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A tax micro-simulator for Mexico (MEXTAX) and its application to the 2010 tax reforms

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Abstract:

We develop a tax micro-simulator model (MEXTAX) that can quantify the revenue and distributional impact of tax reforms in Mexico using micro-level data. We use MEXTAX to assess revenue-raising reforms to Mexico's direct and indirect tax systems of 2010. Initial proposals by the Executive Power included the introduction of a uniform expenditure tax covering traditionally untaxed necessities (such as food). The reform approved by the Congress replaced this with an increase in the standard (non-uniform) rate of VAT, to avoid regressive impacts. Both reform packages included other minor changes to income tax and excise duties. We argue that given that indirect taxes were changed the most in both reforms, expenditure should be used to measured living standards and proportional progressivity. We find that both the reform package proposed and the reform package approved are progressive if expenditure is used as a measure of living standards, although this is not the case for the proposed reform if income is used. However, the proposed reform would have raised more revenues than the approved reform and we argue that the foregone revenues due to the amendments could have been used to target poorer households more effectively using more direct instruments for redistribution. We also find that using alternative assumptions about missing income or labor supply response affect quantitatively, but not qualitatively, results. The model can be extended to incorporate further behavioral margins and to other countries with similar tax structures.

JEL classification: H20, H22, H30, J20, D30

Keywords: tax policy, micro-simulators, labor supply, Mexico

1. Introduction

In 2009 the Mexican government debt to gross domestic product (GDP) ratio stood at 26.7%, while the government deficit was 2.1% of GDP. Although these figures were low relative to the position of most developed countries and comparable to many developing countries' figures at that time,[1] they hide a substantial imbalance: government revenues from general taxation accounted for less than 9% of GDP, while expenditure stood at 24.2% of GDP.[2] The difference between these figures was (and still 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, the restricted access of the Mexican government to credit markets when oil prices are weak, and the fact that proven reserves of Mexican oil are declining, there is a 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,[3] 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%,[4] 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 put forward by the Executive Power for larger increases in duty rates, increases in regulated prices, and the introduction of a comprehensive 2% VAT (named Contribución para el Combate a la Pobreza or CCP) on all goods (including those currently not covered). This last element was considered as regressive as it involved extending tax to necessities goods such as food and medicines.[5] When assessing fiscal reforms such as these, an important element of the appraisal is to ascertain the distributional impact of the reforms.

In this paper we present a novel micro-simulation model (MEXTAX) that we have developed to analyse these tax reforms and future actual and counterfactual reforms in Mexico. MEXTAX models accurately the rules and structure of complex tax systems, under a set of reasonable assumptions. It covers income tax (on employment income), value added taxes (VAT), excise duties and social security contributions. In its baseline version, MEXTAX provides the distributional impact of reforms and revenue estimates relative to a status-quo tax system,

[1] It is important to note that even a moderate to low debt ratio could lead to a debt crisis if, for example, there is a liquidity constraint that prevents countries to serve their debts regardless of the debt level, as argued by Manasse and Roubini (2005). In fact, Mexico experienced a liquidity debt crisis in 1995 according to the same authors. Reinhart, Rogoff and Savastano (2003) and Reinhart and Rogoff (2009) also argue that countries with relatively low levels of debt can fall repeatedly into debt default: what they call debt intolerance. They argue that taking ino account institutional and political variables is necessary to construct a "safe" level of debt for each country. This is not the focus of this paper though.

[2] See Table A1 in the Appendix for a table with some basic fiscal figures from 2000 to 2014, sourced from the Bank of Mexico.

[3] 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.

[4] 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%.

[5] Table A2 in the Appendix explains in detail each of these tax changes for each reform.

under the assumption that economic agents do not change their behavior as a response to tax changes (referred usually as an arithmetic micro-simulator). This provides a first order approximation to the welfare effects of a reform (an upper bound on losses, and a lower bound on gains, as a result of reforms). Judgement is then needed to determine which set of figures is most meaningful and relevant. MEXTAX can also provide distributional and revenue results under the assumption that economic agents respond to tax changes along specific margins, which are incorporated in a stylised and assumption-driven way. A key feature of MEXTAX is that it is written to be both flexible (so that it can be applied to a wide range of reforms) but also easily accessible to other researchers. Indeed, the program is available for use and as a basis for further development by other researchers.[6]

We also discuss a number of methodological issues. First, is how to define the measure of living standards when assessing the distributional impact of a tax reform or tax system. We discuss the benefits of using both income and expenditure to rank households according to their living standards. We also argue that whether one uses expenditure or income to assess proportionality of gains/losses can alter qualitatively the distributional results, and that the choice should be based on the type of tax (direct or indirect) being anlaysed. If a reform package comprises changes to both direct and indirect taxes, both should be used, considered and compared. Second, we also use a sensitivity analysis approach to deal with specific areas of missing information in the context of using micro-simulation models such as MEXTAX. The key areas of uncertainty that we consider in this paper are missing data on income in household surveys; and how individuals change their labor supply when direct taxes change.[7]

Using MEXTAX and the micro-data from the *Encuesta Nacional de Ingresos y Gastos de los Hogares* (ENIGH) collected in 2008, we find that the approved reforms to income tax, VAT and duties in 2010 were progressive and the proposed reforms put forward by the Executive Power regressive if income is used as a measure of living standards to both rank households and assess proportionality. However, the latter look still somewhat progressive when analysed as a proportion of expenditure along the expenditure distribution.[8] In addition, the proposed reform would have yielded extra revenues relative to the approved reform mainly due to the introduction of the CCP. In cash-terms, most of the additional taxes would have been paid by richer households (assessed in terms of income or expenditure), even if these payments would have represented a lower proportion of their net income or expenditure relative to poorer households. The amendments to the initial proposals were therefore progressive in relative terms but regressive in absolute terms. We argue that these foregone revenues could have been used to target poorer households more effectively using more direct instruments for

[6] The programs and user manual are available for free from the authors upon request. The authors are also working on making these available for free online.

