)^{ExtElast}$$

The change in gross income can be broken down into three components: the part due to the change in work efforts at the margin; the part due to changes in participation in the formal labor

[26] In the UK the amount of benefits one receives when out of work is largely independent of how much one earned whilst in work. That is the benefits system provides "welfare" as opposed to acting as a system of social insurance. In many other developed economies, including most of mainland Europe, benefits received depend directly on past earnings. This complicates matters somewhat but it is usually possible to separate the social-insurance from the welfare elements of the system and consider only the latter.

market; and an interaction term. These, together with the METRs and PTRs, allow one to calculate the revenue effects of the reforms.[27]

The elasticities chosen reflect what is known about how responsive different people are to the tax system in developed countries such as the UK or US. Section 7.1 discusses future work in order to estimate these elasticities for Mexico. Table 5.1 shows the assumed intensive margin (top panel) and extensive margin (bottom panel) elasticities for our assumed "low", "medium" and "high" responsiveness scenarios. The extensive-margin elasticities for mothers with children aged 11 or under are twice those of the rest of the population.

Table 5.1 Assumed formal employment income elasticities

Type of individual	**Elasticity**		
	Degree of Responsiveness		
	"Low" (B1)	**"Medium" (B2)**	**"High" (B3)**
Intensive margin			
Bottom 90% of employment income distribution	0.05	0.1	0.2
91st to 99th percentile or women with children aged < 12	0.1	0.2	0.4
100th percentile of the distribution	0.2	0.4	0.8
Extensive margin			
Top 40% of the employment income distribution	0.05	0.1	0.2
41st to 60th percentile	0.1	0.2	0.4
21st to 40th percentile	0.15	0.3	0.6
1st to 20th percentile	0.2	0.4	0.8

Notes: These elasticities have been chosen with reference to the elasticities used in the analysis of the IFS' Mirrlees Review of tax systems for the 21st century.

Because our model is completely reduced-form and is not derived from a model of utility maximisation (although it is consistent with such a model), it is not possible to look at the welfare effects of the tax changes after allowing for labor supply response. It is possible to look at the impact on the amount of formal employment income (which may be considered a proxy for formal labor supply), and on the amount of revenue obtained from the tax reforms (in total, but not separately by tax).

Table 5.2 shows the initial formal employment income by age group and education group (column 1) and the predicted changes in this under the "low", "medium" and "high" responsiveness scenarios for the proposed reforms. Table 5.3 repeats the analysis for the approved reforms.

[27] In implementing this we assume that the METRs and PTRs calculated at the initial gross income continue to apply at the new gross income. This will not be fully accurate under a tax system with progressive marginal rates but should be a good approximation for fairly small changes in tax rates such as those considered in this paper.

Table 5.2 Change in formal employment income (proposed reforms)

Demographic Group	*Initial formal labor income $ (mex)*	*Change in formal labor income$ (mex)* "Low" (B1)	"Medium" (B2)	"High" (B3)
Age Group				
Under 18	3,830	-16.5	-32.9	-65.5
18 – 24	130,000	-477	-951	-1,890
25 – 34	403,000	-1,640	-3,280	-6,520
35 – 49	689,000	-3,280	-6,550	-13,000
50 – 64	260,000	-1,340	-2,670	-5,300
65 +	18,200	-99	-197	-392
Education Group				
None or Preschool	7,670	-24.8	-49.4	-98.5
Primary School	121,000	-434	-866	-1,720
Secondary School	243,000	-870	-1,740	-3,460
Degree (inc. advanced)	356,000	-1,720	-3,440	-6,830
Commercial/Professional	776,000	-3,800	-7,580	-15,100

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 5.3 Change in formal employment income (actual reforms)

Demographic Group	*Initial formal labor income $ (mex)*	*Change in formal labor income$ (mex)* "Low" (B1)	"Medium" (B2)	"High" (B3)
Age Group				
Under 18	3,830	-5.1	-10.1	-20.2
18 – 24	130,000	-160	-320	-640
25 – 34	403,000	-806	-1610	-3,210
35 – 49	689,000	-1890	-3760	-7,490
50 – 64	260,000	-813	-1620	-3,230
65 +	18,200	-61.7	-123	-245
Education Group				
None or Preschool	7,670	-7.6	-15.3	-30.6
Primary School	121,000	-146	-292	-583
Secondary School	243,000	-317	-633	-1,260
Degree (inc. advanced)	356,000	-976	-1,950	-3,870
Commercial/Professional	776,000	-2,290	-4,560	-9,080

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

The main thing to note from these results is that the response to even fairly small changes in tax rates can be quite significant. For instance, under the high-responsiveness assumptions, an increase in METRs of, on average, 0.9% and an increase in PTRs of, on average, 0.6% are estimated to lead to a reduction of 1.1% in the formal employment income of those aged 35 – 49

(the age group with the highest incomes). The extent of behavioral change across demographic groups varies, reflecting differences in the extent to which reforms impact upon them, and in assumed responsiveness of their working and remuneration decisions.

Table 5.4 shows how allowing for behavioral response affects the amount of revenue raised from both the proposed and the approved package of reforms.

Table 5.4 Effect of labor supply response on revenues from tax reform

Reform	**Annual Revenue ($ millions Mex)**			
	Baseline	**"Low" (B1)**	**"Medium" (B2)**	**"High" (B3)**
Proposed				
ISR	8,470	-	-	-
IVA	38,000	-	-	-
IEPS	4,080	-	-	-
Total	50,550	48,710	46,880	43,180
Approved				
ISR	5,990	-	-	-
IVA	10,900	-	-	-
IEPS	3,060	-	-	-
Total	19,950	18,850	17,760	15,620

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

The results show that allowing for behavioral response has a modest, but clearly non-negligible impact on the estimated revenues from both the proposed and the approved reforms. For instance, under the high, medium, and low responsiveness scenarios, respectively, estimated revenues are around 85%, 93% and 96% of the estimated revenues under the assumption of no behavioral response for the proposed reforms. For the approved reforms, the equivalent ratios are 78%, 89% and 94%. The importance of behavioral response is greater for the approved reforms because in this case the additional revenues (and higher tax rates) are concentrated amongst people with higher initial tax rates. Given the formulas outlined above, a higher initial tax rate means a larger response to a given percentage point increase in tax rates.

Together with the earlier theoretical discussion, these results demonstrate that taking into account behavioral response can make quantitatively important differences to the estimated revenues from tax reforms.

5.2 The incidence of indirect taxes

In our baseline analysis we assume that the full impact of changes in indirect taxes is incident on consumer prices and hence allocate the changes in tax payments to households based on their purchases. Attempts to estimate the part of VAT increases borne by consumers (termed VAT pass-through) have generally found that prices rise to largely, but not necessarily fully, pass the burden to consumers (Blundell (2009)). Some studies find that the degree of pass-through increases in the degree of product-market competition (Carare and Danninger (2008)). Given the elasticity of demand, the more elastic the supply, the higher the proportion of the burden is

on consumers. Given the elasticity of supply, when demand is more inelastic the tax burden will be higher for consumers.

In this section we investigate the impact less-than-full pass-through could have on the results of our distributional analyses and revenues estimates. It should be noted that this analysis does not tell us to what extent VAT is passed through; instead it assumes various pass-through rates and uses an approach based on sensitivity analysis.

Drawing on the literature we choose two alternate assumptions about pass-through: 50% and 75%. We assume the rate of pass-through is the same for all type of goods and services (although in reality it is likely to differ due to differences in the elasticity of demand and supply). In addition, for each of these less-than-full pass-through assumptions, we investigate how the results change when we allocate the part of VAT increases borne by producers (50% in the case of 50% pass-through and 25% in the case of 75% pass-through) to employment and capital income in different proportions. In particular we look at the cases in which workers bear 0%, 50%, and 100% off the VAT increases absorbed by producers in the form of lower pre-tax wages; and the rest is borne by lower pre-tax capital income. The 50% share for workers is based on the labour/output ratio in the Mexican economy. These give us six options for investigating different behavioral responses related to incomplete pass-through of indirect taxes, which we describe in the table below. The Excel tables referred to in Table 5.5 contain the full set of results for each scenario (see attached spreadsheet results.xls).

If producers bear part of the impact of increases in excise duties or VAT in the form of lower profits or wages, the distributional and revenue impact of changes to IVA, IEPS and ISR taxes in the proposed and approved reforms will differ from when the burden is borne entirely by consumers. Introducing less-than-full VAT pass-through reduces the amount raised by the indirect taxes themselves but also reduces the amount raised through direct taxes paid by workers (and by capital owners, although ISR on capital income is not modelled). Both ISR and social security contributions payments will be affected when workers bear part of the burden of IVA or IEPS increases in the form of lower pre-tax wages. Although we do not model ISR paid on capital income, we do adjust the amount of capital income to take into account the proportion of the changes in indirect taxes borne by capital owners (and in doing so assume a 10% average tax rate on capital income). This means that total household income will change both because of a change in employment income and a change in capital income.

Table 5.5 Taxonomy of behavioral analysis related to the incidence of indirect taxes

Type of assumptions	Incidence of a change in indirect tax on:			
	Producers			Consumers
	Total	*Of which* Labor	Capital	
Baseline assumptions	0%	0%	0%	100%
Behavioral analysis				
(B4) Tables A5.1a and A5.1b	25%	0%	100%	75%
(B5) Tables A5.2a and A5.2b	25%	50%	50%	75%
(B6) Tables A5.3a and A5.3b	25%	100%	0%	75%
(B7) Tables A5.4a and A5.4b	50%	0%	100%	50%
(B8) Tables A5.5a and A5.5b	50%	50%	50%	50%
(B9) Tables A5.6a and A5.6b	50%	100%	0%	50%

Note: assumptions about formality, missing income and missing expenditure are as in the baseline analysis, see section 3.1 and table 4.1 for more details.

To model less-than-full pass-through, we model pre-tax prices falling by an amount so that for the given increase in the IVA (or IEPS) rate, the fall in the pre-tax price is such that the consumer price increases by only 75% (or 50%) of what it would have increased under full pass-through. This fall in pre-tax prices is not 25% (or 50%), but is instead a smaller amount. Less than full pass-through means that the impact of tax changes on consumers' spending power is no longer the same as (minus) the change in the amount of taxes paid because of changes in pre-tax goods prices.

The direct impact on consumers can be calculated as the change in post-tax prices, whilst the impact through wages will be estimated by reducing pre-tax incomes and re-calculating net income and the amount of ISR and social security contributions paid.

How does less-than-full pass-through affect the results of our distributional analyses and revenues estimates? Table 5.6 shows the results for the scenarios under which consumers bear 75% of the increase in indirect taxes. It shows the cash impact of the tax reforms and the impact as a proportion of expenditure for both the proposed and approved reforms. Columns (1) and (5) show the baseline results, columns (2) and (6) show the results when the 25% of indirect tax increases borne by producers is allocated fully to capital owners (scenario B4), columns (3) and (7) show the results from assuming labor bears 50% and capital owners 50% (scenario B5), and columns (4) and (8) show the results when labor bears 100% (scenario B6). Table 5.7 show

a similar set of results for the scenarios under which consumers bear 50% of the increase in indirect taxes and producers the other half (scenarios B7, B8 and B9).

Table 5.6 shows that qualitatively, the distributional pattern remains the same under these three scenarios; both sets of policies look progressive. However, there are important quantitative differences relative to the baseline and across the different scenarios. In cash terms, losses are smaller for the poorest nine-tenths of households, on average, under all scenarios for both the proposed and approved reforms because of smaller losses due to the direct effect of changes in indirect tax payments. Losses for poorer households under scenario B4 are particularly low because poorer households have relatively little capital income (on which the part of the tax not incident on prices is assumed to fall in this scenario). In scenarios B5 and B6, cash losses are bigger relative to B4 (but less than under the baseline) for the poorest nine-tenths, because their share of wage income (which now is assumed to bear part of the burden) is greater than their share of capital income (which bears less of the burden than under scenario B4).

Under scenario B4, the richest tenth households see an increase in their cash losses relative to the baseline assumptions (due to the concentration of capital income amongst the rich), whilst under scenario B5 and B6 they see small falls in their losses.

We now turn to looking at the pattern of losses as a proportion of total expenditure. Scenario B4 shows both proposed and approved reforms to be more progressive than under the baseline assumptions. Under scenario B5, the proposed and approved reforms look slightly more progressive than under the baseline assumptions whilst under scenario B6, the proposed reforms look more progressive (but not the approved reforms).

Table 5.6 Total average gains and losses due to reforms by total expenditure decile group, 75% pass-through

Reform	*$ (mex) cash loss or gain due to reforms*				Change as a % of expenditure			
	Baseline (1)	B4 (2)	B5 (3)	B6 (4)	Baseline (5)	B4 (6)	B5 (7)	B6 (8)
Proposed								
Poorest Decile	-460	-357	-369	-380	-1.24%	-0.97%	-1.00%	-1.03%
Decile Group 2	-744	-568	-609	-649	-1.34%	-1.02%	-1.10%	-1.17%
Decile Group 3	-901	-700	-750	-797	-1.35%	-1.05%	-1.13%	-1.20%
Decile Group 4	-1,061	-819	-889	-958	-1.38%	-1.07%	-1.16%	-1.25%
Decile Group 5	-1,277	-1,012	-1,099	-1,184	-1.45%	-1.15%	-1.25%	-1.34%
Decile Group 6	-1,509	-1,254	-1,343	-1,431	-1.50%	-1.25%	-1.34%	-1.43%
Decile Group 7	-1,735	-1,427	-1,532	-1,636	-1.52%	-1.25%	-1.34%	-1.43%
Decile Group 8	-2,127	-1,834	-1,931	-2,027	-1.60%	-1.38%	-1.45%	-1.52%
Decile Group 9	-2,981	-2,972	-2,924	-2,876	-1.73%	-1.72%	-1.69%	-1.67%
Richest Decile	-6,151	-6,884	-6,357	-5,829	-1.83%	-2.04%	-1.89%	-1.73%
Approved								
Poorest Decile	-96	-76	-80	-83	-0.26%	-0.21%	-0.22%	-0.23%
Decile Group 2	-177	-136	-149	-162	-0.32%	-0.25%	-0.27%	-0.29%
Decile Group 3	-225	-176	-192	-208	-0.34%	-0.26%	-0.29%	-0.31%
Decile Group 4	-289	-223	-246	-268	-0.38%	-0.29%	-0.32%	-0.35%
Decile Group 5	-376	-300	-327	-355	-0.43%	-0.34%	-0.37%	-0.40%
Decile Group 6	-483	-405	-433	-461	-0.48%	-0.40%	-0.43%	-0.46%
Decile Group 7	-591	-492	-525	-558	-0.52%	-0.43%	-0.46%	-0.49%
Decile Group 8	-791	-687	-718	-748	-0.59%	-0.52%	-0.54%	-0.56%
Decile Group 9	-1,262	-1,229	-1,214	-1,199	-0.73%	-0.71%	-0.70%	-0.70%
Richest Decile	-3,179	-3,323	-3,159	-2,994	-0.94%	-0.99%	-0.94%	-0.89%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 5.7 presents the results of assuming consumers bear 50% of the indirect tax increases. In general cash losses are smaller under scenarios B7, B8 and B9, than under scenarios B4, B5 and B6, respectively. This is because the falls in gross incomes associated with less pass-through are partially offset by reductions in direct tax payments meaning less of a reduction in net income. Again, the exception is for the tenth richest group of households under scenario B7 (for which the concentration of capital income amongst this group means that the greater reduction in capital income under B7 compared to B4 is more important). This makes both reforms significantly more progressive under scenario B7, relative to the baseline and to scenario B4. Under scenario B8, both reforms look also more progressive than under the baseline assumptions. Scenario B9 paints the proposed reform as more progressive but there is no clear effect on the distributional impact of the approved reform.

