MEXTAX: a tax micro-simulator for Mexico and its application to the 2010 tax reforms

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(joint work with Laura Abramovsky and Orazio Attanasio)
Outline

• Introduction
  – The 2010 tax reforms

• The MEXTAX simulator
  – Data
  – Structure
  – Assumptions

• How do we measure living standards?
  – Expenditure versus income

• Distributional impact of the 2010 reforms
  – Baseline results
  – Accounting for missing income
  – Accounting for labour supply responses
Introduction

• Growing interest in understanding distributional and behavioural effects of taxes in low and middle income countries
  – Inefficient and/or inequitable tax systems stymie development
  – Need to raise revenue or switch to new revenue streams
  – Mexico faces decline in oil revenues and hence will need to increase non-oil revenue

• Develop a tax microsimulation tool and investigate methodological issues for simulating tax reform for Mexico
  – Calculates tax payments for each household
  – Aggregate to produce revenue estimates and summary distributional analysis

• Important methodological decisions to make
  – Account for behavioural response or not?
  – Whether to, and if so, how to adjust for misreporting of income or spending?

• Apply it to simulate the impact of 2010 Mexican tax reform
The 2010 tax reforms

Initially proposed in 2009 (Proposed)

- introduction of 2% expenditure tax (the CCP) on all goods and services
- increase in the IEPS tax rate
  - on alcohol drinks +20%, modelled as increase in rate from 50% to 53%
  - on beer from 25% to 28%
  - on tobacco, modelled as increase in rate from 160% to 164%
  - on lottery games from 20% to 30%
  - on telecommunications services from 0% to 4%
- increase in the top three rates of income tax (ISR)
  - from 28% to 30%, 21.95% to 23.52% and 19.94% to 21.36%. Reduce 16% threshold
  - Only the part of tax paid on employment income is considered

Approved and implemented in 2010 (Approved)

- increase in VAT rate from 15% to 16%, abstracting from differences in border areas
- increase in the IEPS tax rate
  - on alcohol drinks +20%, modelled as increase in rate from 50% to 53%
  - on beer from 25% to 26.5%
  - on tobacco, modelled as increase in rate from 160% to 164%
  - on lottery games from 20% to 30%
  - on telecommunications services from 0% to 3%
- increase in the top three rates of income tax (ISR)
  - from 28% to 30%, 21.95% to 23.52% and 19.94% to 21.36%
  - Only the part of tax paid on employment income is considered
MEXTAX: Data and structure

- MEXTAX is a simple but flexible tax micro-simulator developed in Stata
  - Uses ENIGH (2008) as its source of individual-level income and household-level expenditure data
  - ENIGH files are processed to obtain gross income by category (e.g. salary, bonus), indicators of tax evasion (informality), and household demographics

- Based on a modular approach
  - User amends “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 etc. 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
  - Easy to do actual and counterfactual reforms

- 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)
  - Excise duties (IEPS)
MEXTAX: The parameters modules

********** INCOME TAX THRESHOLDS **********

scalar NUMBAND3 = 0
scalar BAND0 = 0
scalar BAND1 = 5952.84
scalar BAND2 = 50524.92
scalar BAND3 = 88793.04
scalar BAND4 = 103218.00
scalar BAND5 = 123580.20
scalar BAND6 = 249243.48
scalar BAND7 = 392041.96
scalar BAND8 = 1000000000

********** INCOME TAX RATES **********

scalar RATE1 = 0.0192
scalar RATE2 = 0.064
scalar RATE3 = 0.1056
scalar RATE4 = 0.16
scalar RATE5 = 0.1792
scalar RATE6 = 0.1994
scalar RATE7 = 0.2196
scalar RATE8 = 0.28

********** INCOME SUBSIDY LIMITS **********

scalar NUMCREDS = 11
scalar LCRED0 = 0.01
scalar LCRED1 = 21227.52
scalar LCRED2 = 31840.56
scalar LCRED3 = 41674.08
scalar LCRED4 = 42454.44
scalar LCRED5 = 53353.80
scalar LCRED6 = 56606.16
scalar LCRED7 = 74696.04
scalar LCRED8 = 85266.00
scalar LCRED9 = 88587.96
scalar LCRED10 = 1000000000
MEXTAX: standard assumptions

• We make the following assumptions in ALL of our analysis
  – Members of state government SS schemes face national government SS schedule
  – Formal workers comply with tax law on all income
  – Formal workers paid at least the Mexico City minimum wage
  – Income Tax and employees’ SS contributions incident fully on the worker

• We make the following assumptions in our baseline analysis
  – Workers are considered to be formal if covered by an SS health scheme through own their work
  – Expenditure is considered to be formal (and subject to VAT and duties) unless the type of vendor is a street market or stall
  – VAT and duties are fully incident on the consumer
  – No adjustment is made for under-reporting of income or expenditure
  – No change in behaviour in response to tax changes
Key issue: rich or poor? (I)

- Income is typically used as the measure of living standards to define “rich” and “poor” when looking at the distributional effects of a tax reform.