[7] This paper draws heavily in two reports to the World Bank, Abramovsky, Attanasio, Emmerson, Phillips and Villarreal (2010) and Abramovsky, Attanasio, Emmerson, and Phillips (2011). Further details on these and other issues such as the uncertainty on how to define informality in the labor and consumption markets and other margins of behavioral response incorporated in MEXTAX can be found in these reports.

[8] These results are based on a number of practical and economic assumptions, which are described in detail in section 2.2 of this paper. Some of these assumptions relate to the incidence of taxes and cannot be proven, although they are standard in this type of analysis. Furthermore, we have tested the sensitivity of our results to alternative assumptions about the degree of pass-through (to consumer prices) of indirect taxes and who bears the part not born by consumers (workers and capital owners). We found that the distributional effects of the reforms analysed in this paper remain quantititavely unchanged, although there are some important quantitative differences. See section 5.2 in Abramovsky et al. (2011) for more details.

redistribution (see Abramovsky et al (2015) for a more detailed discussion about this result). While these results are qualitatively robust, the specific assumptions made when adjusting the raw data to account for under-reporting of income and expenditure, and the specific assumptions made about the degree of labor supply responsiveness are both found to have modest quantitative effects on the results.

Our project responds to the need to assess the distributional and revenue impacts of these reforms and future actual and counterfactual reforms in Mexico. By focusing on a number of important issues such as data quality and behavioral response and uncertainty about how best to respond to these issues, it also provides a sensitivity-analysis approach that ensures this uncertainty is recognised and reflected in results.

It builds on existing tax micro-simulation models for Mexico developed by other researchers. For instance, the *Centro de Estudios de las Finanzas Públicas* (CEFP) - a quasi-autonomous research group that reports to the Mexican Congress - and Carlos Absalón and Carlos Urzúa – funded by the United Nations Development Programme (UNDP) – have both utilised micro-simulation models to analyse the 2010 tax reforms. In their analyses (CEFP (2009a,b,c,d,e,f), Absalón and Urzúa (2009a,b, 2010)), however, they choose one set of assumptions and have not published findings on the sensitivity of their results to those chosen. We hope by focusing on the issue of data quality and behavioral response this paper can act as a spur for further research and further investment in improving the quality of micro-data available to researchers.

The literature on micro-simulation in developing economies is increasingly emphasising the importance of integrating micro-simulation models with macro and general equilibrium models (see Davies (2009), for instance). To our knowledge, however, a tax micro-simulator integrated with a general equilibrium model with the requisite degree of heterogeneity is not available for any country – although general equilibrium models with stylised tax systems or representative households do exist (see Plumb (2001), and Schaefer and Peichl (2006), for instance) – and the theoretical, econometric and practical issues involved in developing such a model are very significant (see Adam and Bozio (2009) for a discussion of the difficulties of fully accounting for behavioral response in policy costing – and doing it for distributional analysis would be even more difficult). With this in mind we feel an approach based on modelling individual components of behavior separately, as with MEXTAX, is a useful way forward. Furthermore, it allows more detailed consideration of the distributional and behavioral effects of reforms affecting different types of households or individuals differently. If and when fully integrated tax micro-simulation and general equilibrium models become available, the sensitivity of results to the specification of the model and calibrated and assumed parameters should be tested.

The rest of the paper is structured as follows. In section 2 we describe the MEXTAX simulator, and discuss our approach to measuring living standards and addressing the problem of uncertainty about data and behavior. Section 3 presents the revenue and distributional impact of reforms prior to any adjustments for the under-reporting of income or expenditure or allowance for changes in behavior. In section 4 we show how different methods of allocating missing income and expenditure affect results, whilst section 5 shows how the size of the labor supply response significantly affects revenue estimates. Section 6 summarises the paper and provides a brief discussion on the importance of both further developing quantitative tools for the analysis of tax reform, and the need to think more broadly about the impact of reforms.

2. An introduction to MEXTAX and methodology

In this section we first discuss the main features of MEXTAX and the main assumptions needed to proceed with analysis. We then consider methodological issues that are relevant when using micro-simulators to assess the distributional and revenue impacts of tax reforms.

2.1. MEXTAX

MEXTAX is a micro-simulator that models the tax system at the level of the individual (or household) using survey or micro-level administrative data. It calculates taxes paid for each household, and produces summary distributional and revenue analysis. It can be used both on the basis of no-behavioral-response (which provides a first-order approximation for welfare effects of reforms) and allowing for certain forms of behavioral response. The version used in this paper , includes the following taxes: Income tax (ISR) (modelled for employment income only so far); employees' social security contributions (IMSS and ISSSTE); Value Added Tax (IVA); and Excise duties (IEPS). It does not model spending on cash transfers (except the earned-income ISR subsidy) or on public services, although it can relatively easily be extended to cover the former.[9]

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.[10]

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 /

[9] In fact, in Abramovsky et al (2015) we use a more recent version that extends it to assess a range of different cash transfers.

[10] Full details of this process, the files and the programs used to create these data sets can be found in appendix A of Abramovsky et al (2011).

expenditure distributions and by household types.[11] 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).[12] The idea is that the user amends the interface module which contains settings on the type of analysis to be performed and certain assumptions to be made; and the parameter modules which include tax rates, thresholds, and other characteristics of the tax system under the base and reform systems. Tax calculations and distributional analysis modules are not 'system specific' and need not be amended for a large number of reforms. In this way, users can easily assess actual and counterfactual reforms.