Table 5.7 Total average gains and losses due to reforms by total expenditure decile group, 50% pass-through

Reform	*$ (mex) change in net income per annum*				Change as a % of expenditure			
	Baseline (1)	B7 (2)	B8 (3)	B9 (4)	Baseline (5)	B7 (6)	B8 (7)	B9 (8)
Proposed								
Poorest Decile	-460	-254	-277	-301	-1.24%	-0.69%	-0.75%	-0.81%
Decile Group 2	-744	-393	-474	-554	-1.34%	-0.71%	-0.85%	-1.00%
Decile Group 3	-901	-499	-596	-692	-1.35%	-0.75%	-0.89%	-1.04%
Decile Group 4	-1,061	-577	-717	-852	-1.38%	-0.75%	-0.93%	-1.11%
Decile Group 5	-1,277	-748	-920	-1,090	-1.45%	-0.85%	-1.04%	-1.24%
Decile Group 6	-1,509	-999	-1,176	-1,346	-1.50%	-1.00%	-1.17%	-1.34%
Decile Group 7	-1,735	-1,118	-1,328	-1,532	-1.52%	-0.98%	-1.16%	-1.34%
Decile Group 8	-2,127	-1,540	-1,733	-1,925	-1.60%	-1.16%	-1.30%	-1.44%
Decile Group 9	-2,981	-2,963	-2,867	-2,767	-1.73%	-1.72%	-1.66%	-1.60%
Richest Decile	-6,151	-7,617	-6,562	-5,506	-1.83%	-2.26%	-1.95%	-1.64%
Approved								
Poorest Decile	-96	-56	-63	-70	-0.26%	-0.15%	-0.17%	-0.19%
Decile Group 2	-177	-95	-121	-147	-0.32%	-0.17%	-0.22%	-0.26%
Decile Group 3	-225	-128	-159	-190	-0.34%	-0.19%	-0.24%	-0.28%
Decile Group 4	-289	-158	-203	-247	-0.38%	-0.21%	-0.26%	-0.32%
Decile Group 5	-376	-223	-278	-333	-0.43%	-0.25%	-0.32%	-0.38%
Decile Group 6	-483	-326	-382	-439	-0.48%	-0.32%	-0.38%	-0.44%
Decile Group 7	-591	-393	-459	-525	-0.52%	-0.34%	-0.40%	-0.46%
Decile Group 8	-791	-583	-644	-705	-0.59%	-0.44%	-0.48%	-0.53%
Decile Group 9	-1,262	-1,196	-1,167	-1,137	-0.73%	-0.69%	-0.68%	-0.66%
Richest Decile	-3,179	-3,469	-3,138	-2,808	-0.94%	-1.03%	-0.93%	-0.83%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Tables 5.8 and 5.9 show that allowing for less-than-full pass-through has a modest, but clearly non-negligible impact on the estimated revenues from both the proposed and the approved reforms. For instance, under the 75% pass-through assumption (Table 5.8), B4, B5 and B6 scenarios, respectively, estimated revenues are around 98%, 96% and 94% of the estimated revenues under the assumption of no behavioral response for the proposed reforms. For the approved reforms, the equivalent ratios are very similar: 97%, 96% and 94%, respectively. Under the 50% pass-through assumption (Table 5.9), the negative impact of incomplete pass-through on both revenues from income tax levied on employment income and from indirect taxes is slightly higher relative to assuming 75% pass-through. For the proposed reforms, the ratios to the baseline revenues are 96%, 92% and 87% for B7, B8 and B9, respectively. The ratios for the approved reforms are 95%, 91% and 88%. Importantly, when workers bear part of the increase in indirect taxes in the form of lower pre-tax wages (scenarios B5, B6, B8 and B9), there is a reduction in revenues raised from social security contributions and the revenues raised from income tax (ISR) levied on employment income is also reduced. In conclusion,

allowing for behavioral response in the form of less-than-full pass-through yields a smaller increase in revenues from the same set of reforms than when full pass-through is assumed.

Table 5.8 Revenue Raised from the Reforms, 75% pass-through

Reform	Annual Revenue ($ millions Mex)			
	Baseline	**B4**	**B5**	**B6**
Proposed				
ISR	8,470	8,470	7,600	6,700
Social security	--	--	-137	-275
IVA	38,000	37,000	37,000	37,000
IEPS	4,080	3,990	3,990	3,990
Total	50,550	49,460	48,453	47,415
Approved				
ISR	5,990	5,990	5,720	5,450
Social security	--	--	-43.1	-86
IVA	10,900	10,400	10,400	10,400
IEPS	3,060	3,010	3,010	3,010
Total	19,950	19,400	19,086.9	18,774

Notes: Cash amounts are in millions ofMexican $ 2008 per annum. Both ISR and social security contributions payments are affected when workers bear part of the burden of IVA or IEPS increases in the form of lower pre-tax wages.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 5.9 Revenue Raised from the Reforms, 50% pass-through

Reform	Annual Revenue ($ millions Mex)			
	Baseline	**B7**	**B8**	**B9**
Proposed				
ISR	8,470	8,470	6,700	4,870
Social security	--	--	-275	-551
IVA	38,000	36,000	36,000	36,000
IEPS	4,080	3,900	3,900	3,900
Total	50,550	48,370	46,325	44,219
Approved				
ISR	5,990	5,990	5,450	4,910
Social security	--	--	-86.1	-172
IVA	10,900	9,930	9,930	9,930
IEPS	3,060	2,960	2,960	2,960
Total	19,950	18,900	18,253.9	17,628

Notes: Cash amounts are in millions ofMexican $ 2008 per annum. Both ISR and social security contributions payments are affected when workers bear part of the burden of IVA or IEPS increases in the form of lower pre-tax wages.
Source: ENIGH 2008 and authors' calculations using MEXTAX

5.3 Consumer Demand

In this section we estimate the impact of tax changes on the pattern of consumer demand by estimating the degree of price responsiveness by consumers (denoted as B10). We do this using a Quadratic Almost Ideal Demand System (QUAIDS), a demand system that allows the share of each type of good in total expenditure to vary in a flexible way with goods able to be luxuries

(i.e. having an income elasticity of greater than 1) at one level of total expenditure and necessities (i.e. having an income elasticity of less than 1) at another (Banks, Blundell and Lewbel (1997)). This allows us to look at how changes in indirect taxes affect expenditure patterns, revenues and consumer welfare. The model assumes that the utility obtained from any particular good is not affected by the amount one works (and therefore demand for goods is also unaffected), and it does not allow for positive or negative externalities from expenditure on certain goods (for instance fuel, alcohol and tobacco). The assumption of separability of goods demand and leisure can be tested empirically (see section 6), but the assumption of no externalities cannot be easily altered and is a significant limitation on the usefulness of standard demand models for looking at the welfare effects of excise duties on goods with negative externalities. Full details of the QUAIDS model can be found in Appendix C.

In order to ensure that the model can be feasibly estimated it is necessary to aggregate the very detailed expenditure breakdowns 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[28]:

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

By aggregating goods in such a way, our demand model is suitable for modelling the welfare impacts of changing the rate of IVA and imposing IVA on additional classes of goods. However, this level of aggregation means that we cannot model, for instance, substitution between different kinds of alcoholic beverage when the duties rates on different types of beverages change by different amounts. Whilst this limits the number of questions the existing demand model can be used to assess, we would argue that analysis of very detailed goods categories is best done using bespoke demand systems tailored to the question at hand.[29]

Prices (and associated expenditure weights) used to calculate the prices of the aggregate commodities have been provided to us by the Bank of Mexico for 46 cities. The Bank of Mexico also provided data on the city whose prices are used for each municipality with a population of greater than 15,000 that is included in the ENIGH. The Bank determines these linkages using

[28] A full description of the products in each category can be found in table C.1 in Appendix C.
[29] For instance, if one wanted to estimate the impact of differential taxation of forms of alcohol and changes in alcohol taxation, one may want as categories the various forms of alcohol, tobacco, non-alcoholic drinks, food-out, food-in, other leisure, and "other goods and services".

distance, population size, and other characteristics. Links between the cities and municipalities of less than 15,000 people are not made by the Bank and are instead computed by the authors using travel time according to Google maps. This simple method was chosen to ensure ease of replication by other researchers and for future (and past) waves of ENIGH.

The prices of the aggregated commodities are calculated as weighted arithmetic averages of the prices of the individual goods making up the commodity. Arithmetic as opposed to geometric averages (termed Stone prices) are used because geometric averages assume within-group own price elasticities of -1 and compensating cross-price elasticities which would mean that the welfare costs of changes in indirect taxes would be lower (than when not allowing for behavioral response) by assumption rather than because of the demand system estimates of the potential for substitution between different aggregate commodities.

We model changes in indirect taxes as increases in the prices of the aggregate commodities. When a commodity contains goods which are seeing differential proportional increases in prices due to changes in tax (for instance, the alcohol and tobacco group where different changes may be made to the duty rates), the increase in the price of that commodity is the arithmetic weighted average of price changes of the goods within the category (averaged across the entire population). If the within-group composition differs systematically across the population (for instance, poorer households consuming alcohol in the form of beer, and richer households in the form of wine), or the extent of tax evasion varies across the population, this estimated change in prices might not reflect well the change in prices for the types of goods within that group that particular households face. This is a limitation of the demand modelling (more so for the analysis of changes in IEPS than for changes in IVA) and one that should be improved upon in future analysis of consumer responses to expenditure taxation in Mexico.

Our measure of the welfare cost of indirect tax changes is called the compensating variation (CV), that is the amount of income required to allow a consumer to obtain the same level of utility when prices increase (due to increases in indirect tax) once one allows for the ability to substitute between goods. We can then compare the averages of these CVs to averages of the welfare costs of indirect tax changes under the assumption of no behavioral response for broad groups of people (e.g. expenditure decile groups).

We use a demand model that has been estimated using unadjusted ENIGH data and this simulation has been conducted using the baseline (unadjusted) data for this reason. It is important that the estimation and simulation use the same data (e.g. the same corrections for the under-reporting of income or expenditure) otherwise the predictions of the demand system will not correspond well with the observed patterns of expenditure in the data used in the MEXTAX simulator.

Table 5.10 shows the distributional impact of the indirect tax changes. Columns (1) and (4) show the cash and proportional change in tax payments as estimated by MEXTAX under the assumption of no behavioral response. Columns (2) and (5) again assume no behavioral response but the impact of the tax changes is calculated using estimated (as opposed to actual) expenditure shares for the 12 commodity groups and the increase in average price for each of these groups implied by the tax changes (as opposed to the actual "increase in price" for that type for each household given the households within-group expenditure composition). Columns

(3) and (5) show the estimated welfare cost of the tax reform after allowing for behavioral response (measured by the CV).

Comparing columns (1) with (2) shows that the fact that we assume each household faces the same percentage price increase has a disortionary effect. For poorer households, actual increases in indirect tax payments (1) are lower than the no-behavioral response impact of the tax increases if within-group composition of goods was the same for all households (2). This may reflect, partly, the greater informal expenditure by poorer households.

Table 5.10 Welfare changes when allowing households to adjust their spending pattern as a consequence of changes in *indirect* taxes

Reform	***$ (mex) cash loss or gain due to changes in indirect taxes***			**Change as a % of expenditure**		
	Baseline – No behavioural response (1)	**No behavioral response – estimated shares (2)**	**B10 (3)**	**Baseline – No behavioural response (4)**	**No behavioral response – estimated shares (5)**	**B10 (6)**
Proposed						
Poorest Decile	-458	-500	-499	-1.24%	-1.35%	-1.35%
Decile Group 2	-724	-770	-769	-1.30%	-1.39%	-1.39%
Decile Group 3	-874	-920	-919	-1.31%	-1.38%	-1.38%
Decile Group 4	-1,016	-1,049	-1,048	-1.32%	-1.37%	-1.37%
Decile Group 5	-1,190	-1,206	-1,205	-1.35%	-1.37%	-1.37%
Decile Group 6	-1,357	-1,366	-1,365	-1.35%	-1.36%	-1.36%
Decile Group 7	-1,540	-1,546	-1,545	-1.35%	-1.35%	-1.35%
Decile Group 8	-1,813	-1,781	-1,779	-1.36%	-1.34%	-1.34%
Decile Group 9	-2,381	-2,298	-2,297	-1.38%	-1.33%	-1.33%
Richest Decile	-4,473	-4,328	-4,325	-1.33%	-1.29%	-1.28%
Approved						
Poorest Decile	-94	-123	-121	-0.25%	-0.33%	-0.33%
Decile Group 2	-167	-202	-203	-0.30%	-0.36%	-0.37%
Decile Group 3	-214	-254	-254	-0.32%	-0.38%	-0.38%
Decile Group 4	-273	-296	-297	-0.36%	-0.39%	-0.39%
Decile Group 5	-344	-355	-356	-0.39%	-0.40%	-0.40%
Decile Group 6	-415	-420	-421	-0.41%	-0.42%	-0.42%
Decile Group 7	-488	-481	-482	-0.43%	-0.42%	-0.42%
Decile Group 8	-613	-586	-588	-0.46%	-0.44%	-0.44%
Decile Group 9	-864	-802	-803	-0.50%	-0.46%	-0.47%
Richest Decile	-1,755	-1,714	-1,716	-0.52%	-0.51%	-0.51%

Notes: 100/80/50 equivalence scale, total expenditure includes monetary and non monetary consumption. Cash amounts are in Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

Table 5.11 shows spending patterns before the reforms, what they would be estimated to be after the proposed reforms, and what they would be estimated to be after the approved reforms. The tax changes are shown to have only a very small impact on spending patterns. Larger tax

rises or ones concentrated only on particular goods may be expected to have more of an impact on demand patterns. Given the barely changed spending patterns, it is perhaps unsurprising that table 5.12 shows allowing for consumer spending patterns to change has no noticeable impact on revenues from the indirect tax changes in this instance.

Table 5.11 Changes in average spending patterns after changes in *indirect* taxes

Reform	***Share of good i in total expenditure***		
	Before reform	**After *proposed* reform (B10)**	**After *approved* reform (B10)**
1) Food and drink on which no IVA is levied	26.9%	27.1%	26.8%
2) Food and drink and meals out on which IVA is levied	12.9%	12.9%	12.9%
3) Alcoholic drinks and tobacco (IVA and IEPS levied)	0.6%	0.6%	0.6%
4) Clothing and footwear (IVA levied)	7.2%	7.2%	7.2%
5) Household goods, services and communications (IVA levied, IEPS sometimes levied)	21.6%	21.5%	21.6%
6) Household goods, services and communications (no IVA levied)	1.6%	1.6%	1.6%
7) Transport and vehicle fuels (IVA levied, IEPS sometimes levied but not modelled)	7.3%	7.2%	7.3%
8) Public transport and other transport on which no IVA levied	6.3%	6.4%	6.4%
9) Health and education goods (no IVA levied)	3.2%	3.2%	3.2%
10) Health and personal goods and services (IVA levied)	7.6%	7.6%	7.6%
11) Leisure and hotel services (IVA sometimes levied)	4.1%	4.0%	4.0%
12) Other services	0.6%	0.6%	0.6%

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

Table 5.12 Effect of consumer demand response on revenues from changes in indirect taxes

Reform	Annual Revenue ($ millions Mex)	
	Baseline	B10
Proposed		
IVA	38,000	38,000
IEPS	4,080	4,080
Total indirect tax	42,080	42,080
Approved		
IVA	10,900	10,900
IEPS	3,060	3,060
Total indirect tax	13,960	13,960

Notes: Cash amounts are in millions of Mexican $ 2008 per annum.
Source: ENIGH 2008 and authors' calculations using MEXTAX

6. The efficiency of the tax reforms

As well as concerns about the equity of tax proposals, Governments should also concern themselves with whether their reforms raise revenue in a way that is economically efficient. In this section we make a qualitative assessment of the relative merits of the proposed and approved reform packages. We do not compare either set of reforms to a counterfactual "optimal" reform nor do we assess quantitatively the deadweight loss associated with the increases in tax rates. Section 6.1 addresses the reforms to ISR and section 6.2 addresses the reforms to IVA and IEPS.

6.1 Income Tax (ISR)

The initial proposals and the approved plans for reforms to ISR are very similar and there is unlikely to be any great difference in the efficiency with which they raise revenue. However, a temporary increase in the top rates of ISR may not be a particularly efficient way to raise revenues, for a number of reasons.

First, the Mexican income tax (ISR), like income taxes in most countries, is levied on the normal (risk-free) return to capital (savings), as well as super-normal returns and labor income. Taxing the normal return to capital is generally seen as economically inefficient as it makes consumption in the future more expensive relative to today (because of the tax incurred on the interest earned), distorting decisions about when to consume and how much to save and invest (see Chapter 13, Mirrlees et al (forthcoming) for a simple exposition of this argument). An increase in ISR rates would increase this distortion.

Second, the Mexican ISR has an unusually large set of exemptions and deductions. For instance, half of overtime pay (up to a limit) is exempt from ISR, and up to 100% of profit-sharing receipts, annual bonuses and vacation allowances are exempt from ISR. Deductions are also

allowed for private medical insurance.[30] Such exemptions distort the form of remuneration and provide avoidance opportunities. An increase in the rate of ISR would increase such problems.

Together, these features of the Mexican ISR system mean that it is not as economically efficient as it could be. Increases in the rate of ISR would be less economically costly if the system itself were less distortionary. Improving the workings of the system by taxing currently exempt income and exempting the normal return to savings would lead to large numbers of winners and losers. However, the current system has a number of features that are unlikely to be 'fair': it is not clear that it is fair to tax patient people more than impatient people (as taxing the return to savings does) or to tax more heavily those jobs that do not involve an element of performance related pay than those who do (as the existing system of exemptions does). Furthermore, if the reforms lead to changes in the degree of progressivity of the tax system, changes can be made to the structure of marginal rates to offset such an effect.

The increases in the rate of ISR tax increases are temporary. Different aspects of individual behavior will change in the face of temporary and permanent changes. For instance, one would expect investment in human capital to change only following permanent changes in the relevant incentives, while other type of adjustments are more likely to be observed (and to be accentuated) in the face of temporary changes. It is therefore unclear whether the reform would raise more or less revenue than would tax rises that were expected to be permanent.