- But many people with measured low incomes do not necessarily have low living standards:
  - Measurement error
  - Temporarily low incomes
  - Lifecycle issues (retired or students)

- In general, those with the lowest reported incomes report spending more than their income, and those with the highest reported incomes report spending less.

- Those with the lowest reported spending typically report earning more, those with the highest reported spending typically report earning less than they spend.

- Assessing the progressivity of reforms to indirect taxes by looking at losses/gains as a fraction of income can give misleading results, and vice versa.
Key issue: rich or poor? (II)

• Imagine a uniform expenditure tax
  – E.g. the 2% tax initially proposed for the 2010 Budget
  – Over a lifetime this must be distributionally neutral

• But it will look regressive as a fraction of income over the income distribution
  – Income is less than spending (on which 2% tax is levied) for low income, and more than spending for high income

• And it will look progressive as a fraction of income over the spending distribution
  – Income is more than spending (on which 2% tax is levied) for low spenders, and less than spending for high spenders

• A similar problem when looking at the impact of direct taxes as a proportion of spending

• When tax reforms combine both indirect and direct tax changes it is important to use both income-based and expenditure-based analysis
Analysis of the 2010 tax reforms
Baseline: Losses to households as a % of income (I)

Gain/loss (% of net total income)

Income decile group

-1.250%
-1.000%
-0.750%
-0.500%
-0.250%
0.000%

Poorest 2 3 4 5 6 7 8 9 Richest

Income Tax IVA IEPS
Baseline: Losses to households as a % of income (II)
Baseline: Losses to households as a % of expenditure

Bar chart showing the loss (in % of total expenditure) for different expenditure decile groups from the poorest to the richest, with the total group also included. The chart indicates a steady decrease in loss percentage from the poorest to the richest decile groups.
Methodology: sensitivity to missing income (I)

- Major problem of under-reporting of income and spending in the ENIGH survey

<table>
<thead>
<tr>
<th>Income Source</th>
<th>Altimir Factor</th>
<th>Implied % Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>1.470</td>
<td>68.0%</td>
</tr>
<tr>
<td>Self Employment</td>
<td>2.290</td>
<td>43.7%</td>
</tr>
<tr>
<td>Capital</td>
<td>23.677</td>
<td>4.2%</td>
</tr>
<tr>
<td>Transfer</td>
<td>1.295</td>
<td>77.2%</td>
</tr>
<tr>
<td>Other</td>
<td>1.000</td>
<td>100%</td>
</tr>
</tbody>
</table>

Based on 1998 ENIGH and National Accounts

- Important to adjust income and spending in order to obtain accurate revenue estimates
  - And to obtain distributional impacts for non-linear income and social security taxes
Methodology: sensitivity to missing income (II)

• Previous research has multiplied incomes from each source by a constant factor

• But it is unlikely that everyone under-reports income by the same constant factor

• We look at following assumptions on missing income/expenditure
  – Income source-specific constant factors based on national accounts aggregates (MI1)
  – Employment income factor that increases smoothly as employment income increases (MI2, MI3)
  – Random allocation of missing income according to characteristics of households (MI4)
  – Expenditure is adjusted in all instances by same factor as a household’s income
Comparing baseline with MI1 results

-1.25% - 1.00% - 0.75% - 0.50% - 0.25% 0.00%

Expenditure decile group

- Baseline
- MI1

Expenditure (%) of total expenditure
Comparing MI2 and MI3 with MI1 results.
Methodology: sensitivity to missing income (III)

- Allowing for complete omission of income sources by households is the biggest departure from existing work in Mexico.

- We first decide what fraction of individuals are under-reporting the income source (by either under reporting the amount or complete omission) relative to the number reporting they receive that source in the survey.

- Based on the characteristics of those reporting an amount we predict who this fraction of individuals are (allowing for prediction error).