MEXTAX 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 prices changes induced by changes in taxes.
- A consideration of the efficiency implications of the proposed and approved reforms. [13]

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.

2.2. Assumptions

In order to conduct the distributional analysis, a number of practical and economic assumptions need to be made. The following assumptions are maintained throughout the analysis carried out in this paper:[14]

[11] For brevity, in this paper we do not present the analysis of the 2010 Mexican tax reforms by household type (or demographic characteristics). This is usally informative in 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. Results can be provided upon request for the interested reader.

[12] Full details of the simulator program can be found in appendix B of Abramovsky et al (2011).

[13] See Abramovsky et al (2011) for more details on different behavioral margins and efficiency considerations not fully covered in this shorter paper.

[14] These assumptions are similar to the ones made by Absalon and Urzua (2009a, b, 2010) and CEFP (2009a,b,c,d,e,f) in their analysis of the Mexican 2010 tax reforms. Table 2.2 of Abramovsky et al (2011)

- 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.
- 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.[15] Expenditure on petrol and telecoms, which is subject to IVA, is always considered to be formal.
- IVA and IEPS are fully incident on the consumer.

In addition, the following assumptions are made in the baseline analysis discussed in section 3 but are varied when considering uncertainty in income data and individuals' behavior in sections 4 and 5:

- No adjustment is made for under-reporting of consumer expenditure or for the under-reporting of incomes.
- Economic agents do not change their behavior when taxes change.

2.3. Ranking households according to living standards

One of the key uses of MEXTAX and tax micro-simulators more generally, is analysis of the distributional impact of tax reforms (or the tax system). In order to conduct such analysis, one first needs to determine what variable is used to measure living standards to define who is "rich" and "poor. In order to assess this, one must first understand that household surveys generally pick up a 'snapshot' measure of income or expenditure (e.g. income in the last month, or spending on different types of items in periods ranging from one week to one year). But such a short term measure might not accurately reflect the living standards of the household in either the short or long run. For instance, households with low incomes may be able to use borrowings, savings or previously purchased durable goods to maintain their living standards, at least in the short run. The ability of individuals to smooth their consumption in response to idiosyncratic shocks and predictable lifecycle variations in income has led economists to argue since at least the late 1980s that consumption may be a superior measure of living standards than income (Poterba (1989), Cutler and Katz (1992), Slesnick (1993), Blundell and Preston (1996)). This might suggest a preference for using expenditure to rank households. But expenditure is not the same as consumption: expenditure captures the purchase costs of durable goods like cars, whereas consumption captures the flow of benefits from these goods. Like income, expenditure may be volatile, with households purchasing certain items infrequently, especially larger durable goods such as motor vehicles or new kitchens (but also food if they bulk purchase). Excluding durable goods from the measure of expenditure removes

provides a comparison of our baseline assumptions to those of previous analysis of the se same reforms by CEFP and Absalón and Urzúa that highlights the few differences.

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

much of this problem but introduces a new one: you may rank households incorrectly if they devote different proportions of their budgets to durable goods.

It is therefore not clear whether expenditure represents a better measure of a household's living standards than income: both are volatile, and furthermore, both suffer significant measurement error in surveys. For this reason it is often worthwhile conducting analysis ranking households both according to their position in the income distribution and in the expenditure distribution. Hence, we present both results in section 3.

Another issue is that because households have different sizes, and hence different 'needs', household income (or expenditure) needs to be adjusted for household size when assigning households to the different income/expenditure groups that will form the basis of the distributional analysis. A simple approach is to adjust household income for household size by dividing incomes and/or expenditures by the number of household members. Households are then assigned their position in the distribution based on per-capita income. However, to the extent that there are economies of scale within households, and children require fewer resources than adults, this may mean that large households and households containing children are placed lower in the income distribution than they should be. Therefore, when deciding where households are in the income/expenditure distribution, the 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 the 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.[16]

2.4. Assessing the proportional impacts of a reform or system

In addition to quantifying the cash-terms gains and losses from tax reforms for households across the distribution of income and expenditure to assess *absolute* progressivity, one often also wants to assess proportional gains or losses to assess *relative* progressivity. But gains and losses measured as a proportion of what? Most analyses typical assess relative progressivity using income. However, a careful consideration suggests that whilst direct taxes (those where the taxbase is income) should be measured as a proportion of income, the relative progressivity of indirect taxes is best assessed using payments as a proportion of expenditure. This is because it provides a better understanding of the the impact on "spending power", and of the long-term impact of indirect tax changes.

[16] The particular scale used is arbitrary but considered; we have chosen it to be roughly mid-way between the scales used in the European Union (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 seems likely 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. The full report on the 2010 reforms (Abramovsky et al (2011)) tests the sensitivity of results to the choice of equivalence scale and finds it to be unimportant in this instance.

For example, consider a uniform expenditure tax such as the 2% tax initially proposed by the Mexican Executive Power for the 2010 Budget.[17] With expenditure equal to income over a lifetime this must be equivalent to 2% of both lifetime income and lifetime expenditure, and therefore unambiguously distributionally neutral.[18] Measured as a fraction of expenditure, each household, whether rich or poor, faces a 2% reduction in their spending power, showing correctly that the reform is distributionally neutral. However, it will look regressive as a fraction of income over the income distribution because income is, on average, less than spending (on which 2% tax is levied) for households with low measured incomes, and more than spending for those with high measured incomes. On the other hand it will look progressive as a fraction of income over the distribution of household expenditure, because income is more than spending (on which the 2% tax is levied) for households with low expenditure, and less than spending for households with high expenditure.