Generally it is preferable to have a smaller permanent increase in tax rates (that raise the same amount of revenue in present-value terms) rather than a temporary increase. This is because the deadweight cost of a tax increases more than proportionally with increases in the tax rate meaning that it is generally less economically costly to raise the same amount of revenue using a constant rate of tax over time, than rates that are low in some years and high in others. This is true even if such tax-rate smoothing leads to periods of government budget deficit and surplus, unless government's face binding credit constraints. A rationale for the temporary tax increase may therefore be that following the late 2000s recession and financial 'crisis', Mexico's access to credit was severely restricted. However, in general, such temporary tax increases are not an efficient way of addressing temporary deficits.

6.2 VAT (IVA) and duties (IEPS)

The increase in the rate of tax on beer is, like the increase in ISR rates, temporary. For similar reasons this may not be an optimal policy response. The reason for the introduction of a specific duty on telecommunications is unclear. If it is seen as a redistributive policy, for reasons outline below, it is unlikely to be a particularly well targeted method of redistributive taxation, and distorts consumer spending decisions.

By far the biggest difference between the proposed and approved reforms is the replacement of the 2% comprehensive spending tax with a (much smaller) 1% increase in the rate of IVA. In order to assess the relative economic efficiency of these proposals we therefore assess the case for uniform versus differentiated rates of commodity taxation. In doing this we abstract from externalities (which we believe are better tackled through specific duties or subsidies under the IEPS system).

[30] Other deductions exist, for example for voluntary pension contributions, but these are generally not as distortionary.

We first address one common argument for differentiated rates of commodity taxation: a desire for redistribution. For instance, a number of countries (including Mexico and the UK) have a zero-rate of VAT for food, in part, because food is a larger share of household budgets for poor households than for rich ones. The zero-rating of food is therefore of more benefit as a proportion of spending for poor households than for rich households, and is in this sense progressive. However, despite spending a lower fraction of their budget on food than the poor, the rich spend a greater amount in cash terms[31] and therefore the cash benefit of zero-rating is greater for the rich. This means that the zero-rating of food is not a particularly well-targeted method of redistribution. Other mechanisms (for instance welfare programs such as Oportunidades, or direct taxes) may be able to be better targeted at poor households in middle income countries (like Mexico) or high income countries (like the UK). Hence, an increase in the standard rate of IVA is likely to be less progressive than using part of the revenues from an increase in a uniform commodity tax to compensate poorer households. This would suggest that departures from uniform rates of commodity tax are difficult to justify when non-linear direct-taxes and welfare policies are feasible.[32]

Hence, the case for uniform or non-uniform commodity taxes should be decided upon which system is most economically efficient. The standard view (since Atkinson and Stiglitz (1976)) is that uniformity of tax rates is optimal (in the presence of a non-linear income tax) unless preferences over different goods are affected by whether and how much one works.[33] That is, uniformity is preferable (to avoid distortions to people's decisions about which goods to consume) unless some goods are complements for leisure and others substitutes. The reasoning behind this is that economic efficiency can be improved by taxing more highly goods that are complementary to leisure (and vice versa) to offset some of the disincentives to working resulting from taxation more generally. Therefore in order to judge whether the proposed introduction of a (small) uniform expenditure tax is more or less efficient than an increase in the existing non-uniform IVA, we need to ascertain the degree to which commodity demands and working decisions are related (after controlling for income).

Browning and Meghir (1991) show that this can be tested relatively easily by including hours of work or the employment status in the demand system share equations. We implement this method in this paper by including the employment status of the head of the household as one of the demographic variables in our demand system. Goods for which the coefficient on this is positive are complements for work, and goods for which the coefficient on this is negative are complements for leisure.[34]

[31] Although food is a necessity (i.e. it has an income elasticity of less than 1) it is still a normal good (i.e. it has an income elasticity of greater than 0).

[32] It should be noted that in optimal tax theory rather than redistributing from those with high incomes to those with low incomes, the objective is generally to redistribute from those of high earning ability to those of low earning ability. Mirrlees (1976) shows that even with a non-linear income tax this means one might want higher taxes on goods consumed disproportionately by high ability people, and vice versa.

[33] The mainstream view is that this result supersedes arguments for differentiation based on the "inverse elasticity" rule (where taxes are higher on goods for which demand is less elastic, and vice versa) and "Ramsey Rules" (where cross-price elasticities of demand are also taken into account). Whilst the inverse elasticity rule is a special case that may not apply when the prices of one good affect the demand of another, the reasoning for this rejection of the general-equilibrium Ramsey Rule is less clear and remains the subject of some debate amongst economists.

[34] It should be noted that this strategy requires that any mismeasurement of total expenditure and expenditure by sub-component is orthogonal to employment status.

Table 6.1 shows the coefficients on the employment indicator, and whether IVA is applied, for each of the 12 goods in our demand system. They show clearly that demand for goods is not separable from whether one works or not; suggesting that, in principle, there is scope for differentiated taxation of goods to offset the disincentive effects of income taxation on labor supply. However, the existing set of goods subject to IVA does not correspond clearly with complements for leisure (i.e. a negative coefficient in the table), nor vice versa.[35] Hence, clothing and food eaten outside the home or otherwise subject to IVA are both complements to work, yet are subject to IVA, whilst "Non-IVA Household, etc", which as the name suggests is not subject to IVA is a substitute to work.

Table 6.1 Effect of an employed household head on expenditure shares

Good	Coefficient on Employment	VAT Status
Non-IVA Food	0.0084**	No IVA
IVA Food and Food Out	0.0124**	IVA
Alcohol and Tobacco	0.0000	IVA
Clothing	0.0111**	IVA
IVA Household, etc.	-0.0311**	IVA
Non-IVA Household, etc.	-0.0041**	No IVA
IVA Transport	-0.0079**	IVA
Non-IVA Transport	0.0211**	No IVA
Non-IVA Health, Education	-0.0068**	No IVA
IVA Health, Education	0.0022*	IVA
Leisure Goods and Services	-0.0051**	Generally IVA
Other Services	0.0002	Generally IVA

Source: ENIGH 2008, Bank of Mexico Price Indices and authors' calculations

These results suggest that an increase in the rate of tax on all goods is likely to be a more efficient way of meeting a given revenue requirement than a larger increase in the rate of IVA incurred on the existing sub-set of goods to which it applies. This means that the initial proposals would be a more economically efficient way of raising a given amount of revenue than (a suitably scaled up version of) the approved reforms.

In general, consideration of administrative burden and compliance issues is thought to reinforce the case for uniformity. For instance, a key issue of rate differentiation is the creation of difficult 'boundary problems'. If one good is subject to the standard rate of IVA but a very similar good is

[35] The way tax rates would optimally differ across goods reflects not only the complementarity status of a particular good, but also cross-price effects from other goods. 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. However, complementarity and substitutability of individual goods are likely to be good as a basic guide to the direction in which taxes should vary.

not, producers may face difficulty in determining what rate of IVA should be charged on their product, increasing administration and compliance costs. There may also be costly disagreements between manufacturers and the tax authorities over the precise boundary between goods. Two classic examples from the UK illustrate this. First, United Biscuits took HMRC (the UK tax authority) to court over its decision that one of their product's (Jaffa Cakes) was a chocolate-covered biscuit (and hence subject to the standard rate of tax) rather than a chocolate cake (and therefore zero-rated). United Biscuits won this case.[36] On the other hand, Procter and Gamble lost a case in which they argued that one of their products (Pringles) should not be considered a potato crisp (and therefore subject to tax) but instead a savoury cake or biscuit (and therefore zero-rated).[37] As well as provoking legal disagreements, the boundaries may lead to changes in ingredients or product characteristics that are designed to limit tax liability but are otherwise economically inefficient.

A final consideration is that non-compliance with IVA is likely to differ significantly across goods, particularly in an economy with a sizeable informal sector. For instance, for some goods in which transactions occur predominantly in cash (e.g. food) it would be relatively easy to avoid paying IVA, whilst for others involving written contracts (e.g. telecoms and utilities) it is relatively difficult to avoid paying IVA. Differences in the ease of evasion mean it is likely that the elasticity of demand for formal expenditure with respect to the rate of IVA will differ across goods. Models of optimal commodity taxation need to be further developed to determine whether this could provide a justification for non-uniformity of rates.

7. Future developments and avenues for research

In this section we discuss three main areas where we feel future research effort would be most productively spent. In section 5 we showed that behavioral responses can significantly reduce the amount of additional revenue raised from tax increases, and can alter the distributional pattern of welfare losses. Hence, in section 7.1, we discuss the ways in which one may improve the modelling of labor supply, including the decision of whether to work formally or informally. Section 7.2 discusses how one may go about gaining more knowledge about the extent to which increases in the rate of IVA and IEPS are passed on to consumers. Section 7.3 discusses the importance of improving the quality of household data, particularly regarding the measurement of unearned income and the incomes of richer households. Section 7.4 discusses a number of issues that would need to be addressed conceptually and with the ENIGH survey if there was a desire to expand the model to include the cash transfer system (benefits/welfare). We wish for future research to be a collaborative effort involving researchers at the IFS, the World Bank, and in Mexico and other developing countries.

7.1 Labor supply

Understanding the effects of tax reform on labor supply is an important part of evaluating policy. For instance, if people respond to an increase in a tax rate by working less, investing less and engaging in additional avoidance and evasion to such an extent that tax revenue falls, even a Government that is mainly concerned about equity (rather than efficiency) would not wish to introduce such a policy. Whilst these types of concerns are relevant whenever one analyses

[36] For more details please see http://www.hmrc.gov.uk/manuals/vfoodmanual/vfood6260.htm
[37] For more details please see http://www.hmrc.gov.uk/briefs/vat/brief3209.htm

changes in income taxes, in the context of Mexico (and more generally medium income countries) they are particularly salient and important because of the presence of an additional margin: the decision to participate in the formal or informal labour markets. In our methodological paper (Abramovsky et al (2010)) we stated the following issues to be of key importance in the study of labor supply in Mexico (and possibly other middle income countries)[38]:

- How (exogenous) changes in incentives individuals face to work in the informal sector affect whether workers are formally employed or not.
- The calculation of taxable income elasticities (à la Feldstein) which will be informative of the revenue impact of changes in tax rates, and provide a useful summary statistic for overall behavioral response.
- An exploration of how changes in indirect taxes affect labor supply decisions (recognising that as well as reducing the return to work, indirect taxes may impact labor supply because of non-separabilities between consumption and leisure).

In this section we discuss each of these issues in a little more detail. We focus on our new insights, partially informed by the work presented in this report; our original thoughts on the issue can be found in section 3.4.2 of the methodology paper and will not be presented again.

Incentives and disincentives for formality

In common with many middle-income countries, Mexico has a large informal sector. The tax, social security and welfare system can provide powerful incentives and disincentives for individuals to work formally (and firms to produce formally) and declare their income to the tax authorities. For instance, a higher rate of income tax (or social security contributions that are not matched by increases in benefits) would increase the incentive for informality. Changes in marginal tax rates that affect some people but not others may provide the necessary exogenous variation in tax treatment required to estimate a model of the decision of whether to work formally or informally (and, if linked firm-employee data is available, the decisions by firms of which sector to operate in).[39] We think there is scope for work with Mexican partners that will investigate whether the 2010 reforms are suitable for such analysis.

Employers incentives to hire workers informally and employees incentives to accept such work depends upon the social security and welfare benefits one obtains both in the formal and informal sectors. Policy reforms can again provide exogenous variation in incentives that can identify the importance of such issues. In particular, in Mexico, the introduction of *Seguro Popular* in 2001 (a health insurance provided to low income households not covered by social security) provides a good natural quasi-experiment to asses this type of question. *Seguro Popular* was first introduced as a pilot in specific states, and was gradually rolled out across the rest of the country. Two recent papers (Bosch and Campos-Vazquez (2010), and Campos-Vazquez and Knox (2010)) use this staged roll-out to investigate the extent to which *Seguro Popular* has encouraged informal over formal work. They reach different conclusions. The first

[38] We also highlighted the importance of incentives for high earners to shift employment income to corporate income or self-employment income. Unfortunately it has not been possible to explore this issue further in this paper as discussions with economists in Mexico did not provide the additional insights we had hoped to obtain.
[39] For the purposes of model estimation, variation in tax systems and reforms across regions or states would be useful, but unlike its neighbour the United States, Mexico maintains a fairly centralised system of direct taxes.

paper estimates that formal-sector employment would have been around 2.4% higher (and the number of formal firms 3.8% higher) if the policy had not been introduced, whilst the latter paper finds no noticeable effect on the rates of informality. This lack of consensus means more research is needed in this area. The answer is important because access to healthcare and the growth of the formal sector are important policy objectives in middle income countries like Mexico.

Developing the taxable income elasticity approach

In section 5.1, we estimated the impact of tax rates on formal employment income and tax revenues using three sets of assumed intensive and extensive margin elasticities ('low', 'medium' and 'high' responsiveness). We noted two areas where this work needs further development.

First, there is a paucity of estimates of the elasticity of labor supply and taxable income for Mexico. This means our scenarios have been developed with reference to results from the UK and USA. However, the degree of responsiveness and the pattern of responsiveness across demographic groups may differ quite substantially in Mexico. We therefore think that obtaining estimates of labor supply elasticities and taxable / formal income elasticities (by demographic groups) for Mexico should be a key priority for research. The 2010 tax reforms, which increased marginal income tax rates for some workers but not others, may provide a quasi-experiment providing the necessary exogenous variation in tax rates, although the timing (post-recession) might make this difficult.

Second, we believe that the reduced form models where one set of elasticities accounts for all types of response (both *real* – such as a cut in the number of hours work – and *shifting* – avoiding or evading tax by altering the form of remuneration) are not suitable for modelling the revenue implications of tax reforms. This is because a *'real'* response reduces total income and therefore consumer expenditure but on the other hand a *'shifting'* response changes the composition but not necessarily the level of income. This means that ideally we would have separate elasticities for real and shifting responses, and separate PTRs and METRs that include and do not include indirect taxes.

The data requirements for estimating the real and shifting elasticities separately are much greater than for standard taxable income elasticites. That is because, whilst tax-payer records contains taxable income and tax rates which is sufficient for the calculation of taxable income elasticities, by definition it does not include income on which taxes are evaded, which is required for the calculation of the shifting response. An incremental improvement may be the calculation of shifting elasticities based on the utilisation of legal avoidance mechanisms but it is unclear what proportion of the shifting response this will pick up. Alternatively, changes in expenditure (as measured in surveys like ENIGH) may be able to be used to infer something about the change in total (as opposed to taxable) income. This is an area of research that is due to be discussed further at the IFS.

Non-separabilities between leisure and consumption

By including indirect taxation in the METRs and PTRs used in its labor supply modelling, MEXTAX already accounts for the fact that increases in IVA and IEPS reduce work incentives by decreasing the purchasing power of a unit of effort/time. However, we think that further

research is needed to investigate to what extent differential commodity taxation can be used to encourage work by taxing complements to leisure more highly and complements to work less highly. Table 6.1 shows that our demand modelling finds evidence that there are non-separabilities between commodity demand and work behavior in Mexico, but further research in this field might be informative.

7.2 The incidence of indirect taxes

In this paper, we have explored how different assumptions about the degree of pass-through (to consumer prices) of indirect taxes and who bears the part not born by consumers affect the distributional and revenue impact of the 2010 Mexican tax reforms. The results suggest that allowing for less-than-full VAT pass-through makes an important quantitative difference to the distributional and revenue results. In particular, results are highly sensitive to the way that the part of the burden not feeding through to higher prices is distributed between the owners of capital and workers. Our analysis is assumption-driven and does not tell us to what extent VAT was passed through in the reforms analysed in this paper; how the burden that falls on producers is allocated to workers and capital owners; or how it varies across goods/industries.

Attempts to estimate the part of VAT increases borne by consumers are usually conducted as case studies of specific tax reforms and look separately at different markets. In these studies, it is generally found that prices rise to largely, but not necessarily fully, pass the burden to consumers (Blundell (2009)). Given the elasticity of demand, the more elastic the supply, the higher the proportion of the burden is on consumers. Given the elasticity of supply, when demand is more inelastic the tax burden will be higher for consumers.

In the case of Mexico, Aportela-Rodriguez and Werner-Wainfeld (2002) assess price changes of different product groups after the increases in VAT in non-border areas in the year 1995. They find that prices increased relatively more for product groups such as food, drinks and tobacco, for which the supply is more elastic and the demand more inelastic. Gagnon (2007) also estimates the pass-through of the VAT hike in 1995 and finds that between 70 and 80 percent of the VAT increase got passed-through very rapidly, with little additional pass-through thereafter. There is an more extensive literature assessing the extent of indirect taxes pass-through of tax reforms conducted in Europe (a report on the workings of the current EU VAT which includes an analysis of VAT pass-through using various case studies is due to be published this autumn).