- We then predict the amount of under-reported income for each of these individuals (allowing for prediction error and drawing from the actual distribution of reported amounts to avoid imposing normality of predictions).

- We scale up these amounts so that the total income by source matches national accounts figures.
Comparing baseline with MI4 results

Gain/loss (as % of total expenditure)

Expenditure decile group

MI1  MI4

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Methodology: sensitivity to missing income (IV)

- How correct for missing income affects revenue estimates:

<table>
<thead>
<tr>
<th>Reform</th>
<th>Baseline</th>
<th>MI1</th>
<th>MI2</th>
<th>MI3</th>
<th>MI4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISR</td>
<td>5,990</td>
<td>13,100</td>
<td>17,800</td>
<td>20,400</td>
<td>12,100</td>
</tr>
<tr>
<td>IVA</td>
<td>10,900</td>
<td>30,200</td>
<td>30,200</td>
<td>30,100</td>
<td>34,200</td>
</tr>
<tr>
<td>IEPS</td>
<td>3,060</td>
<td>8,260</td>
<td>8,210</td>
<td>8,150</td>
<td>9,890</td>
</tr>
<tr>
<td>Total</td>
<td>19,950</td>
<td>51,560</td>
<td>56,200</td>
<td>58,650</td>
<td>56,190</td>
</tr>
</tbody>
</table>
Methodology: Behavioural response

• Taxes paid by specific individuals and households and revenue can be calculated holding behaviour fixed

• But changes in taxes affects incentives to work, to declare income, what items to buy, etc

• Program allows one to look separately at 3 margins of response
  – Changes in pre-tax commodity prices, wages and profits for indirect tax
  – Changes in consumer spending patterns
  – Labor supply (formal employment income elasticities)

• Ideally would want to estimate models of these responses
  – But lack of identification means we use assumption-driven sensitivity tests
Methodology: Behavioural response – labor (I)

- Increases in tax may discourage work and increase incentive for informal work

- Ideally estimate a structural model of working decisions and tax evasion
  - Exogenous variation in incentives?
  - Accurate data on incomes and labor supply?

- Reduced-form model “formal employment income” income elasticities
  - Not differentiate between “real” and “shifting” response but does include both
  - Decisions to shift out of formal sector completely – participation tax rate and elasticity
  - Decisions to change formal income at margin – marginal effective tax rate and elasticity

- Allows us to look at revenue and changes in taxable employment income
  - But not changes in revenue by tax or welfare effects

\[ \text{Gross}_{\text{new}} = \text{Gross}_{\text{old}} \times \left( \frac{1 - \text{METR}_{\text{new}}}{1 - \text{METR}_{\text{old}}} \right)^{\text{IntElast}} \times \left( \frac{1 - \text{PTR}_{\text{new}}}{1 - \text{PTR}_{\text{old}}} \right)^{\text{ExtElast}} \]
Methodology: Behavioural response – labor (II)

<table>
<thead>
<tr>
<th>Type of individual</th>
<th>“Low” (B1)</th>
<th>“Medium” (B2)</th>
<th>“High” (B3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intensive margin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom 90% of employment income distribution</td>
<td>0.05</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>91&lt;sup&gt;st&lt;/sup&gt; to 99&lt;sup&gt;th&lt;/sup&gt; percentile or women with children aged &lt; 12</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>100&lt;sup&gt;th&lt;/sup&gt; percentile of the distribution</td>
<td>0.2</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Extensive margin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top 40% of the employment income distribution</td>
<td>0.05</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>41&lt;sup&gt;st&lt;/sup&gt; to 60&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>21&lt;sup&gt;st&lt;/sup&gt; to 40&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>0.15</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; to 20&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>0.2</td>
<td>0.4</td>
<td>0.8</td>
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Methodology : Behavioural response – labor (III)

- Degree of behavioural response affects revenues from tax reforms:

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<tr>
<td>Total</td>
<td>19,950</td>
<td>18,850</td>
<td>17,760</td>
<td>15,620</td>
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</tbody>
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Summary and Conclusion

- Mextax is a simple tax-microsimulator that can be used to calculate revenue and distributional impact of reforms
  - Includes simple stylised behavioural response

- Thinking about methodological issues in tax analysis is very important
  - How to determine measure of living standards
  - How to account for the uncertainty driven by poor quality data
  - How to account for the uncertainty around behavioral response

- Importance of improving the micro-data
  - Improvements to ENIGH and access to administrative data

- Importance of further research on the effects of taxes on labor supply and on informal sector