The argument that showing VAT payments as a fraction of income may give a misleading impression of the lifetime distributional impact of VAT is driven by the potential for households to borrow and save, but it does not rely on households being able to borrow freely or have large amounts of savings to draw down. Neither does it rely on consumers being rational and forward looking or engaging in optimal consumption smoothing.

To see this, consider a household with a long run income of 100 US dollars per week but who is currently spending 200 US dollars per week, funded by drawing down the last of their savings. Furthermore, suppose that the rate of VAT is 20% on all goods and services. The household would pay 40 US dollars per week in VAT, equal to 20% of their current spending but 40% of their current income. The question is, which measure is a better reflection of the impact of VAT on the household? It is true that their current income is a better measure of their long run purchasing power than their current expenditure is. But it does not follow that expressing VAT payments as a proportion of current income gives a better measure of the impact of VAT on that long run purchasing power. This is because when the household is forced to cut their spending back to the level of their long run income (100 US dollars per week), the amount of VAT they would pay falls to 20 US dollars per week. This is equal to 20% of their current and long run income, and their long run expenditure of 100 dollars per week.

When combining the results of direct and indirect tax reforms to look at the overall impact of a package of reforms, there is no perfect way to combine results. One approach is to to add up the cash gains/losses calculated using both the direct tax and benefit model and the indirect tax model and express results both as a percentage of income and as a percentage of expenditure. This means there is one figure for the total cash gain/loss and two figures for the percentage gain/loss. When assessing progressivity, households should also be ranked according to their income and expenditure. When all results show the same pattern – proportional gains, for instance, increasing or decreasing with income/expenditure – then a reform can be judged as clearly regressive or progressive. Where the different sets of results differ, judgement must be used. We do this in section 3 when presenting results of our baseline simulations of the 2010 reforms.

[17] Consideration of a flat 2% income tax shows that a similar problem afflicts analysis of the impact of direct taxes using household spending as the measure of living standards used to calculate proportional gains or losses.
[18] Bequests and inheritances complicate the exposition but do not change the conclusions.

2.5. Uncertainty in micro-simulation models: the case of missing data and behavior

Microsimulation model-builders also have to address a number of uncertainties related to data, and economic behavior. In this paper we consider the sensitivity of results to two such uncertainties: the distribution of income and expenditure than is 'under-reported' in the household survey data used by the model; and the extent to which individuals respond to changes in financial work incentives by adjusting their labour supply (or their reported earnings, at least). [19] We do this using a sensitivity-analysis approach based on varying the specific methods used to account for these issues and looking at how this affects results.

Whilst the varying assumptions used are chosen to be an improvement upon the baseline assumption of no missing income or expenditure (or at least no bias from ignoring it) and no labor supply response, the specific alternate assumptions made remain largely arbitrary. Hence, when conducting these sensitivity analyses, we are not attempting to provide a definitive answer for how these issues such be addressed, nor do the different scenarios "bound" the results. Instead, we wish to show how the results change when different but plausible assumptions are made. This serves two purposes. First, when there is uncertainty about key inputs to analysis using micro-simulation models like MEXTAX, we feel it is important that this is recognised and taken into account, in case results (e.g. whether a reform is progressive or regressive, or is revenue neutral) are strongly affected by the specific assumptions made. Whilst the use of various assumptions will not tell you which is correct, it will avoid giving the impression of having a definitive answer when one is actually uncertain. Second it may also provide a spur to future research by demonstrating the importance of the assumptions and therefore of improving the quality of the underlying ENIGH data or labor supply models for Mexico.

Section 4 of this paper shows how estimates of revenue and the distributional impact of reforms are affected by the method used to account for the under-reporting of income and expenditure in ENIGH. Section 5 describes how we incorporate labor supply responsiveness in MEXTAX and demonstrates the sensitivity of results to the choice of labor supply elasticities.

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: that is without any adjustment for the under-reporting of income or expenditure or allowance for labor supply response. The first panel of table 3.1 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

[19] MEXTAX also incorporates two other margins of behavioral response to tax changes (see Abramovsky et al (2011) for more details). In particular, users can vary assumptions about the incidence of indirect taxes, allowing some of the cost of increases 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 shareholders of companies affected by changes in indirect taxes). As with the labor supply model, the chosen pass-through rates and incidence on labor versus capital income are chosen by the user as opposed to estimated. It also incorporates a demand system estimated by the authors using the 2008 ENIGH and regional prices. This allows simulation of substitution between goods when prices change, and the calculation of the resultant welfare and revenue effects. Abramovsky et al (2015) utilises this demand model and MEXTAX to analyse the Mexican indirect tax system in more detail.

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. As discussed in sections 2.3 and 2.4, 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 reform to VAT and duties under the approved reform yielded neutral distributional effects using income: around 0.3% of losses for IVA and 0.1% of losses for IEPS, which is constant across income deciles (this is not shown in the table for brevity but can be calculated using columns 4 and 5 as a share of column 1 for each income decile of Table 3.1). Overall, 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).

Hence, if one uses income as the measure of living standards, whilst the approved and implemented reforms look progressive, the same cannot be said for the plans as initially proposed. Therefore the amendments to the initial proposals incorporated into the final approved reforms are found to be progressive (reducing the losses of the poorest tenth of households by an amount equivalent to around 1.4% of net income, and those of the richest

tenth by only 0.6% of net income).[20] This is almost entirely driven by the removal of the CCP, (the component of the initial proposals which made the overall package look regressive if income is used as a measure of living standard). The income tax reform in the proposed and approved reforms have very similar (and progressive) impacts.

Tables 3.2 repeats the analysis of table 3.1, but rather than use income as our measure of living standards we instead use households' 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). It is also the base for the tax reforms that raise the largest part of revenue in our simulations (i.e. the increases in IVA and IEPS).