However, this literature does not estimate how the part of the increase in indirect taxes borne by producers is distributed between capital owners and workers. For this, data at the firm-level is needed with information on profits, wages and prices, the markets the firms operate in and the VAT status of products. We think that further research on these issues is important, in light of the results discussed in this paper but the data requirements are clearly extremely demanding.

Most of the studies mentioned above use a reduced form, difference-in-differences identification strategy, using tax reforms as natural experiments and comparing price changes of goods affected and unaffected by the reforms. Further understanding of these issues would benefit from a more structural analysis, in which both supply and demand of a specific good is considered, and information about labor and capital markets are also incorporated in the analysis. This is a much more ambitious research agenda. There are examples in the literature that go some way in this direction. For example, they use a structural approach that takes into

account consumer preferences and the mode with which firms compete in a specific market to estimate the degree of pass-through and the impact of changes in indirect taxes (see, for instance, Griffith et al (2010)).

7.3 Improving the micro-data

The sensitivity analyses we have conducted show that accounting for missing income and expenditure in ENIGH 2008 is important to properly estimate the distributional and revenue effects of tax reforms. In particular, the way missing income and expenditure are allocated can make important quantitative differences in the distributional analyses and estimates of revenue changes due to reforms.

It is important to note that none of the assumptions tested in our sensitivity analysis represents the best way to improve data on incomes or expenditures. However, we consider the sensitivity analysis an important and illuminating exercise which can guide policy makers in determining ways to improve data, for example by linking different survey data and accessing administrative data to get more accurate figures for income, and by improving the way formal expenditure is defined.

As a first step, given that ENIGH is being used increasingly for policy analysis as well as more descriptive analysis (such as calculating poverty rates and expenditure patterns), additional effort should be placed on improving coverage of high income households that are currently under-represented in the survey, and in improving the sampling weights as far as possible. Ideally, the government should also link the survey data with administrative data in a similar manner to the Department for Work and Pensions in the UK. However, if permission is required there may be concerns that permission will be non-random (e.g. richer households may be less likely to give permission). Mexican researchers have also suggested using the census (which theoretically covers all households in Mexico and includes questions on income) to adjust ENIGH weights or incomes to account for under (or over) representation of households at different parts of the income distribution..

A UK example of the difference good quality data can make to policy costings may be informative. IFS researchers have shown that assuming no behavioral response, using the UK's household survey (the Family Resources Survey) one would obtain an estimate of between £2 and £4 billion (depending on which year's survey is used) for revenue arising from the new 50p tax rate on incomes over £150,000, whilst administrative tax micro-data provides an estimate of around £6.5 billion.[40] The FRS suffers significantly less from under-reporting and other problems than does Mexico's ENIGH, so the size of discrepancies in Mexico are likely to be even larger.

We think that improvements to the incomes data are important and would welcome the opportunity for future collaboration with the World Bank and Mexican researchers and officials in taking this idea forward. Probably one of the most pressing needs is to improve the information on informality. One possible option is to have the current labor force survey (ENOE), which is large and runs as a rotating panel, to contain, with a certain periodicity, a

[40] IFS researchers have also shown that allowing for behavioral response is very important in this context. Once one allows for this, their central estimate revenue is essentially zero (using the administrative micro-data).

special module on informality. It might be extremely useful to experiment with innovative modules.

7.4 Expanding coverage to include cash welfare transfers

Governments redistribute resources not only through the tax system but also through spending on public services (such as health and education) and cash transfers. Indeed, cash transfers (generally termed benefits in Europe and welfare in the United States) are often found to be responsible for a larger fraction of redistribution than taxes (see Barnard (2010) for the UK case). Given that Mexico operates a number of means-tested and contributory cash transfer schemes, the fact that MEXTAX does not allow one to model changes in cash transfers (although existing levels of transfers are reflected in household net income) limits the usefulness of the present version of the program as a tool for studying redistributive policies. For instance, the initial proposals for the 2010 tax reforms envisaged a significant expansion of cash transfer programs (such as *Oportunidades*), notionally funded by the introduction of the CCP 2% general expenditure tax. Whilst we believe an understanding of the redistributive effects of the tax reforms is interesting in its own right (not least because other tax increases could have been used to fund the expansion of the cash transfer programs), it would also be useful to have a picture of the full package of reforms.

Expansion of MEXTAX to include the main cash transfers (such as *Oportunidades*) is therefore something that should be considered going forwards. However, the complicated nature of the means-test for Oportunidades, making use of a poverty index calculated using a set of socio-economic and demographic characteristics, and the limit of 5 million recipients, makes modelling program entitlement and receipt complex. There are both conceptual issues (for instance, how does one decide who receives the benefit if entitlement exceeds the maximum allowable number of recipients) and practical issues in the context of a tax simulator designed to use generic code that makes use of system-specific parameters, a programming method which seems to be infeasible for the simulation of *Oportunidades*.

Oportunidades and PROCAMPO (a transfer to farmers based on the size of their holdings) are the only two programs not linked to the social security system that are directly recorded in ENIGH. Other targeted welfare programs such as *Programa de desayunos escolares* could not be modelled without additional questions on receipt of such benefits and on characteristics used to determine eligibility. The amounts of contributory benefits (such as unemployment insurance, pensions, widow(er)s benefits, disability benefits and maternity benefits) received depends not only on current circumstances but past contributions. Modelling entitlement to and receipts of these benefits fully would therefore require data on earnings and contributions histories which is not feasible for a household survey. Alternatively if one is content with being able to model changes in standard benefit amounts but not eligibility criteria (such as contributions conditions), questions on whether the respondent is in receipt of a benefit and, if so, the amount of that benefit received, should suffice.[41] The inclusion of such variables seems more feasible and will allow significant further developments to MEXTAX and other micro-simulation tools.

[41] This method is used to impute entitlement to various disability and maternity benefits in the IFS's UK tax and benefit micro-simulator TAXBEN.

8. Conclusions

This paper has been ambitious in its attempt to subject the analysis of the 2010 tax reforms to substantial sensitivity tests and to begin the process of taking into account behavioral response, but necessarily conservative in maintaining that the quantitative results and methods should not be seen as 'correct' in the context of significant data problems. We now draw together what we feel are the main conclusions from this work.

First, under our baseline assumptions, the initially proposed reforms for 2010 look progressive when a household's expenditure is used to define living standards. The amendments made to the approved reforms have made the tax proposals more progressive, but they are also likely to have led the reforms to be less economically efficient. Both of these effects are largely due to the substitution of a significant new uniform expenditure tax with a smaller increase in the rate of the existing non-uniform IVA.

We have shown that the use of income or expenditure as one's measure of living standards can make an important difference to whether a package of reforms is considered progressive or regressive. Our view is that expenditure should be used when one is assessing the distributional impact of a set of reforms which largely consist of changes to indirect taxes, and income should be used when reforms largely consist of changes to direct taxes, social insurance or welfare systems. For the 2010 reforms the choice of equivalence scales is unimportant but this may not be the case when reforms are targeted at particular types of households.

The discrepancy between aggregate income in ENIGH and in National Accounts was identified as a big obstacle to robust analysis of tax reforms at the start of this project and we believe that the work we have done in this paper reinforces that view. Our sensitivity analysis shows that the specific assumptions made can have an important quantitative impact on results.[42] This means that the ad-hoc methods used in this paper and other papers, and in particular increasing all incomes by a constant Altimir factor, should not be seen as a viable solution. Therefore we feel that it is important that more effort is exerted in improving the quality of surveys and provisions should be made for the linking of the survey data to administrative data. At the very least, the publishing of aggregate tabular data on reported gross income and taxable income (by source) would allow evidence-based adjustments to the ENIGH data (either through the application of factors that vary across the income distribution and by individual characteristics, or through re-weighting the data). This would be a significant improvement on the status quo.

Finally, we feel there is a need for significant research on the behavioral response to taxation, both in terms of labor supply, and in terms of the classical incidence of indirect taxes. The extent to which this very ambitious agenda is feasible depends upon data availability and input from the academic and policy community in Mexico and elsewhere. Some of this research, in particular the refinements to the taxable income elasticity approach, would have much wider applicability and interest beyond Mexico.

[42] It should be noted that our sensitivity analysis does not produce formal "bounds" on the impact of assumptions on results, but simply the impact of some particular alternative and plausible assumptions. Even if we had found no impact from changing assumptions in the way we do under scenarios S1 – S12 and B1 – B10, this would not have proved that results were invariant to *any set* of assumptions that could be made.

Bibliography

Abramovsky, L., O. Attanasio, C. Emmerson and D. Phillips (2010), "The distributional impact of reforms to direct and indirect tax in Mexico: Methodological Issues and Approach", Institute for Fiscal Studies

Absalón, C. and C. Urzúa (2009a), "Mexico Country Report", Fiscal Schemes for Inclusive Development, United Nations Development Program

Absalón, C. and C. Urzúa (2009b), "Notes on the FTI PIT-Simulator", Mimeo

Absalón, C. and C. Urzúa (2010), "Impactos Distributivos de la Reforma Fiscal 2010 en Mexico: Un Analisis de Microsimulacion", Instituto Technologico y d Estudios Superiores de Monterrey

Adam, S. (2005), "Measuring the marginal efficiency cost of redistribution in the UK", Institute for Fiscal Studies Working Paper 05/14, IFS

Altimir, O. 1987. “Income Distribution Statistics in Latin America and Their Reliability.” Review of Income and Wealth. 33 (2).

Aportela-Rodríguez, J. and A. Werner-Wainfeld (2002), "La Reformal al Impuesto al Valor Agregado de 1995: Efecto Inflacionario, Incidencia y Elasticidades Relativas", Documento de Investigación No. 2002/01, BANCO DE MÉXICO

Arulampalam, W., M. P. Devereux and G. Maffini (2009), “The Direct Incidence of Corporate Tax on Wages”, Oxford University Centre for Business Taxation Working Paper 0917, University of Oxford

Atkinson, A.B. and J.E. Stiglitz (1976), "The Design of Tax Structure: Direct versus Indirect Taxation", Journal of Public Economics Vol. 6, pp 55 – 075

Bank of Mexico (2010), “Annual Report 2009”

Banks, J., R. Blundell and A. Lewbel (1997), “Quadratic Engel Curves and Consumer Demand”, The Review of Economics and Statistics, Vol. 79, No. 4, pp 527 – 539

Barnard, A. (2010), "The effect of taxes and benefits on household income,
2008–09", Office of National Statistics non-journal article

Blundell, R. (2009), "Assessing the temporary VAT cut policy in the UK", Fiscal Studies, Vol 30, No. 1, pp 31 - 38

Bosch, M. and R. M. Campos-Vázquez (2010), "The trade-offs of social assistance programs in the labor market: The case of the Seguro Popula program in Mexico", Serie documentos de trabajo del Centro de Estudios Economicos 2010/12, El Colegio de Mexico

Brewer, M., E. Saez and A. Shephard (2010), "Means Testing and Tax Rates on Earnings", Chapter 2 of Dimensions of Tax Design: the Mirrlees Review, J. Mirrlees, S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles and J. Poterba (eds), Oxford University Press

Browning, E. (1995), "Effects of the Earned Income Tax Credit on Income and Welfare", National Tax Journal, Vol. 48 No. 1, pp 23-43

Browning, M. and C. Meghir (1991), "The Effects of Male and Female Labor Supply on Commodity Demands", Econometrica, Vol. 59, No. 4, pp 925 - 951

Campos-Vázquez, R. M. and M. Knox (2010), "Social protection programs and employment: the case of Mexico's Seguro Popular program", Serie documentos de trabajo del Centro de Estudios Economicos 2010/14, El Colegio de Mexico

Carare, A., and S. Danninger (2008),"Inflation Smoothing and the Modest Effect of VAT in Germany", International Monetary Fund Working paper 08/175

Centro de Estudios de las Finanzas Públicas (2009a) "Modelo de Microsimulación del Impuesto Sobre la Renta – Rentención de Salarios – Nota Metodológica". CEFP, Palacio Legislativo de San Lazaro, agosto 2009

Centro de Estudios de las Finanzas Públicas (2009b) "Simulador de la Incidencia del Impuesto al Valor Agregado. Nota Metodológica". CEFP, Palacio Legislativo de San Lazaro, septiembre 2009

Centro de Estudios de las Finanzas Públicas (2009c) "Simulador de la Incidencia del Impuesto Especial sobre Producción y Servicios en Bienes y Servicios No Petroleros. Nota Metodológica". Notacefp / 053 / 2009. CEFP, Palacio Legislativo de San Lazaro, septiembre 2009

Centro de Estudios de las Finanzas Públicas (2009d) "Análisis de la Incidencia de los Impuestos al Consumo en la Reforma Fiscal 2010: Iniciativa vs. Dictámenes". CEFP / 081 / 2009. CEFP, Palacio Legislativo de San Lazaro, noviembre 2009

Centro de Estudios de las Finanzas Públicas (2009e) "Incidencia de la Miscelánea fiscal 2010 aprobada por el H. Congreso de la Unión" CEFP / 082 / 2009. CEFP, Palacio Legislativo de San Lazaro, noviembre 2009.

Centro de Estudios de las Finanzas Públicas (2009f) "Reforma Fiscal 2010" CEFP / 086 / 2009. CEFP, Palacio Legislativo de San Lazaro, noviembre 2009.

Feldstein, M. (1995), "The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act", The Journal of Political Economy, Vol. 103, No. 3, pp 551 - 572

Gagnon, E. (2007), "Price Setting during Low and High Inflation: Evidence from Mexico", International Finance Discussion Papers, No. 896, Board of Governors of the Federal Reserve System

Griffith, R., L. Nesheim, and M. O'Connell (2010), "Sin taxes in differentiated product oligopoly: an application to the butter and margarine market", Cemmap Working Papers, CWP37/10, December 2010.

Gruber, J. and E. Saez (2002), "The elasticity of taxable income: evidence and implications", The Journal of Public Economics, Vol. 84, No. 1, pp 1 - 32

INEGI (2010), "Sistemas de Cuentas Nacionales de Mexico. Cuentas de bienes y servicios 2005-2009. Año base 2003. Primera version", available at: http://www.inegi.org.mx/sistemas/biblioteca/detalleSCNM.aspx?c=16867&upc=0&s=est&tg=49&f=2&pf=Cue ; last accessed 18 January 2011.

Mendoza, E.G., A. Razin, and L.L. Tesar (1994), "Effective Tax Rates in Macroeconomics. Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption", Journal of Monetary Economics, Vol. 34, pp 297-323

Mirrlees, J. (1976), "Optimal tax theory: a synethesis", The Journal of Public Economics, Vol. 6, No. 4, pp 327 - 358

Mirrlees, J., S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles and J. Poterba (Forthcoming), "Tax by Design: the Mirrlees Review", Oxford University Press

Samaniego, R., A. Mitsuko Endo Martinez, V. Mendoza Montenegro and F. M. Zorrilla Mateos (2006), "Medición de la Evasión Fiscal en México", CAEPP, Instituto Tecnológico Autónomo de México

Secretaría de Hacienda y Crédito Público (SHCP) (2010), "Distribución del pago de impuestos y recepción del gasto público por deciles de hogares y personas"

APPENDIX A: DESCRIPTION OF DATA CREATION

The main data used in the analysis carried out in this paper is from ENIGH 2008. Using this survey we construct the main input files to be used in the MEXTAX simulator, combining information from all the different datasets contained in ENIGH 2008 raw data, except the files 'noagro', 'erogaciones', and 'gastotarjetas'.

We use these data, together with a number of assumptions about how the raw variables translate into the variables necessary for our simulator (such as formality status, and gross incomes) to create three model input datasets: a household file, an expenditure file and an individual file (that includes income and social security status). Testing the sensitivity of results to changes in assumptions about what income and expenditure is formal and how to account for the discrepancy between total income and expenditure as measured in the ENIGH and in national accounts is done through adjusting these input files.

This appendix describes each of these files in more detail; the programs used to create the variables and the input files, including the reverse engineering of gross labor income; and how we create alternative input files using these programs to conduct our sensitivity analysis.

A1. Main programs and datasets

Firstly, we describe the three main data generating programs necessary to generate the final input datasets used in our simulator: create_processed_data; create_grossincome; and create_MEXTAX_input_data. The first two programs generate intermediate datasets containing expenditure and income figures at the household and individual level that are combined to generate the MEXTAX input files (done by the program create_MEXTAX_input_data). These two programs are modified in order to change the expenditure categories, the definition of formality of workers and consumption, the way missing income and expenditure are corrected for, etc. In this way we generate alternative input files that feed in to our simulator to conduct sensitivity analyses. A further program, 'regress_income_random,' is used in the sensitivity analysis to deal with under-reported income using a regression-based approach.