Looking at the proposed reforms, cash losses increase with total expenditure, particularly for income tax (as was the case for table 3.1). 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 (not shown in table 3.2). This is in contrast to the analysis of table 3.1 which found the introduction of the 2% uniform expenditure tax to have been regressive. 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 for the proposed reforms 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.

[20] See Table 3.1b in Abramovsky et al (2011) for a detailed breakdown of the gains by tax from the amendments to the initial proposals.

Table 3.1. 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 3.2. 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***				**Change as a % of net expenditure (7) = (6)/(1)**	**% of total revenue change born by each decile** (8)
			ISR (3)	**IVA (4)**	**IEPS (5)**	**Total (6)**		
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

Looking at the approved and implemented reforms, the poorest tenth of the population lose, on average, 96 pesos per year (equivalent to 0.26% of their total expenditure), whilst the richest tenth of the population lose, on average, 3,179 pesos per year (equivalent to 0.94% of their expenditure).

Hence, if one uses expenditure as the measure of living standards, both the approved and implemented reforms and the initial proposals look to be progressive. Indeed, the amendments made to the initial proposals have little effect on the overall degree of progressivity (reducing the losses of the poorest tenth of household by around 1.0% of household expenditure, and those of the richest tenth by 0.9% of household expenditure). This clearly demonstrates that the choice of living standard measure can make a clear difference to the analysis of tax reforms. This does not hold if one uses income, only the proposed reform seems progressive.

However, as Table 3.3. shows, the proposed reform would have yielded higher revenues mainly from the introduction of the CCP. Although measured as a proportion of income or expenditure, poorer households did gain most from the amendments as shown above, the cash-terms gains were much larger for households with high levels of income and expenditure. In other words, the reduction in tax take from the amendments was weakly targeted at poorer households. In Abramovsky et al (2015) we show that increases in Mexico's main cash transfers (Oportunidades and non-contributory pensions), and even simple universal cash transfers would have been much more beneficial to poor households. This shows the distributional case for zero rates of VAT on goods like food is weak – especially given the growing sophistication of cash transfer programmes in particularly middle income countries.

Table 3.3 also shows the estimated revenue from our baseline model and compares it to the estimates produced by CEFP using national accounts data and highlights an important issue that we address in the next section. 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 largely IVA zero-rated) is relatively well accounted for in ENIGH, whereas non-food items (many of which are subject to standard IVA) are poorly accounted for.

Table 3.3. 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

4. Uncertainty: the distribution of missing income and expenditure

A significant issue for micro-simulation in Mexico is that households both under-report their incomes and expenditures when surveyed for ENIGH and that the survey does not cover those households towards the top of the income distribution (see, for instance, Lopez-Calva et al (2007, 2008)). This leads to total aggregate income and expenditure (grossed-up using sample weights) recorded in ENIGH to be significantly lower than national accounts aggregates, and means the shape of the income distribution is mis-characterised. Both can lead to (downwardly) biased estimates of revenue and the latter, erroneous conclusions about the distributional impact of reforms.

Previous micro-simulation models (see Absalón and Urzúa (2009a,b, 2010) and CEFP (2009a,b,c,d,e,f)) have addressed the problem of under-reporting incomes in the ENIGH by adjusting employment incomes using a fixed factor. We repeat this here but also employ a number of other methods of adjustment. This allows us to see how the choice of method to allocate missing income and expenditure affects the distributional pattern of losses and estimated revenues from the 2010 tax reforms. Whilst the varying assumptions used in this section are chosen to be an improvement upon the baseline assumption of no missing income (or at least no bias from ignoring such income), the alternate assumptions 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 because of an absence of external data (such as tax records) that is suitable for use in a more refined method.

In section 4.1, we describe the standard method for accounting for missing income using a constant factor for each type of income. Section 4.2 discusses an approach where the factor for employment incomes increases with the level of incomes to account for the fact that under-estimation of aggregate income is believed to largely reflect under-estimates towards the top of the income distribution (potentially due to sampling problems). In section 4.3, we describe a

method that randomly allocates missing income based on the observable characteristics of individuals that allows for the complete omission of income sources as well as under-reporting the amount. In the three cases, we use the implied household level total income adjustment factor to adjust each household's expenditures, maintaining each household's savings ratio and expenditure patterns.[21] In section 4.4, we present the results of these exercises and compare them to the baseline results with no adjustment for missing incomes and expenditures.

4.1 Fixed income-based factors

The standard practise employed by previous researchers is to allocate missing incomes by increasing each source by a constant factor so that aggregate incomes in ENIGH match administrative (National Accounts) aggregates. This method is known as the Altimir method following Altimir (1987) which advocated such an approach. We repeat this method, taking information from a presentation by G. Leyva Parra from the *Instituto Nacional de Estadística y Geografía* (2001) that uses the 1998 ENIGH to calculate adjustment factors for each source of income.[22] In particular, it suggests using a factor of 1.6173 for monetary employment income; a factor of 2.5191 for monetary income from self employment; 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). We apply these factors to each income source reported in ENIGH 2008 by each of the members of a household.[23] Together, these adjustments imply an adjustment factor for total household income that varies according to the importance of each source in the composition of each household's total income. This implied household level factor is then used to adjust each household's expenditures, maintaining each household's savings ratio and expenditure shares. We refer to this method of accounting for missing income as scenario MI1. Results are presented in tables 4.1 and 4.2 below.

4.2 Variable employment income factors

In section 4.1 we described how to use 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 and expenditure is driven to a large extent by the 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 order to investigate whether this is an important issue, we also perform the analysis based on the assumption that the employment incomes of individuals in the bottom half of the earnings distribution are reported correctly and that all under-reporting of employment income is accounted for by individuals who are in the top 50% of the earnings distribution. The factor by which they are increased to 'correct' for this under-reporting is increasing with income. In the first scenario MI2, the ratio increases over the top 50% of the earnings distribution from a

[21] Abramovsky et al (2011) also conduct analysis where expenditure is adjusted so that expenditure by category of expenditure matches that recorded in National Accounts.

[22] 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.

[23] See Abramovsky, Attanasio, Emmerson and Phillips (2011), Appendix A, for a description of how we assign each of the income sources in ENIGH 2008 to these broad income sources.

factor 1.014 for those in the 50th percentile to a factor of 1.56 at the 90th percentile (i.e. an increase of 0.014 for every percentile one moves up the employment income distribution) and then to 1.914 at the 100th percentile. In scenario MI3, 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.

4.3 Randomly allocating missing income to households

There are two potential major 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 4.1 and 4.2 described 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.[24] 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 we propose to do in this section and we refer to this as scenario MI4. 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 one can how sensitive results are to a number of different assumptions. In this paper we assume the following "under-reporting factors"[25]:

- 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.
- 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.

[24] See page 14, Abramovsky et al (2010) for further discussion of these two issues. 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).

[25] In Abramovksy et al (2011) we test the sensitivity of results to the doubling and halving of these percentages. They are shown to play some role, but not a major one. We also see whether the results are driven by the particular random vector used in predictions and find this to be not the case.

- No households under-report the other sources of income they have.

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. We call this the "adjusted proportion".
- Predict an index value (plus an error term drawn randomly from the error distribution[26]) using the LPM 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".
- 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 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 who has been deemed to have under-reported that source in the first stage of the procedure.

[26] 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.

- 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.
- These predictions are based on an assumption of a normal distribution of errors, and are therefore adjusted to account for this problem.
- The amount estimated to be under-reported for each source is then aggregated and compared to the amount of missing income implied by national accounts and where there is a discrepancy is adjusted (by multiplying by a fixed factor) so that it is consistent with national accounts.
- An individual's and household's income is then calculated by adding their reported incomes to the amount that they are estimated to under-report by.
- Finally, household expenditure is adjusted so that each household's expenditure patterns and savings ratio remains unchanged (as with scenarios MI1 to MI3).

4.4 Results

Table 4.1 shows how the distributional impact of the proposed and approved reforms changes when accounting for missing income and expenditure using the methods described above. Results are presented using total expenditure as our measure of living standards.

Column 2 shows that when we increase income sources by source-specific constant factors and increase expenditure by the implied household-level factors (scenario MI1), cash losses increase substantially relative to the baseline results (column 1), as higher income means a greater yield from the IRS reforms and higher expenditure 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 (column 7).

Columns 3 and 4 of table 4.1 show 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 poorer households (who are now assumed to earn and spend less) and rise for richer households (who are now assumed to earn and spend more). Compared to scenario MI1 (income-based constant factors), under the initial proposals, the average cash losses fall for the poorest 70% of households under scenario MI2 ("low" concentration) and rise for the richest 30% of households. Under scenario MI3 ("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 (columns 8 and 9 of table 4.1), 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 MI1 and MI3, whilst the equivalent figures for the richest tenth of households are 0.8% and 0.96%, respectively.

Columns 5 and 10 of table 4.1 show that, qualitatively, the distributional pattern remains the same under scenario MI4; using expenditure as our measure of living standards, both policies look progressive. In cash terms, moving to the regression-based framework 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.

Table 4.2 shows how revenue estimates change under the different scenarios. Under scenario MI1 revenues are significantly greater as a result of increasing ISR, IVA and IEPS receipts. The estimated revenue from the tax reforms increases as one increases the extent to which missing employment income is concentrated amongst the highest earners (i.e. moving from MI1 to MI2 and then MI3). 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 MI2 and MI3 are designed so that aggregate gross income matches gross income in MI1 (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.

MEXTAX's estimates of the revenues obtained from the reforms using method MI4 is less than under method MI1 (where a set of constant factors is used to account for under-reporting of income). This reflects the fact that under method MI4 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. The increase in

yield from the reforms to IVA and IEPS under scenario MI4 to account for missing incomes and expenditures 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 and therefore indirect tax revenue.