A1.1 The 'create_processed_data' program

This program uses each of the ENIGH raw data files to generate the following intermediate datasets

- Intermediate datasets with individual characteristics:
  Pobla08.dta

Variable	Description	Definition	Raw ENIGH dataset	Observations	Used in the programs
Folioviv	Residence identifier		Pobla08		
Foliohog	Household identifier		Pobla08		
Numren	Individual identifier		Pobla08		
rel_head	Relationship to the head	rel_head = 1 (Head) if parentesco=101; rel_head = 2 (Head spouse) if parentesco= 201, 202, 203, 204; rel_head = 3 (Children) if parentesco= 301, 302, 303, 304, 305; rel_head = 4 (Employee) if parentesco>=401&parentesco<= 461 or parentesco==999; rel_head = 5 (Not related) if parentesco>=501&parentesco<= 503; rel_head = 6 (Other relative) if parentesco>=601&parentesco<9 99	Pobla08		create_MEXTAX_input_data
sex	Sex	variable sexo	Pobla08		create_MEXTAX_input_data
age	Age	variable edad	Pobla08		create_MEXTAX_input_data
education	Education	variable n_instr161	Pobla08		create_MEXTAX_input_data
empstat	Employment status in the last month	trabajo_2=1 (in employment) if trabajo=1 or verifica = 1,2,3,4,5; trabajo_2=2 (not in employment) if trabajo=2 or verifica =6	Pobla08		create_MEXTAX_input_data
inst_1	Social security: IMMS	variable inst_1	Pobla08		create_grossincome
inst_2	Social security: ISSSTE	variable inst_2	Pobla08		create_grossincome
inst_3	Social security: State ISSSTE	variable inst_3	Pobla08		create_grossincome
inst_4	Social security: PEMEX	variable inst_4	Pobla08		create_grossincome
inscr_1	Medical insurance through work	variable inscr_1	Pobla08		create_grossincome
ss_med_ins	Medical insurance through social security	ss_med_ins=1 if inst_1=1 or inst_2=2 or inst_3=3 or inst_4=4; 0 otherwise	Pobla08		create_grossincome, create_MEXTAX_input_data

trabajos_stateworker.dta

Variable	Description	Definition	Raw ENIGH dataset	Observations	Used in the programs
folioviv	Residence identifier		Trabajos		
foliohog	Household identifier		Trabajos		
numren	Individual identifier		Trabajos		
state_main	Main job in a state-owned institution	numtrab=1, clas_emp=3; for each worker	Trabajos		create_grossincome
state_sec	Secondary job in a state-owned institution	numtrab=2, clas_emp=3; for each worker	Trabajos		

- Intermediate datasets with household characteristics

hhtype.dta

Variable	Description	Definition	Raw ENIGH dataset	Observations	Used in the programs
folioviv	Residence identifier		Pobla08		
foliohog	Household identifier		Pobla08		
edad_head	Age of the household head	variable edad if parentesco=101	Pobla08		Used to create hhtype
numhead	Number of household head	Number of individuals in the household with parentesco=101 by (folioviv, foliohog)	Pobla08		
numspouse	Number of spouses of the head	Number of individuals in the household for which the variable parentesco is between the range 200 and 299	Pobla08		Used to create hhtype
numchild	Number of children	Number of individuals in the household for which the variable parentesco is between the range 300 and 399, and edad<18	Pobla08		Used to create hhtype
numadult_child	Number of adult children	Number of individuals in the household for which the variable parentesco is between the range 300 and 399, and edad >=18	Pobla08		Used to create hhtype
numdomper	Number of domestic personnel	Number of individuals in the household for which the variable parentesco is between the range 400 and 413	Pobla08		Used to create hhtype
numdomperrel	Number of relatives of the domestic personnel	Number of individuals in the household for which the variable parentesco is between the range 421 and 461	Pobla08		Used to create hhtype
numnonrel	Number of individuals not related to the head	Number of individuals in the household for which the variable parentesco is 501	Pobla08		Used to create hhtype
numtutor	Number of tutors	Number of individuals in the household for which the variable parentesco is between the range 502 and 599	Pobla08		Used to create hhtype

numotherrel	Number of other relatives of the head	Number of individuals in the household for which the variable parentesco is between the range 600 and 699	Pobla08		Used to create hhtype
numguest	Number of guests	Number of individuals in the household for which the variable parentesco is between the range 700 and 998	Pobla08		Used to create hhtype
numpens	Number of pensioners	Number of individuals with edad>=64	Pobla08		Used to create hhtype
hhtype	Household type	hhtype = 1 "couple", 2 "single", 3 "couple children under 18", 4 "single children under 18", 5 "head pensioner, couple", 6 "head pensioner, single", 7 "other family no children under 18", 8 "other family children under 18", 9 "multifamily no children under 18", 10 "multifamily children under 18" (see program for a detailed description of the coding)	Pobla08	Multifamily households are those with (relatives of) domestic personnel, or tutors, or guests, or other non-relatives.	create_MEXTAX_input_data
numfam	Number of families in the household	Each of individuals that are domestic personnel, or tutors, or guests, or other non-relatives are counted as an extra family in the household	Pobla08		

hogares.dta

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier		hogares		
foliohog	Household identifier		hogares		
residentes		Number of members in the household	hogares		
factor	Sample weight	variable factor	hogares		create_MEXTAX_input_data
estrato	Stratum	variable estrato	hogares		create_MEXTAX_input_data
ubica_geo	Area identifier	variable ubica_geo	hogares		create_MEXTAX_input_data
est_dis	Sample stratum	variable est_dis	hogares		create_MEXTAX_input_data
upm	Primary sampling unit	variable upm	Hogares		create_MEXTAX_input_data

- Household expenditure/consumption intermediate datasets

gastos_agg_cat.dta

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier				
foliohog	Household identifier				
expnum	Expenditure category	Expnum=1,2,3,4,5,6,7,9,10,11,12, 13,15,16,18,19,20,21,22,23,24, 25,31,34,36,37,41,42,43,46,47, 48,49,50,51,53	Gastos		

		See description of each exp`x' variable (x=1-60) in table on 'consumption file' below			
gas_tri	Quarterly expenditure	Total quarterly expenditure by household, for each expnum	Gastos		create_MEXTAX_input_data
gas_mon	Monthly expenditure	Total monthly expenditure by household, for each expnum	Gastos		create_MEXTAX_input_data

Similar files are created for the gastodiario data, the gastoeduca data and non-monetary consumption data

gastos_agg.dta

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier				
foliohog	Household identifier				
gas_tri	Quarterly expenditure	Total quarterly expenditure by household	Gastos		create_MEXTAX_input_data
gas_mon	Monthly expenditure	Total monthly expenditure by household	Gastos		create_MEXTAX_input_data

Similar files are created for the gastodiario data and the gastoeduca data.

irent.dta

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier				
foliohog	Household identifier				
irent	Monthly estimated imputed rent	Irent=estim32mon if estim32mon>=0 or =0 if estim32mon<0	hogares	This is used to add to non-monetary income and expenditure at the household level	create_MEXTAX_input_data

nomonet_agg.dta.dta

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier				
foliohog	Household identifier				
autocon	Non-monetary Monthly Autoconsumption	clave=(A001-A247, B001-B007, C001-C024, D001-D026, E001-E033, F001-F017, G002-G022, H001-H136, I001-I026,J001-J072, K001-K036, L001-L029, M001-M018, N001-N016) & tipogasto=1	nomonetario	This is used to add to non-monetary income and expenditure at the household level	create_MEXTAX_input_data
reminkind	Non-monetary Monthly Remuneration Inkind	clave=(A001-A247, B001-B007, C001-C024, D001-D026, E001-E033, F001-F017, G002-G022, H001-H136, I001-I026,J001-	nomonetario	This is used to add to non-monetary income and	create_MEXTAX_input_data

		J072, K001-K036, L001-L029, M001-M018, N001-N016) & tipogasto=2		expenditure at the household level	
transfer	Non-monetary Monthly Transfers	clave=(A001-A247, B001-B007, C001-C024, D001-D026, E001-E033, F001-F017, G002-G022, H001-H136, I001-I026,J001-J072, K001-K036, L001-L029, M001-M018, N001-N016) & tipogasto = 3, 4	nomonetario	This is used to add to non-monetary income and expenditure at the household level	create_MEXTAX_input_data
inc_nmgains	Non-monetary Monthly Capital Gains	clave=(Q001-Q016, G001) & tipogasto= 2,3,4	nomonetario		

Monthly expenditure figures are calculated dividing quarterly expenditure figures provided in ENIGH by 3 (variable gas_tri in files gastos, gastodiario and gastoeduca; variable apo_tri in file nomonetario).

As in previous existing work, we use the variable lug_com to classify expenditure into formal and informal. Informal expenditure comprises purchases from informal vendors such as street markets as defined by lug_com equals 1, 2 or 3.

The classification of goods and services into the different taxation categories corresponds to the VAT and Duties systems valid in 2008; it is based in CEFP (2009a).

- Household net income intermediate dataset *ingresos_mon_net_agg.dta*

Variable	**Description**	**Definition**	**Raw ENIGH dataset**	**Observations**	**Used in the programs**
folioviv	Residence identifier				
foliohog	Household identifier				
inc_emp	Monetary Monthly Employment Income	clave=P001-P009, P011, P013, P015, P017, P018	ingresos	This is used to generate total monetary income at the household level	create_MEXTAX_input_data
inc_semp	Monetary Monthly Self-Employment Income	clave=P067-P080	ingresos	This is used to generate total monetary income at the household level	create_MEXTAX_input_data
inc_cap	Monetary Montly Capital Income	clave=P012, P016, P023-P031,P065	ingresos	This is used to generate total monetary income at the household level	create_MEXTAX_input_data
inc_tran	Monetary Montly Transfers Income	clave=P033-P045, P066, P032	ingresos	This is used to generate total monetary income at the household level	create_MEXTAX_input_data
inc_oemp	Monetary Montly Other Employment Income	clave=P020-P022, P063, P064	ingresos	This is used to generate total monetary income at the household	create_MEXTAX_input_data

				level	
inc_other	Monetary Monthly Other Income	clave=P046	ingresos	This is used to generate total monetary income at the household level	create_MEXTAX_input_data
inc_mgains	Monetary Monthly Capital Gains	clave=P048-P062	ingresos		

A similar file at the individual level is also created.

Monthly income figures are calculated taking into account the period in which the survey was applied to each particular household. For each income source, the quarterly figure is divided by one of the following numbers: 2.99178 if decena equals 1; 3.02465 if decena equals 2; 3.02465 if decena equals 3; 3.02465 if decena equals 4; 3.00821 if decena equals 5; 3.00821 if decena equals 6; 3.00821 if decena equals 7; 3.02465 if decena equals 8; 3.02465 if decena equals 9.

A1.2 The 'create_grossincome' program

In the ENIGH survey, household members' report their net income; that is their income after paying their personal income taxes and making their social security contributions. Create_grossincome calculates gross labor income figures based on the net incomes they report for each source of employment income and the structure of the tax and social security systems in 2008 when the data was collected. It draws very heavily on a similar program developed by CEFP/CIEP, although it incorporates the additional feature of calculating gross income by source (rather than just total taxable employment income) meaning that, in principle, exemptions for different sources can be varied (although they were not a part of the reforms analysed in this paper).

To get gross labor income for each household, individuals' incomes are grouped into the following categories: Wages and salaries; overtime; end-of-the-year bonus; incentives, rewards and prizes; holiday bonuses and allowances in cash; profit sharing from secondary subordinated work and end-of-the-year bonus; and other labor income.

First, we apply the exemptions for the various sources to separate the net income into the taxed part and the part that is exempt from tax. We wish to allow users of MEXTAX to vary the exemptions for income sources and this means one needs gross income by source rather than taxable income in the final dataset used by the tax simulator. In order to do this correctly, we need to know the order in which different sources of income are taxed (to know which marginal tax rates apply to different sources of income when people report their net income amount for that source). However, it has not been possible to gain a full understanding of how the tax system operates in this regard. Hence, initially we will use the tax rates and social security contributions to calculate gross income using total taxable net income. We will then calculate an average effective tax rate (the ratio between total tax paid and total gross income) and apply this to each income source to get gross income for each of these. This means that, at present, the tax simulator will not give fully accurate results for the revenue from changes in exemptions (even conditional upon the underlying ENIGH data). However, changes in tax rates and allowances are not affected by this problem and hence the existing data is suitable for the analysis of the tax reforms discussed in this paper.

Monthly income figures are calculated taking into account the period in which the survey was applied to each particular household. For each income source, the quarterly figure is divided by one of the following numbers: 2.99178 if decena equals 1; 3.02465 if decena equals 2; 3.02465 if decena equals 3; 3.02465 if decena equals 4; 3.00821 if decena equals 5; 3.00821 if decena equals 6; 3.00821 if decena equals 7; 3.02465 if decena equals 8; 3.02465 if decena equals 9.

As mentioned before, we use the following definition of formal worker as a baseline to classify income into formal and informal in the adult file: formal workers are individuals with a positive amount of (net) income through labor and receiving any of the following social benefits (as provided by the ENIGH file pobla08): IMSS (inst_1=1), ISSSTE (inst_2=2), state ISSSTE (inst_3=3) or PEMEX (inst_4=4), through work (variable inscr_1=1). Contributions to social security differ for workers covered by the private sector health service (IMSS) or by the public sector (ISSSTE, state ISSSTE or PEMEX) as described in the methodology paper (Abramovsky et al (2010)). When an individual appears to be covered by IMSS and any of the public sector health systems, we use information from the ENIGH file trabajos about whether the worker's main job is in the public or private sector (variables clas_emp and numtrab=1).

We assume that all workers comply with all her tax and social security obligations, that taxable income comes from principal and/or secondary employment, and that the tax impact falls entirely on the worker. In line with the analysis of CEPF we assume that all formal workers receive at least a minimum salary (as prevailing in the DF in 2008).

The dataset generated by this program is incomes.dta and this is used to create the adult input file described below.

A1.3 The 'create_MEXTAX_input_data' program

This program uses the intermediate datasets described in A1.1 to create the final input files to be used in the MEXTAX simulator: the adult/individual file; the household file; and the consumption file. We describe what is contained in each of these in the tables below. As described before, to conduct our sensitivity analyses we use this program to combine different intermediate datasets that embody different assumptions about formality and ways to deal with missing income/expenditure, and create alternative input files for the MEXTAX simulator. We convert all monthly figures contained in the intermediate files to annual figures in Mexican $ 2008.

Household file

Variables	Definition	ENIGH 2008 file	Variable description
folioviv	Residence identifier		
foliohog	Household identifier		
numren	Individual identifier		This is just to be able to merge results from the adult file collapsed at the household level. There is only one observation for each household and numren=01 for all households.
residents	Number of household members	Hogares	
menores	Number of household members under 12 years old	Concen	
mayores	Number of adult household members		residentes-menores
eqsc_5030	Equivalence scale		1+ (mayores-1)*(0.5) + menores*(0.3)
eqsc_7045	Equivalence scale		1+ (mayores-1)*(0.7) + menores*(0.45)
eqsc_8055	Equivalence scale		1+ (mayores-1)*(0.8) + menores*(0.55)
eqsc_9060	Equivalence scale		1+ (mayores-1)*(0.9) + menores*(0.6)
factor	Sampling weights	Hogares	
estrato	Stratum	Hogares	
ubica_geo	Area Identifier	Hogares	
hhtype	Household type	Pobla08	See hhtype.dta above
numfam	Number of families in the household	Pobla08	See hhtype.dta above
totexp	Annual total expenditure (monetary and non-monetary) in Mexican $ 2008	gastos, gastodiarios, gastoeduca, nomonatario, hogares	Sum of all expnum categories defined in consumption file below + non-monetary expenditure irent + (autocon+ reminkind+ transfer) defined in nomonet_agg.dta above
monexp	Annual monetary expenditure in Mexican $ 2008	gastos, gastodiarios, gastoeduca	Sum of all expnum categories defined in consumption file below
nmonexp	Annual non-monetary expenditure in Mexican $ 2008	nomonatario, hogares	irent + (autocon+ reminkind+ transfer) defined in irent.dta and nomonet_agg.dta above

totinc	Annual net total (current) income (monetary + non-monetary) in Mexican $ 2008	ingresos , nomonetario, hogares	(inc_emp+inc_semp + inc_cap+ inc_tran+ inc_oemp+ inc_other+ irent+ autocon +reminkind +transfer) defined in ingresos_mon_net_agg.dta and nomonet_agg.dta above
moninc	Annual net monetary (current) income in Mexican $ 2008	ingresos	(inc_emp+inc_semp + inc_cap+ inc_tran+ inc_oemp+ inc_other) see definition in ingresos_mon_net_agg.dta
moninc_e	Annual net employment monetary (current) income in Mexican $ 2008	Ingresos	inc_emp, see definition in ingresos_mon_net_agg.dta

Consumption file

All expenditure categories 'exp' are annual figures in Mexican $ 2008.

Variables	Formal/ Informal	Tax classification 2008	Definition	ENIGH 2008 file	Variable description	Demand system categories	
						Variable name	Description
folioviv			Residence identifier				
foliohog			Household identifier				
exp1	Formal	VAT exempted	Health services	Gastos	(Clave=J001, J004, J005, J007, J008, J013, J016, J017, J018, J036, J039, J062, J072) & lug_com>3	expnum9	Non-taxed health and education
exp2	Formal	VAT exempted	Education services	Gastoeduca	(Clave=E001-E008, E015, E017, T905) & lug_com>3	excluded	
exp3	Formal	VAT exempted	Lottery	Gastos	(Clave=E029) & lug_com>3	expnum11	Leisure and hotels
exp4	Formal	VAT exempted	Public, school transport and transport abroad	Gastodiario	(Clave=B001-B007, E013, M001, T902) & lug_com>3	expnum8	Non-taxed transport goods and services and petrol
exp5	Formal	VAT exempted	Transfers and other services	Gastos	(Clave=G002-G006, G011, N006, N007, N011-N016) & lug_com>3	none (excluded)	
exp6	Formal	VAT exempted	Leisure goods and services	Gastos	Clave=E020-E022, E026 & lug_com>3	expnum11	Leisure and hotels

exp7	Formal	VAT exempted	Household good and services	Gastos	Clave=G012-G019 & lug_com>3	expnum6	Non-taxed household goods, services and electronics
exp8	Formal	VAT zero rate	Food and drinks	Gastodiario	(Clave=A001-A068, A070, A072-A197, A203-A215, A218, A242) & lug_com>3	expnum1	Non-taxed food and drinks
exp9	Formal	VAT zero rate	Education goods	Gastos	(Clave= E014) & lug_com>3	expnum9	Non-taxed health and education
exp10	Formal	VAT zero rate	Household good and services	Gastos	(Clave= G007) & lug_com>3	expnum6	Non-taxed household goods, services and electronics
exp11	Formal	VAT zero rate	Leisure services	Gastos	(Clave= L029) & lug_com>3	expnum11	Leisure and hotels
exp12	Formal	VAT zero rate	Health-related goods and services	Gastos	(Clave=J009, J010, J014, J020-J035, J037, J038, J042, J044-J059, J063, J064, T910) & lug_com>3	expnum9	Non-taxed health and education
exp13	Formal	VAT zero rate	Health-related goods and services	Gastos	(Clave=J061) & lug_com>3	expnum10	Taxed personal goods and services (including taxed health; education; etc)
exp14	Formal	VAT zero rate*	Food and drinks	Gastodiario	(Clave=A069, A071, A216, A217) & lug_com>3	expnum1	Non-taxed food and drinks
exp15	Formal	VAT taxed	Food and drinks	Gastodiario	(Clave=A198-A202, A219-A222, A243-A247, T901) & lug_com>3	expnum2	Taxed food, drinks and food out
exp16	Formal	VAT taxed	Household goods and services	Gastos	(Clave= C001-C024, T903, G008-G010, G020-G022, T909, F007, T911, I001-I026, K001-K044, L001-L022, T907) & lug_com>3	expnum5	Taxed household goods, services, communications and electronics
exp17	Formal	VAT taxed	Personal goods and services, including education and health	Gastos	(Clave= D001-D026, T904, E016, E018, E019) & lug_com>3	expnum10	Taxed personal goods and services (including taxed health; education; etc)

exp18	Formal	VAT taxed	Other non-food goods and services	Gastos	(Clave= E009-E012, M005, N008-N010, T915**)** & lug_com>3	none (excluded)	
exp19	Formal	VAT taxed	Leisure services	Gastos	(Clave= E023-E025, E027, E028, E030-E033, T912, L023-L028, N003-N005) & lug_com>3	expnum11	Leisure and hotels
exp20	Formal	VAT taxed	Transport goods and services	Gastos	(Clave= F013-F017, T906, T913, M002-M004, M006-M018) & lug_com>3	expnum7	Taxed transport goods and services and petrol
exp21	Formal	VAT taxed	Clothing, footware and accesories	Gastos	(Clave= H001-H136, T908) & lug_com>3	expnum4	Taxed clothing and footware
exp22	Formal	VAT taxed	Other non-food goods and services	Gastos	(Clave= N001-N002, T914) & lug_com>3	expnum12	Other (taxed and non-taxed, such as financial services)
exp23	Formal	VAT taxed	Health-related goods and services	Gastos	(Clave= J002, J003, J006, J011, J012, J015, J019, J040, J041, J043, J060, J065-J071) & lug_com>3	expnum10	Taxed personal goods and services (including taxed health; education; etc)
exp24	Formal	VAT taxed	Petrol	Gastos	(Clave= F010, F011,F012) & lug_com>3	expnum7	Taxed transport goods and services and petrol
exp25	Formal	VAT taxed	Telecoms	Gastos	(Clave= F001 , F002, F003, F004, F005, F006, F008, F009) & lug_com>3	expnum5	Taxed household goods, services, communications and electronics
exp26	Formal	VAT and duties	Under 14˚ alcohol	Gastodiario	(Clave=A228, A231 ,A234, A232, A238) & lug_com>3	expnum3	Taxed Alcohol and tobacco
exp27	Formal	VAT and duties	14˚-20˚ alcohol	Gastodiario	(Clave= A226, A237) & lug_com>3	expnum3	Taxed Alcohol and tobacco
exp28	Formal	VAT and duties	Over 20˚ alcohol	Gastodiario	(Clave = A223, A225, A227, A229, A230, A233, A235, A236) & lug_com>3	expnum3	Taxed Alcohol and tobacco
exp29	Formal	VAT and duties	Beer	Gastodiario	(Clave= A224) & lug_com>3	expnum3	Taxed Alcohol and tobacco

exp30	Formal	VAT and duties	Tobacco	Gastodiario	(Clave= A239, A240) & lug_com>3	expnum3	Taxed Alcohol and tobacco
exp31	Informal	VAT exempted	Health services	Gastos	(Clave=J001, J004, J005, J007, J008, J013, J016, J017, J018, J036, J039, J062, J072) & lug_com<4	expnum9	Non-taxed health and education
exp32	Informal	VAT exempted	Education services	Gastoeduca	(Clave=E001-E008, E015, E017, T905) & lug_com<4	excluded	
exp33	Informal	VAT exempted	Lottery	Gastos	(Clave=E029) & lug_com<4	expnum11	Leisure and hotels
exp34	Informal	VAT exempted	Public, school transport and transport abroad	Gastodiario	(Clave=B001-B007, E013, M001, T902) & lug_com<4	expnum8	Non-taxed transport goods and services and petrol
exp35	Informal	VAT exempted	Transfers and other services	Gastos	(Clave=G002-G006, G011, N006, N007, N011-N016) & lug_com<4	none (excluded)	
exp36	Informal	VAT exempted	Leisure goods and services	Gastos	Clave=E020-E022, E026 & lug_com<4	expnum11	Leisure and hotels
exp37	Informal	VAT exempted	Household good and services	Gastos	Clave=G012-G019 & lug_com<4	expnum6	Non-taxed household goods, services and electronics
exp38	Informal	VAT zero rate	Food and drinks	Gastodiario	(Clave=A001-A068, A070, A072-A197, A203-A215, A218, A242) & lug_com<4	expnum1	Non-taxed food and drinks
exp39	Informal	VAT zero rate	Education goods	Gastos	(Clave= E014) & lug_com<4	expnum9	Non-taxed health and education
exp40	Informal	VAT zero rate	Household good and services	Gastos	(Clave= G007) & lug_com<4	expnum6	Non-taxed household goods, services and electronics
exp41	Informal	VAT zero rate	Leisure services	Gastos	(Clave= L029) & lug_com<4	expnum11	Leisure and hotels

exp42	Informal	VAT zero rate	Health-related goods and services	Gastos	(Clave=J009, J010, J014, J020-J035, J037, J038, J042, J044-J059, J063, J064, T910) & lug_com<4	expnum9	Non-taxed health and education
exp43	Informal	VAT zero rate	Health-related goods and services	Gastos	(Clave=J061) & lug_com<4	expnum10	Taxed personal goods and services (including taxed health; education; etc)
exp44	Informal	VAT taxed	Food and drinks	Gastodiario	(Clave=A069, A071, A216, A217) & lug_com<4	expnum1	Non-taxed food and drinks
exp45	Informal	VAT taxed	Food and drinks	Gastodiario	(Clave=A198-A202, A219-A222, A243-A247, T901) & lug_com<4	expnum2	Taxed food, drinks and food out
exp46	Informal	VAT taxed	Household goods and services	Gastos	(Clave= C001-C024, T903, G008-G010, G020-G022, T909, F007, T911, I001-I026, K001-K044, L001-L022, T907) & lug_com<4	expnum5	Taxed household goods, services, communications and electronics
exp47	Informal	VAT taxed	Personal goods and services, including education and health	Gastos	(Clave= D001-D026, T904, E016, E018, E019) & lug_com<4	expnum10	Taxed personal goods and services (including taxed health; education; etc)
exp48	Informal	VAT taxed	Other non-food goods and services	Gastos	(Clave= E009-E012, M005, N008-N010, T915**)** & lug_com<4	none (excluded)	
exp49	Informal	VAT taxed	Leisure services	Gastos	(Clave= E023-E025, E027, E028, E030-E033, T912, L023-L028, N003-N005) & lug_com<4	expnum11	Leisure and hotels
exp50	Informal	VAT taxed	Transport goods and services	Gastos	(Clave= F013-F017, T906, T913, M002-M004, M006-M018) & lug_com<4	expnum7	Taxed transport goods and services and petrol
exp51	Informal	VAT taxed	Clothing, footware and accesories	Gastos	(Clave= H001-H136, T908) & lug_com<4	expnum4	Taxed clothing and footware

exp52	Informal	VAT taxed	Other non-food goods and services	Gastos	(Clave= N001-N002, T914) & lug_com<4	expnum12	Other (taxed and non-taxed, such as financial services)
exp53	Informal	VAT taxed	Health-related goods and services	Gastos	(Clave= J002, J003, J006, J011, J012, J015, J019, J040, J041, J043, J060, J065-J071) & lug_com<4	expnum10	Taxed personal goods and services (including taxed health; education; etc)
exp54	Informal	VAT taxed	Petrol	Gastos	(Clave= F010, F011,F012) & lug_com<4	expnum7	Taxed transport goods and services and petrol
exp55	Informal	VAT taxed	Telecoms	Gastos	(Clave= F001 , F002, F003, F004, F005, F006, F008, F009) & lug_com<4	expnum5	Taxed household goods, services, communications and electronics
exp56	Informal	VAT and duties	under 14˚ alcohol	gastodiario	(Clave=A228, A231 ,A234, A232, A238) & lug_com<4	expnum3	Taxed Alcohol and tobacco
exp57	Informal	VAT and duties	14˚-20˚ alcohol	Gastodiario	(Clave= A226, A237) & lug_com<4	expnum3	Taxed Alcohol and tobacco
exp58	Informal	VAT and duties	over 20˚ alcohol	Gastodiario	(Clave = A223, A225, A227, A229, A230, A233, A235, A236) & lug_com<4	expnum3	Taxed Alcohol and tobacco
exp59	Informal	VAT and duties	beer	Gastodiario	(Clave= A224) & lug_com<4	expnum3	Taxed Alcohol and tobacco
exp60	Informal	VAT and duties	tobacco	Gastodiario	(Clave= A239, A240) & lug_com<4	expnum3	Taxed Alcohol and tobacco

Note: * This category is assumed to be VAT zero rate for the purpose of integrating the consumer demand system in the simulator. See explanations to table C.1 below. This means that the estimates of IVA revenues are slightly smaller but the difference is negligible since these drink categories are very small in terms of total expenditure.

Adult file

Variables	Formal/ Informal	Description	Definition	ENIGH 2008 file	Variable description
folioviv			Residence identifier		
foliohog			Household identifier		
numren			Individual identifier	pobla08	
age			Age	pobla08	edad
sex			Sex	pobla08	sexo
education			Highest qualification achieved	pobla08	n_instr161
empstat			Whether in work	pobla08	Equals 1 if trabajo=1 or verifica=1,2,3,4,5
formal_w			Whether covered by social security through work	pobla08, trabajos	0=informal; 1=formal IMMS; 2=formal ISSSTE; 3 formal PEMEX
inc1	formal	Gross annual income in Mexican $ 2008	Wages and salaries	ingresos, pobla08, trabajos	clave=P001, P002,P003, P006, P011, P015
inc2	formal	Gross annual income in Mexican $ 2008	Overtime	ingresos, pobla08, trabajos	clave= P004
inc3	formal	Gross annual income in Mexican $ 2008	End-of-the-year bonus	ingresos, pobla08, trabajos	clave=P009
inc4	formal	Gross annual income in Mexican $ 2008	Incentives, rewards and prizes	ingresos, pobla08, trabajos	clave=P005
inc5	formal	Gross annual income in Mexican $ 2008	Holiday bonuses and cash allowances	ingresos, pobla08, trabajos	clave=P007
inc6	formal	Gross annual income in Mexican $ 2008	Profit sharing	ingresos, pobla08, trabajos	clave=P008, P019

inc7	formal	Gross annual income in Mexican $ 2008	Pensions	ingresos, pobla08, trabajos	clave=P032
Inc8	formal	Gross annual income in Mexican $ 2008	Other labor income	ingresos, pobla08, trabajos	Clave=P013, P017, P018 (net of P019)
inc9	formal	Net annual income in Mexican $ 2008	Capital	ingresos, pobla08, trabajos	Clave= P016, P023-P031, P047, P065
inc10	formal	Net annual income in Mexican $ 2008	Other income	ingresos, pobla08, trabajos	inc_semp (clave=P067-P080)+ inc_tran (clave=P033-P045, P066) + inc_other (clave=P046) + inc_oemp (clave=P020-P022, P063, P064)
inc11	informal	Gross annual income in Mexican $ 2008	Wages and salaries	ingresos, pobla08, trabajos	clave=P001, P002,P003, P006, P011, P015
inc12	informal	Gross annual income in Mexican $ 2008	Overtime	ingresos, pobla08, trabajos	clave= P004
inc13	informal	Gross annual income in Mexican $ 2008	End-of-the-year bonus	ingresos, pobla08, trabajos	clave=P009
inc14	informal	Gross annual income in Mexican $ 2008	Incentives, rewards and prizes	ingresos, pobla08, trabajos	clave=P005
inc15	informal	Gross annual income in Mexican $ 2008	Holiday bonuses and cash allowances	ingresos, pobla08, trabajos	clave=P007
inc16	informal	Gross annual	Profit sharing	ingresos, pobla08,	clave=P008, P019

		income in Mexican $ 2008		trabajos	
inc17	informal	Gross annual income in Mexican $ 2008	Pensions	ingresos, pobla08, trabajos	clave=P032
inc18	informal	Gross annual income in Mexican $ 2008	Other labor income	ingresos, pobla08, trabajos	Clave=P013, P017, P018 (net of P019)
inc19	informal	Net annual income in Mexican $ 2008	Capital		Clave= P016, P023-P031, P047, P065
inc20	informal	Net annual income in Mexican $	Other income		inc_semp (clave=P067-P080)+ inc_tran (clave=P033-P045, P066) + inc_other (clave=P046) + inc_oemp (clave=P020-P022, P063, P064)

A2 Programs and datasets used for sensitivity analyses

A key aspect of this project is the use of alternative assumptions about informality, evasion and missing data to test the sensitivity of results to these assumptions. In order to do this, we generated separate copies of the input data files described above embodying the different assumptions (e.g. under-reporting income by a constant factor versus assuming it differs across the income distribution). Table A.2 shows the datasets and versions of the program files used in each of the sensitivity analyses.