Table 4.1 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)	MI1 (2)	MI2 (3)	MI3 (4)	MI4 (5)	Baseline (6)	MI1 (7)	MI2 (8)	MI3 (9)	MI4 (10)
Proposed										
Poorest Decile	-460	-678	-573	-568	-635	-1.24%	-1.34%	-1.31%	-1.30%	-1.33%
Decile Group 2	-744	-1,111	-874	-861	-1,023	-1.34%	-1.46%	-1.37%	-1.37%	-1.42%
Decile Group 3	-901	-1,382	-1,156	-1,117	-1,319	-1.35%	-1.49%	-1.44%	-1.43%	-1.47%
Decile Group 4	-1,061	-1,698	-1,424	-1,343	-1,708	-1.38%	-1.55%	-1.48%	-1.45%	-1.53%
Decile Group 5	-1,277	-2,090	-1,763	-1,595	-2,099	-1.45%	-1.64%	-1.55%	-1.50%	-1.61%
Decile Group 6	-1,509	-2,469	-2,141	-1,945	-2,655	-1.50%	-1.71%	-1.65%	-1.58%	-1.68%
Decile Group 7	-1,735	-2,860	-2,759	-2,442	-3,374	-1.52%	-1.74%	-1.76%	-1.66%	-1.73%
Decile Group 8	-2,127	-4,047	-4,051	-3,451	-5,169	-1.60%	-1.92%	-1.97%	-1.83%	-1.88%
Decile Group 9	-2,981	-5,984	-6,674	-6,731	-8,494	-1.73%	-2.02%	-2.16%	-2.20%	-1.91%
Richest Decile	-6,151	-25,081	-27,046	-28,981	-31,324	-1.83%	-1.82%	-1.91%	-1.99%	-1.86%
Approved										
Poorest Decile	-96	-139	-118	-116	-136	-0.26%	-0.27%	-0.27%	-0.27%	-0.28%
Decile Group 2	-177	-268	-201	-199	-251	-0.32%	-0.35%	-0.31%	-0.32%	-0.35%
Decile Group 3	-225	-356	-298	-283	-353	-0.34%	-0.38%	-0.37%	-0.36%	-0.39%
Decile Group 4	-289	-472	-408	-372	-495	-0.38%	-0.43%	-0.42%	-0.40%	-0.44%
Decile Group 5	-376	-661	-540	-469	-666	-0.43%	-0.52%	-0.48%	-0.44%	-0.51%
Decile Group 6	-483	-848	-730	-642	-905	-0.48%	-0.59%	-0.56%	-0.52%	-0.57%
Decile Group 7	-591	-1,070	-1,076	-901	-1,210	-0.52%	-0.65%	-0.69%	-0.61%	-0.62%
Decile Group 8	-791	-1,708	-1,807	-1,461	-2,102	-0.59%	-0.81%	-0.88%	-0.77%	-0.76%
Decile Group 9	-1,262	-2,838	-3,386	-3,526	-3,517	-0.73%	-0.96%	-1.09%	-1.15%	-0.79%
Richest Decile	-3,179	-10,971	-12,488	-14,028	-11,430	-0.94%	-0.80%	-0.88%	-0.96%	-0.68%

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 4.2 Revenue Raised from the Reforms, constant income-derived factors

Reform	Annual Revenue ($ millions Mex)				
	Baseline (1)	MI1 (2)	MI2 (3)	MI3 (4)	MI4 (5)
Proposed					
ISR	8,470	17,000	21,200	23,400	15,900
IVA	38,000	98,500	97,200	96,600	125,000
IEPS	4,080	11,000	10,900	10,900	13,100
Total	50,550	126,500	129,300	130,900	154,000
Approved					
ISR	5,990	13,100	17,800	20,400	12,100
IVA	10,900	30,200	30,200	30,100	34,200
IEPS	3,060	8,260	8,210	8,150	9,890
Total	19,950	51,560	56,200	58,650	56,190

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

In summary, the qualitative distributional impact of both proposed and approved reforms is found to be insensitive to the particular methods used to adjust for missing income and expendture. 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. Firstly, when incomes are increased by fixed source-specific factors and expenditures correspondingly adjusted (scenario MI1), 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%. Secondly, increasing employment income only for richer households (scenarios MI2 and MI3) makes the reforms look a little more progressive than when incomes are adjusted by constant factors (scenario MI1). Finally, allowing for complete omission of income sources using a regression-based approach to allocating missing income (scenario MI4) makes the reform slightly less progressive.

The sensitivity of results to the assumptions made suggests that more research on the under-reporting of income and expenditure, or linkages between survey and (more accurate and complete) administrative tax records is required. In particular, without such linking or an improvement in the quality of the ENIGH survey data, estimates of the impact distributional impact of reforms and tax revenues based on micro-simulation models must be seen as imprecise and comprehensively tested.

5. Uncertainty: behavioral response and the case of labor supply

In this section we incorporate labor supply responsiveness in MEXTAX and show how this can affect the amount of revenue raised by the 2010 reforms. This involves testing how different assumptions about taxable income elasticities (i.e. how responsive levels of taxable income are to tax rates) affect results. Section 5.1 explains the method and 5.2 shows the results.

5.1 The taxable-income elasticity method

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 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)).[27]

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.[28] While increases in indirect taxes have smaller effects on work incentives than revenue-equivalent increases in direct taxes (because indirect taxes are paid on expenditure funded by unearned as well as earned income), in general, it is not true that indirect taxes have *no* effect; 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

[27] It is very difficult to to attempt to estimate a structural model of labor supply (and the formality decision) for this paper. In the summary and discussion section we discuss research ideas in this area we think are worth exploring in the future.

[28] 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.

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 are smoothly withdrawn as income rises.[29] 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.

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.

We calculate METRs and PTRs as follows:

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

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

[29] 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.

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 market; and an interaction term. These, together with the METRs and PTRs, allow one to calculate the revenue effects of the reforms.[30]

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. To our knowledge, there is no information from Mexico and in section 6 we discuss research ideas in order to estimate these elasticities for this country. 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

[30] 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.

for formal labor supply), and on the amount of revenue obtained from the tax reforms (in total, but not separately by tax).

5.2 Results

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.

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 and sources as table 5.2.

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.

6. Summary and discussion

This paper has described and utilised MEXTAX, a simple tax micro-simulator for Mexico that can be used to estimate the revenue, and distributional impact of a wide variety of tax reforms. It has emphasised that in utilising models such as this, consideration needs to be given to important methodological issues that are often ignored, misinterpreted, or taken for granted.

First is to understand that the question of "how to measure living standards" when assessing the distributional effects of tax and benefit reforms is in fact two questions that may have different answers. In particular, while one may *rank* households in the distribution of living standards using income or expenditure, economic reasoning suggests whether one uses or income or expenditure to assess proportionality of a tax payment (or change in tax payment) depends crucially on the tax instrument in question. In particular, we argue that the analysis of the distributional impact of indirect tax changes should measure changes in tax payments as a proportion of expenditure, whilst analysis of direct tax changes should measure changes as a proportion of income. Both should be considered when a reform package includes changes to both direct and indirect taxes.