Table A.2 Programs and datasets used in the sensitivity analyses

Type of assumptions	**Uses:**	
	Datasets	**Do-files**
Baseline assumptions **Sensitivity analysis**		
(S1) Worker formality definition	ENIGH_Data_ad_s1.dta ENIGH_Data_co.dta ENIGH_Data_hh.dta	create_grossincome_v4_sep_s1.do
(S2) Expenditure formality definition	ENIGH_Data_ad.dta ENIGH_Data_co_s2.dta ENIGH_Data_hh.dta	create_processed_data_v4_s2_exp.do
(S3) Missing income – fixed factors	ENIGH_Data_ad_s3.dta ENIGH_Data_co.dta ENIGH_Data_hh_s3.dta	create_grossincome_v4_sep_s3.do create_processed_data_v6_s3.do create_MEXTAX_input_data_v4_s3.do
(S4) Missing income – fixed factors	ENIGH_Data_ad_s3.dta ENIGH_Data_co_s4.dta ENIGH_Data_hh_s4.dta	create_grossincome_v4_sep_s3.do create_processed_data_v6_s3.do create_MEXTAX_input_data_v4_s4.do
(S5) Missing income – fixed factors	ENIGH_Data_ad.dta ENIGH_Data_co_s5.dta ENIGH_Data_hh_s5.dta	create_processed_data_v6_s5.do create_MEXTAX_input_data_v4_s5.do
(S6) Missing income – fixed factors	ENIGH_Data_ad_s3.dta ENIGH_Data_co_s5.dta ENIGH_Data_hh_s6.dta	create_grossincome_v4_sep_s3.do create_processed_data_v6_s5.do create_MEXTAX_input_data_v4_s6.do
(S7) Missing income – increasing factors	ENIGH_Data_ad_s7.dta ENIGH_Data_co_s7.dta ENIGH_Data_hh_s7.dta	create_grossincome_v4_sep_s7.do create_processed_data_v6_s7.do create_MEXTAX_input_data_v4_s7.do
(S8) Missing income – increasing factors	ENIGH_Data_ad_s8.dta ENIGH_Data_co_s8.dta ENIGH_Data_hh_s8.dta	create_grossincome_v4_sep_s8.do create_processed_data_v6_s8.do create_MEXTAX_input_data_v4_s8.do
(S9) Missing income – random allocation	ENIGH_Data_ad_s9.dta ENIGH_Data_co_s9.dta ENIGH_Data_hh_s9.dta	create_grossincome_v4_sep_s9.do create_processed_data_v6_s9.do create_MEXTAX_input_data_v4_s9.do regress_income_random_s9.do
(S10) Missing income – random allocation	ENIGH_Data_ad_s10.dta ENIGH_Data_co_s10.dta ENIGH_Data_hh_s10.dta	create_grossincome_v4_sep_s10.do create_processed_data_v5_s10.do create_MEXTAX_input_data_v4_s10.do regress_income_random_s10.do

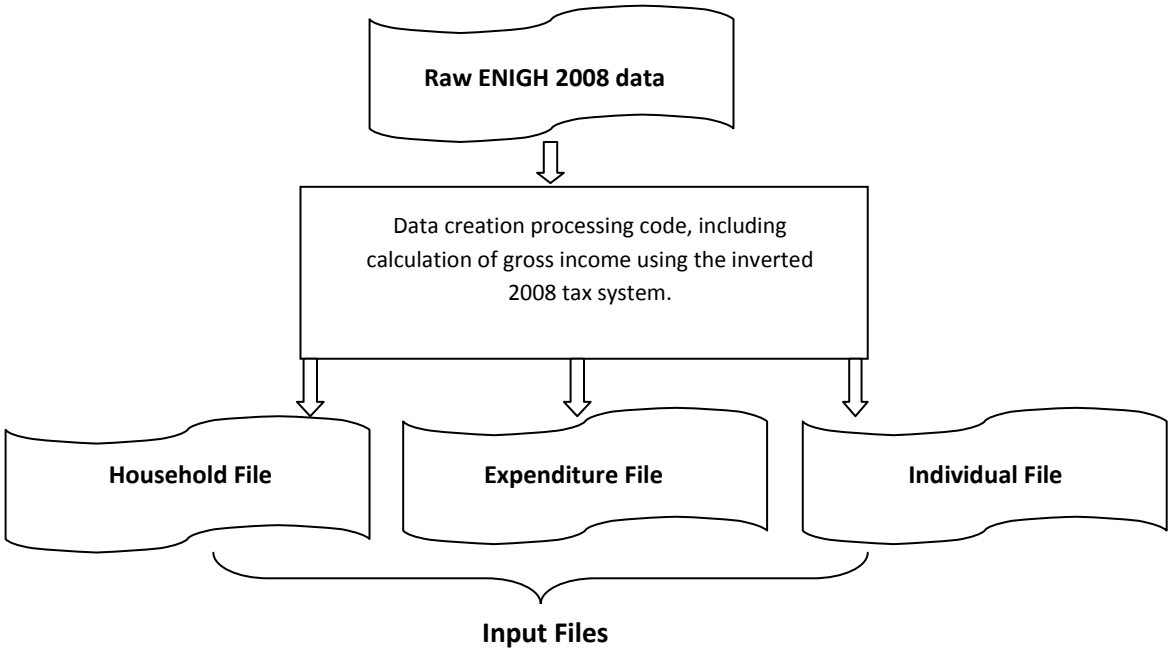
(S11) Missing income – random allocation	ENIGH_Data_ad_s11.dta ENIGH_Data_co_s11.dta ENIGH_Data_hh_s11.dta	create_grossincome_v4_sep_s11.do create_processed_data_v6_s11.do create_MEXTAX_input_data_v4_s11.do regress_income_random_s11.do
(S12) Missing income – random allocation	ENIGH_Data_ad_s12.dta ENIGH_Data_co_s12.dta ENIGH_Data_hh_s12.dta	create_grossincome_v4_sep_s12.do create_processed_data_v6_s12.do create_MEXTAX_input_data_v4_s12.do regress_income_random_s12.do

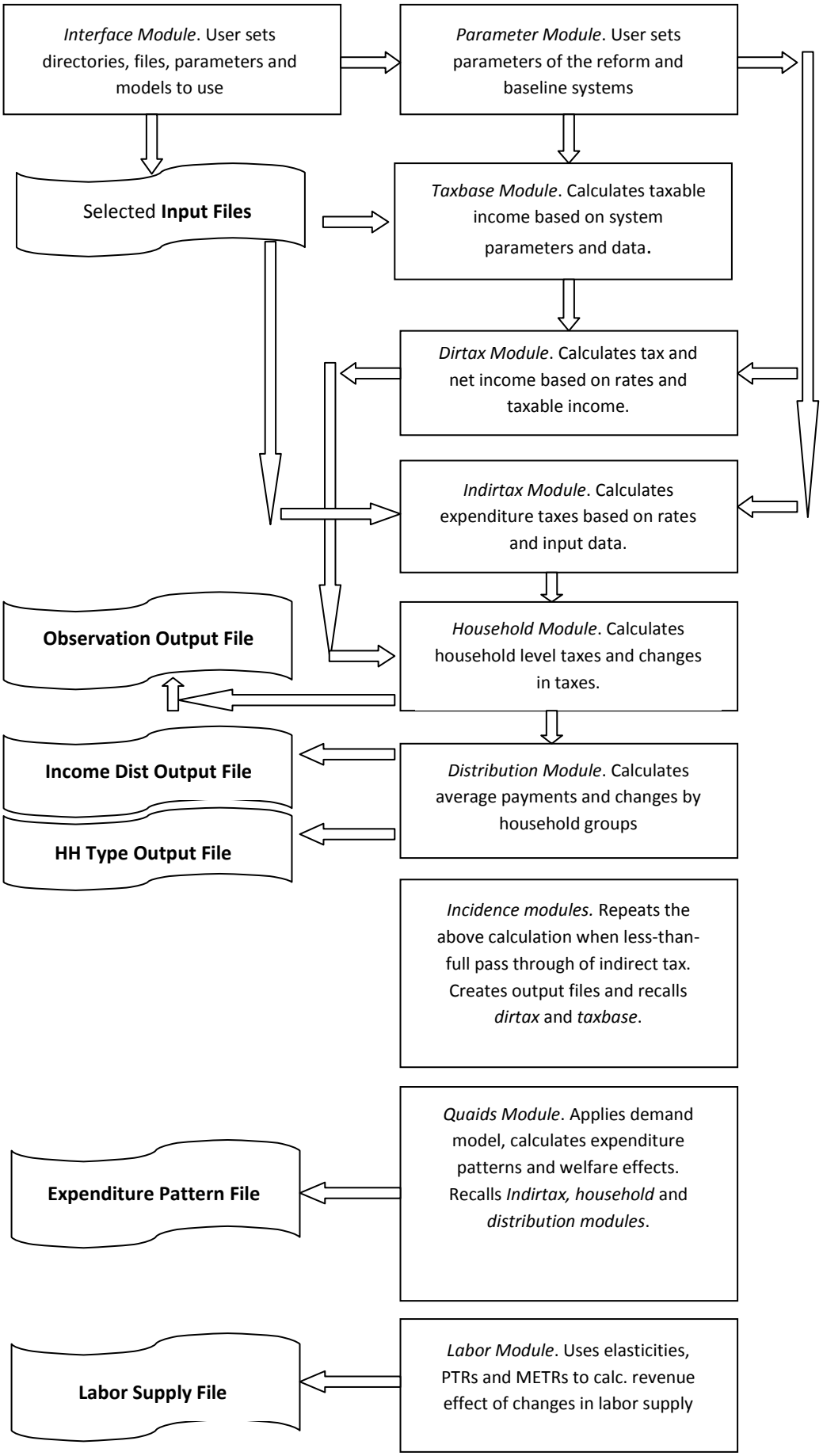
Notes. For full details please see the do files listed in this table.

APPENDIX B: THE MEXTAX PROGRAM

MEXTAX is written in STATA code and is designed so that users do not need to edit the main simulation code but can instead make changes to an interface module (which defines input and output files and whether to run behavioral response modules) and system parameters modules (which define the basic structure and rates of the baseline and reform tax systems). Based on the data and the user-defined tax parameters, separate modules then calculate indirect tax payments, the direct tax base, and direct tax payments before calculating the revenue effects of the reforms and the impact of the tax changes across the income / expenditure distributions and by household types. Separate modules can then be turned on and off according to need to allow for less-than-full pass-through of changes in indirect taxes to changes in consumer prices, as well as to model labor supply (or more correctly, taxable income) and consumer demand responses to tax changes. It has been designed in this way so that users do not have to edit the main program code even if they wish to make fairly major changes to the tax system (e.g. introducing additional tax rates) or the input data (such as additional sources of income or expenditure categories). Figure B.1 is an updated version of section 3.3.4 of the methodology paper and shows the basic structure of the program. We then describe each module in turn.

Table B.1 A graphical representation of MEXTAX




Interface Module. User sets directories, files, parameters and models to use
Parameter Module. User sets parameters of the reform and baseline systems
Selected **Input Files**
Taxbase Module. Calculates taxable income based on system parameters and data.
Dirtax Module. Calculates tax and net income based on rates and taxable income.
Indirtax Module. Calculates expenditure taxes based on rates and input data.
Observation Output File
Household Module. Calculates household level taxes and changes in taxes.
Income Dist Output File
HH Type Output File
Distribution Module. Calculates average payments and changes by household groups
Incidence modules. Repeats the above calculation when less-than-full pass through of indirect tax. Creates output files and recalls *dirtax* and *taxbase*.
Expenditure Pattern File
Quaids Module. Applies demand model, calculates expenditure patterns and welfare effects. Recalls *Indirtax, household* and *distribution modules*.
Labor Supply File
Labor Module. Uses elasticities, PTRs and METRs to calc. revenue effect of changes in labor supply

interface.do

This module contains user-edited instructions on: the directories in which the simulation code, input and output data, and parameter code can be found; the name and location of logfiles; the names of input and output datasets; the existing and reform systems to be used in the analysis; and runs the tax simulator. There are options for whether one wants to conduct the behavioral analysis. The user-edited globals are:

mtax - the directory of the MEXTAX do files

in - the directory that contains MEXTAX input data

out - the directory that MEXTAX output data will be written to

param - the directory containing the parameter definition do files

logfiledecile - the log file for cash and proportional tax changes by decile group

logfiledecile1 - the log file for proportion of change in tax revenues attributable to each decile

logfilehhtype - the log file for cash and proportional tax changes by household type

logfilerevenue - the log file for revenue changes from tax reforms

indata_hh - household data input file

indata_ad - individual and incomes data input file

indata_co - expenditure data input file

outdata_ad - individual level output file

oudtdata_hh - household level output file

sys1 - baseline system number (e.g. 2008)

sys2 - reform system 1 number (e.g. 2010)

sys3 - reform system 2 number (e.g. 20101)

disttype - set equal to 1 to perform analysis with all equivalence scales, 2 for just 100/80/50 scale

There are then a set of globals which are used to determine the type of behavioral analysis to be performed:

labmod - To run labor supply analysis set equal to 1 (2 otherwise)

logfilelabor - the log file for output of labor supply module

consmod - To run the QUAIDs demand analysis set equal to 1

inc_aff_spend - Set equal to 1 for demand modelling to account for changes in net income due to direct tax changes, 2 to exclude this effect (2 is default)

indata_demand - input file containing parameters of demand system

indata_prices - input file containing prices

logfiledemand_welfare - the log file for the welfare effects of tax reforms

logfiledemand_spending - the log file for the changes in spending patterns following tax reforms

logfiledemand_revenue - the log file for revenues from tax reforms allowing for demand effects

NUMGOODSQUAIDS - the number of good categories in the demand system (12 is default)

NUMGOODSDEM - the list of more-disaggregated goods included in demand system

goodslist[1-12] - lists of disaggregated goods in each of the demand system categories

goodslist13 - disaggregated goods excluded from the demand system

categslist[1-60] - states the demand system category for each disaggregated good

indir - To perform analysis with less-than-complete IVA pass-through set equal to 1

prop_prices - The extent of pass through (between 0 and 1)

prop_wages - The extent to which taxes not passed on in prices are born by wages (between 0 and 1)

Four globals (corresponding to logfiledecile, logfilehhtype, logfilerevenue and outdata_ad) are used to define output files for analysis when different assumptions about IVA and IEPS pass-through are made and should be changed for each scenario to avoid over-writing files.

The last global parameter is indic_incidence and this should **not** be edited by the user.

Once all parameters are set, the module then calls the loadprogs.do program which calls the rest of the parts of MEXTAX.

loadprogs.do

This module calls the programs that perform the tax, revenue and distributional calculations and that estimate the behavioral response to a particular set of reforms (given the assumptions provided to MEXTAX). This is done as follows:

- First, for each of the three tax systems chosen in *interface.do* (sys1, sys2, sys3), load the parameters file (*params_X*), and then call *calc_indirtax.do, set_taxbase.do* and *calc_dirtax.do*.
- Then, call *do_household.do* and *do_distanalysis.do*
- Finally, if selected (using consmod, indir and labmod as set in *interface.do*) call *quaids.do, indirect_incidence.do* and *labor.do*.

params_X.do

The user defines the parameters of the VAT (IVA), duties (IEPS), income tax (ISR) and Social Security tax systems in the parameter do files. When naming the do files they should always be of the form params_X.do, where X is the name of the particular system (and corresponds to sys1, sys2 or sys3 as defined in *interface.do*). Existing parameters modules should be used as templates and it is important that the names of scalars are not changed (although of course the values can be).

For indirect taxes the user needs to define the following scalars:

NUMGOODS	- The number of expenditure categories in the input data
OVAT[1-NUMGOODS]	- The standard IVA rate applicable to a particular category in the year the input data was collected. This should not be changed when changing the parameters of a reform or baseline system but only when the data used is from a different year (e.g. 2010).
OBVAT[1-NUMGOODS]	- The border-region IVA rate applicable to a particular category in the year the input data was collected. This should not be changed when changing the parameters of a reform or baseline system but only when the data used is from a different year.
ODUTIES [1-NUMGOODS]	- The IEPS rate applicable to a particular category in the year the input data was collected. This should not be changed when changing the parameters of a reform or baseline system but only when the data used is from a different year.
VAT[1-NUMGOODS]	- The standard IVA rate applicable to a particular category in the tax system under consideration. This should be changed when changing the parameters of a reform or baseline system.
BVAT[1-NUMGOODS]	- The border-region IVA rate applicable to a particular category in the tax system under consideration. This should be changed when changing the parameters of a reform or baseline system.
DUTIES [1-NUMGOODS]	- The IEPS rate applicable to a particular category in the tax system under consideration. This should be changed when changing the parameters of a reform or baseline system.

For income taxes the user needs to define the following scalars:

NUMSOURCES	- The number of income sources in the input data
EXEMPT[1-NUMSOURCES]	- The cash amount of a particular source that is exempt from income tax. For sources of income on which tax is not being simulated (e.g. capital income) this should be set to an amount higher than the largest observed value for that source.
PEXEMPT[1-NUMSOURCES]	- The proportion of a particular source that is exempt from income tax.
MPEXEMPT[1-NUMSOURCES]	- The amount of a source above which no additional proportion is exempt from income tax.
NUMBANDS	- The number of income tax bands
BAND[0-NUMBANDS]	- The upper-limit of each income tax band. The upper limit of the higher band should be higher than the largest observed value for gross income.
RATE[1-NUMBANDS]	- Income tax rates (0 – 1)
NUMCREDS	- Number of bands of employment income subsidy.
LCRED[0-NUMCREDS]	- Upper-limit of each employment-income subsidy band. The 0 band is to ensure that no subsidy is given to those with no earned income.
ACRED[1-NUMCREDS]	- Amount of credit for those with an income in each subsidy band.

For social security the user needs to define the following scalars:

NUMIMSS	- The number of IMSS social security bands.
LIMSS[0-NUMIMSS]	- The upper-limit of each IMSS band.
IMSS[1-NUMIMSS]	- The IMSS rates (0 – 1)
NUMISSSTE	- The number of ISSSTE social security bands.
LISSSTE[0-NUMISSSTE]	- The upper-limit of each ISSSTE band.
ISSSTE[1-NUMISSSTE]	- The ISSSTE rates (0 – 1)
SSNUMSOURCES	- Number of sources of income for social security purposes
SSEXEMPT[1-SSNUMSOURCES]-	-The cash amount of a particular source that is exempt from social security. For sources of income on which tax is not being simulated (e.g. capital income) this should be set to an amount higher than the largest observed value for that source.
SSPEXEMPT[1-SSNUMSOURCES]	- The proportion of a particular source that is exempt from social security.
SSMPEXEMPT[1-SSNUMSOURCES]	- The amount of a source above which no additional proportion is exempt from social security.

calc_indirtax.do

This program first uses the IVA and IEPS rates that applied at the time of the survey underlying the expenditure input data (vectors OVAT, OBVAT and ODUTIES) to calculate pre-tax prices. Total pre-tax expenditure is also calculated. Next, the IVA and IEPS rates that apply under the system under consideration (vectors VAT, BVAT and DUTIES) are used to calculate the amount of IVA and IEPS due under that system. The calculation is done by good and then summed over goods to give a total per household.

set_taxbase.do

First, depending on the value of the global indic_incidence, either the standard input data is loaded (indic_incidence =1) or the data adjusted for less than-full pass-through (indic_incidence =2 or 3). Then using the amount of each income from each source and the exemptions (EXEMPT, PEXEMPT, MPEXEMPT, SSEXEMPT, SSPEXEMPT, and SSMPEXEMPT) the taxbase for income tax and social security contributions is calculated.

Sections allowing for deductions of certain expenses (such as medical insurance) are currently commented out as the inability to model income tax on capital and self employment income (partly due to poor data) means that one cannot calculate the maximum amount deductable (which is typically a fraction of taxable income).

calc_dirtax.do

The first part of the program uses the income tax bands and rates (BAND, RATE) to calculate fixed quotas for income tax: that is the amount of tax paid on income up to the start of each band. This means that when calculating the amount of income tax paid, this can be added on to the amount paid on income within the band an individual finds themselves in, simplifying calculations considerably. The same process is then done for IMSS and ISSSTE contributions.

The amount of subsidy for employment income is calculated using the tax base for income tax and the ACRED and LCRED amounts defined for the system.

Once income tax and social security payments are calculated, net income is calculated as (gross income) – (income tax) – (social security contributions).

Depending on the value of the global indic_incidence, the output is saved either as a standard file (indic_incidence =1) or as output data for the analysis of less-than-full pass-through (indic_incidence =2 or 3).

do_household.do

This module first loads the relevant variables from the input data (individual and household files) and then merges in the results of the indirect and direct tax calculations for the base system (sys1) and the two reform systems (sys2 and sys3). Individual and household level changes in tax payments under the reform systems are then calculated.

Individual-level and household level output files are saved.

do_distanalysis.do

This program first calculates the revenue effects of each reform by summing (and appropriately grossing using sample weights) the changes in tax payments for each tax. This is saved in a log file.

The program then calculates equivalised incomes for each equivalence scale (100/100/100, 100/80/50 and 100/50/30) and equivalised income and expenditure decile groups.

The global disttype (defined in *interface.do*) tells this module whether the full set of distributional analysis should be conducted (disttype=1) or only a partial analysis (disttype=2).

Average cash gains/losses per household by decile group are calculated as (minus) the sum of the change in tax payments in each particular decile group, divided by the number of households in each particular decile group. The average proportional gains/losses per household by decile group are calculated as (minus) the sum of the change in tax payments in each particular decile group, divided by the total income/expenditure of households in each particular decile group. In addition, the proportion of the increase (or decrease) in revenue attributable to each decile group is also calculated for each tax and in total, and compared to the proportion of total income/expenditure attributable to each decile group.

The results are displayed in tables which are saved in log files.

The process is repeated for gains/losses by household type.

indirect_incidence.do

This program allows one to carry out analyses assuming that indirect taxes are partly incident on wages and profits (instead of fully on prices).

The program first loads output data from the indirect tax calculations (performed in *calc_indirtax.do*) and input data from the files indata_ad and indata_hh. Calculations then proceed as follows.

First, post tax-reform consumer prices under the assumption of less-than-full IVA and IEPS pass through, and the associated direct effect of the change in IVA and IEPS on consumers are calculated using the assumed pass-through rate. Then new consumer prices are used to calculate pre-tax prices and the amounts of IVA and IEPS paid under the reform systems.

The next stage is to allocate the part of the burden not borne directly to consumers to gross formal sector employment income and (net) capital income according to the ratio assumed in *interface.do*. It is assumed that the amount of income of each individual with these sources is reduced by the same proportion.

Our tax simulator does not calculate taxes paid on capital income and therefore we assume that capital income faces a tax rate of 10% in this process. For employment income we recalculate the amount of tax paid and net income given the changed gross income calculated in the previous stage by recalling *set_taxbase* and *calc_dirtax*. When doing this we change the value of indic_incidence to 2 so that set_taxbase and calc_dirtax know that they are being called by *indirect_incidence* rather than *load_progs*.

The module then performs the same functions as do_household.do and do_distanalysis.do, outputting to log files and an individual-level data file (logfiledecile_ind, logfilehhtype_ind,

logfilerevenue_ind and outdata_ad_ind). It should be noted that the tables in the decile and household log files show the proportional changes in net income and expenditure (assuming fixed purchase quantities) rather than changes in taxes paid. This is because when pass-through is less than complete, the changes in taxes paid and the gain/loss to households differs.

labor.do

This program allows one to estimate how taxable employment income responds to changes in both direct and indirect taxes, given an assumed set of elasticities (on the intensive and extensive margin).

First, the household-level average tax rates on expenditure are calculated, accounting for informal transactions. These are then added to average income tax and social security rates to get the participation tax rates (PTRs), and to marginal income tax and social security rates to get marginal effective tax rates (METRs).

The user then defines the hours elasticities (intensive margin) and the participation elasticities (extensive margin), which may vary by demographic group. The changes in taxable employment income and the associated changes in tax revenues are then calculated using the calculated PTRs and METRs and the assumed elasticities.

Finally, demographic variables are created and the changes in taxable labor income and revenue are outputted in logfilelabor.

quaids.do

This program allows one to estimate how consumer spending patterns change following tax changes, and how such changes in spending patterns affect the revenues from the tax changes, and consumer welfare. It makes use of demand system estimates calculated in quaids_estimation.do (see Appendix C).

First, the expenditure on each of the 12 demand system goods categories is calculated using the NUMGOODS categories of the MEXTAX indirect tax simulator. This is done to calculate total expenditure on goods included in the demand system , which together with prices (read in from indata_prices) and the coefficients from the demand system (read in from indata_demand), is used to calculate indirect utility and the estimated shares for each of the 12 demand system goods categories for each household.

The price effects of tax reforms are then calculated and are used to estimate the shares for each of the 12 goods categories following the reforms. The expenditure function is then calculated to calculate the compensating variation (CV) for each reform, which (after adding on the change in taxes paid on goods which we cannot include in our demand system) is our measure of the welfare effect of the tax reforms accounting for substitution possibilities. We also calculate the change in expenditure required to obtain the same level of utility if substitution were not possible so that we can evaluate the extent to which substitution possibilities ameliorate the impact of tax changes.

The changes in consumer welfare by decile group and household type are calculated and outputted in logfiledemand_welfare; the changes in expenditure shares are outputted in logfiledemand_spending; and the changes in revenues are outputted in logfiledemand_revenue.

APPENDIX C: THE QuAIDS Demand System

This appendix presents the Quadratic Almost Ideal Demand System (QUAIDS) in detail.

C.1 Assumptions and welfare impacts

The Quadratic Almost Ideal Demand System (QUAIDS) is a generalisation of the Almost Ideal Demand System (AIDS) model that allows for quadratic Engel curves. This rank 3 demand system developed in Banks, Blundell and Lewbel (1997) can therefore allow a good to be a luxury at one level of income and a necessity at another, a property these authors find to be of empirical relevance. The QUAIDS demand system is based on the following indirect utility function:

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

Where x is expenditure, a(p), b(p) and λ(p) are defined as:

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

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

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

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

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

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)

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

(homogeneity)

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

(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 enter as taste-shifters in the share equations, and to maintain integrability they are therefore part of α_i terms in ln*a(p)*:

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

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

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

Calculating the Welfare Impact of Price Changes

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

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

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

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

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).

C.2 Econometric and empirical specification

The QUAIDS is estimated using a 2-step procedure programmed in STATA, with standard errors calculated using a clustered bootstrap procedure. Because total expenditure may be

endogenous we instrument for it using monetary income. This is done using a control function approach.[43]

Stage 1

Before estimation, $a(p)$ and $b(p)$ are unknown. For this reason, $\ln a(p)$ is approximated using the Stone price index

$$\ln p^* \approx \sum_i w_i \ln p_i$$

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.

Stage 2

The parameters estimated in the first stage are 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 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.

Standard errors are calculated using bootstrapping with 500 iterations. Rather than draw the bootstrap samples in an unrestricted manner we take into account that we use variation in prices across city-regions clusters and draw, with replacement, from within clusters as opposed to from the entire sample.

C.3 Data description

This section provides further information about the data used in the estimation of the demand system. These data should be the same as the one used in the MEXTAX micro-simulator. To generate these data the program create_demand_data_dems.do has been used. The system demand is estimated in the program 'quaids_estimation_dems.do'. Descriptions of these programs can be provided at a later date if needed by the World Bank. At the moment the demand system estimation is programmed to run on 12 goods categories – to change the number of categories the user will have to edit the 'quaids_estimation_dems.do' to accommodate this in different stages of the program, such as the number of restrictions.

Table C.1 lists and describes the 12 goods categories included in the demand system, providing detail of the ENIGH expenditure categories included, the Bank of Mexico Prices index codes, and the assumptions made when prices are unavailable for certain goods. Table C.2 lists and describes the demographic variables included in the demand systems.

[43] That is we regress lnx 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.

Table C.1 Definition of categories used in the demand system

Categories	Variable name	ENIGH codes	Bank of Mexico PRICES codes	Notes
Food and drink on which no IVA is levied	expnum1	A001-A197, A203-A214 A215-A216, A217-A218, A242	1-100, 103-110	Prices for A215 (sill bottled water - zero rate) and A216 (sparkling water -iva is levied on this) are together so include in category 1 as A215 represents a bigger expenditure share in ENIGH 2008. A218 (bottled juices or cordials -zero rate) and A217 (prepared water and natural juices -iva is levied on this) are together, include in 1 as A218 represents a bigger expenditure share in ENIGH 2008. No specific price for A242 (food dispensed by government agencies or NGOs).
Food and drink and meals out on which IVA is levied	expnum2	A198-A202, A219-A222, A243-A247, T901	101-102, 111-115, 378-381	
Alcoholic Drinks and Tobacco (IVA and IEPS levied)	expnum3	A223-A241	116-122	
Clothing and footwear (IVA levied)	expnum4	clave>="H001" & clave<="H136", clave=="T908"	134-171	No prices for jewlery, wrist-watches and other women accessories (Banxico code 172, ENIGH code H125-H127, H129, H131): include them and use price of 171 (handbags)

Household goods, services and communications (IVA levied, IEPS sometimes levied)	expnum5	clave>="C001" & clave<="C024", G009-G010, G020-G022, I001-I026, K001-K044, T903, T907, T909, T911, electronics (L001-L022), F001-F009, G008.	184, 186, 189, 190-195, 205-246, 294, 355, 361	No information on the price level of electricity (Banxico code 188, ENIGH code G008); use the price of gas (Banxico code 189). No information on the price level of landline telephone services (Banxico code 190 and ENIGH code F003); or national inter-city phone calls and international calls (Banxico codes 191 & 192 and ENIGH code F002); use the price of internet conexion (Banxico code 355). No price information on mobile telephone services (ENIGH codes F004 and F005); public telephones (ENIGH codes F006); and mail and other communications services (ENIGH codes F007, F009).
Household goods, services and communications (no IVA levied)	expnum6	G007, G011-G019	185, 187	Exclude housing renting cost and imputed rent from this category (Banxico codes 182 and 183 and ENIGH codes G001-G006)
Transport and vehicle fuels (IVA levied, IEPS sometimes levied but not modelled)	expnum7	F010-F017, M002-M004, M006, M012-M018, T906, T913,	310-318, 320-323, 325	No price level information for tolls (Banxico code and ENIGH code M005) or car insurance (Banxico code 319 and ENIGH code N008) ; exclude them. Exclude purchases of automobiles (including cars, bycicles, etc, Banxico codes 311 and 312, ENIGH codes M007-M011)
Public Transport and other transport on which no IVA levied	expnum8	B001-B007, M001, E013, T902	305-309	
Health and Education goods (no IVA levied)	expnum9	Health (J001, J004, J005, J007, J008, J013, J016, J017, J018, J036, J039, J062, J072, J009, J010, J014, J020-J035, J037, J038, J042, J044-J059, J063, J064, T910); Education (E014)	256-265, 268, 269, 271, 272, 276,277, 342, 343	No price level information for education fees (Banxico codes 335-342; ENIGH codes E001-E008, E017, E015, T905), exclude them from the system.
Health and personal goods and services (IVA levied)	expnum10	Taxed education (E016, E018, E019); Taxed health (J002, J003, J006, J011, J012, J015, J019, J040, J041, J043, J060-J061, J065-J071); Personal goods and services (D001-D026, T904)	266-267, 270, 273-275, 278-293, 295, 344-346	Prices for J060 (cotton wool, dressings - iva levied on this) and J061 (surgical alcohol -zero rated) are together so include in category 10 as J060 represents a bigger expenditure share in ENIGH 2008. Exclude education services E009-E012.

Leisure and hotel services (IVA sometimes levied)	expnum11	Non-taxed leisure (E020-E022, E026, E029, L029); Taxed leisure (E023-E025, E027-E028, E030-E033, L023-L028, N003-N005, T912)	347, 349-354, 356-360,362-364,	No specific price for lottery (E029) or hotels.
Other services	expnum12	N001-N002, T914	382-384	No prices information for other services ENIGH codes N006, N007, N009-N010; exclude them from the analysis.

Table C.2 Other variables used in the demand system

Variable name	Description
Demographic variables	
child	Number of household members under 12 years old
adults	Number of household members 12 years or over
sex	= 1 if the head of the household is female, 0 otherwise
empstat	= 1 if the head of the household is employed, 0 otherwise
educlow	= 1 if the head of the household has primary education or less, 0 otherwise
educmid	= 1 if the head of the household has secondary education, 0 otherwise
central	Households in municipalities associated with the following cities: Cuernavaca, Puebla, Queretaro, Guadalajara, Aguascalientes, San Luis Petosi, Tlaxcala, Morelia, Jacona, Iguala, Leon, Tepatitlan, Tolouca, Tulancingo, Cortazar
north_interior	Households in municipalities associated with the following cities: Jimenez, Cuidad Juarez, Chihuahua, Monclova, Monterrey, Torreon, Durango, Fresnillo, Cuidad Acuna
north_coastal	Households in municipalities associated with the following cities: La Paz, Mexicali, Matamoros, Hermosillo, Huatabampo, Tijuana, Culiacan
west	Households in municipalities associated with the following cities: Tepic, Acapulco, Colima
east	Households in municipalities associated with the following cities: Cordoba, Verazruz, San Andres Tuxtla, Tampico
south	Households in municipalities associated with the following cities: Oaxaca, Tehuantepec, Tapachula, Villahermosa
south_east	Households in municipalities associated with the following cities: Campeche, Chetumal, Merida

C.4 Estimated elasticities

Table C.3 shows the estimated compensated price elasticities and table C.4 show the income elasticities. The own-price elasticities confirm that the model satisfies negativity.

Table C.3 Hicksian (Compensated) price elasticities

Good	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Food on which no IVA 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 IVA 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 (IVA and IEPS 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 (IVA 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 (IVA levied, IEPS 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 IVA 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 (IVA levied, IEPS 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 IVA 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 IVA 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 (IVA 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 (IVA 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 have not yet been calculated (due to the time the bootstrapping process takes). An updated version of this table will be provided when this has been completed. 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 C.4 Income elasticities

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

Notes: Standard errors have not yet been calculated (due to the time the bootstrapping process takes). An updated version of this table will be provided when this has been completed. 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.

The patterns of substitution and complementarity seem reasonable. Food on which IVA is not levied (1) is a substitute for food on which IVA is levied and meals out (2). (2) is a substitute for both (1) and alcohol and tobacco (3). Private (7) and public (8) transport are also substitutes. Clothing (4) is complementary with (2) and (3), possibly reflecting additional demand for clothing when one is visiting restaurants and bars and other venues where food and alcohol are served.

The income elasticities are also sensible. Food on which IVA is not levied (1) is a necessity whilst food on which IVA is levied and meals out (2) is a luxury. The other strong necessity is public transport, whilst private transport, leisure goods and services and other services are strong luxuries.