Second is that the one should acknowledge the limitations one faces in terms of the quality of the underlying micro level data and the unkown direction and magnitude of important behavioral responses. We have shown that changing the assumptions about these important inputs into the analysis can make a real difference to results, particularly with respect to revenue estimates. Future analysis of tax reforms should similarly test the sensitivy of results to the assumptions made to ensure that they are robust.

Real progress, however, requires improvements in the micro-data available to researchers. The significant under-counting of self-employment and capital income, and the lack of coverage of the top of the income distribution, together mean that the ENIGH is currently inappropriate for use in simulating many tax reforms. Improvements in the coverage and quality of the ENIGH are therefore important if the survey is to be used for the purposes of micro-simulation as well as its traditional use in measuring poverty. Making available anonymised micro-level data from the Mexican tax records would also prove useful. This could be used directly in the simulation of income tax reforms, and could provide detail on the distribution of gross and taxable income that could be used to adjust ENIGH data for the under-reporting of incomes. Such data is available for researchers in a large number of other OECD countries.

There is also a need for more research on the degree of responsiveness of labor supply in Mexico and other middle income countries, particularly in the context of a large informal economy. 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, as would the provision of additional social benefits to those outside the formal sector. The extent to which individuals can and do respond to changes in taxes by moving between the formal and informal sectors can significantly affect the welfare and revenue effects of tax reforms.

Policy reforms can again provide exogenous variation in incentives that can identify the importance of such issues. For example, 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 (2014), and Campos-Vazquez and Knox (2013)) use this staged roll-out to investigate the extent to which *Seguro Popular* has encouraged informal over formal work. They found negative effects on formal employment.

Reforms to the Mexican pensions system in the late 1990s may also provide an exogenous change in the incentives to being formally employed by changing the generosity of deferred remuneration differently for people with different levels of earnings. Aguila (2011) has analysed the impact of the reforms on private voluntary savings but the impact on formality has not been tested. Attanasio et al (2011) provide such an analysis for pension reforms in Chile, finding that reforms reduced formal employment, particularly amongst women, as the contributions requirements were relaxed.

Another approach is to focus on estimating the elasticity of taxable/formal income (by demographic groups). 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. In particular, Mexico operated a dual income tax system for business income where the taxpayer is liable to the higher of either the standard income tax (ISR) or a cashflow business tax called the *Impuesto Empresarial de Tasa Única* (IETU) from 2008 to 2013. [31] The flat tax under IETU was not increased as part of the 2010 tax reforms, whilst the top rates of ISR were. Hence, some individuals with high incomes would have seen their marginal and average tax rates increase, whilst others would have been unaffected. These two groups look like viable candidates for treatment and control groups for a difference-in-difference analysis of the reform and estimates of the taxable income elasticity.

Together, improvements in the modelling of behavior and in the quality of data available to researchers would make micro-simulation a more useful and accurate component of tax policy analysis in Mexico and other middle income countries. This is an increasingly important research agenda, which can inform the policy debate together with political and social considerations, as such countries focus on increasing domestic revenue mobilisation to finance the rising demands for their public spending.

[31] IETU has been eliminated in the 2014 reform.

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Appendix.

Fiscal indicators

Table A1. Macroeconomic fiscal indicators

	2000	2005	2009	2010	2014
	Millions of current Mexican pesos				
GDP	6,721,639	9,901,532	12,774,632	13,996,025	17,911,968
Government spending	1,239,266	1,958,012	3,088,877	3,333,948	4,527,633
% GDP	18.4%	19.8%	24.2%	23.8%	25.3%
Financial cost	201,017	210,186	262,813	255,755	345,974
% GDP	3.0%	2.1%	2.1%	1.8%	1.9%
Goverment revenues	1,178,813	1,947,816	2,817,186	2,960,443	3,983,056
% GDP	17.5%	19.7%	22.1%	21.2%	22.2%
Tax-revenues	581,703	810,511	1,129,553	1,260,425	1,807,814
% GDP	8.7%	8.2%	8.8%	9.0%	10.1%
Non-tax revenues	286,564	601,994	870,896	819,588	1,080,246
% GDP	4.3%	6.1%	6.8%	5.9%	6.0%
Revenues from enterprises	310,546	535,311	816,737	880,430	1,094,997
% GDP	4.6%	5.4%	6.4%	6.3%	6.1%
Government Budget Balance	-60,453	-10,196	-271,691	-373,505	-544,577
% GDP	-0.9%	-0.1%	-2.1%	-2.7%	-3.0%
Government Debt	1,183,700	1,575,630	3,404,500	3,903,540	6,540,510
% GDP	17.6%	15.9%	26.7%	27.9%	36.5%

Notes: GDP figures are in current prices in million of Mexican pesos using the 2008 base, and refer to the last quarter of each year. Fiscal figures refers to the federal government. Spending figures include capital and current expenditure. Revenue figures include tax and non-tax revenues (these are mostly from public enterprises and organisations). In the balance line, a negative sign represents a deficit and a positive sign represents a surplus. Debt figures correspond to the total net debt of the public sector reported in December of each year.

Source: Website of the Bank of Mexico.

The 2010 Mexican tax reforms

Table A2 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.

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

- Reform to ISR (see table A2., item 1). Only the part of tax paid on employment income is considered.
- The proposed introduction of the expenditure tax (table A2. item 4) and the approved reforms to VAT/IVA (item 2 of table A2., abstracting from the lower rate of 10% in border areas which was increased to 11% by the reforms).
- Reforms to IEPS (table A2, 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.

Table A2. 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 (2009)