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Oferta Laboral en México: un enfoque de variables instrumentales

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1. Introduction

The purpose of this paper is to estimate the labour supply in Mexico during the period 1988-2002, using micro information in a macro context. This objective will be pursued by analysing the factors relating to the decision of how many hours to work crosswise households, which is made by the head of household. This paper also examines whether or not macro factors, such as public spending on education made at the state level, might influence this decision across states. Firstly, the relevant demographic characteristics of heads of households, as well as assorted state decisions about education spending, are examined in order to estimate a labour supply and map the different responses from households across states.

It is useful to estimate the wage elasticity in order to account for the factors that make people work more hours and observe whether there is a preference for work or leisure and how spending on education, and the resulting wage effects, makes people modify their choices. There are several factors that influence the endogenous relationship between hours of work and wages; that is, the decision to work is affected by regional differences, limited number of vacancies across states, lack of unemployment benefits and reduced benefits received from government.

The Mexican case is interesting not only because of the differences in wage, education and development across states but also because of the tendency to work more hours per week than several developed countries on a regular annual base. For example, during the period of time considered and based only on working people aged 20-55 years old, one observes that men work on average 48[1] hours while women work about 38 hours per week. Alesina and Glaeser (2005) compare the hours worked by those employed and at working age in Europe and United States. They note that the US has the highest value for working hours, which is 39[2], while the lowest is Italy with

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[1] According to INEGI, from 1995-2004 and for every second quarter per year, the total occupied population worked on average 42 hours, while men worked 45 and women 37 hours per week.

[2] Hamermesh and Slemrod (2005) explained that the increasing hours worked of high-income people in US was the result of "workaholism", defined as an addiction to work,

37. For Germany the value is 36; France is 36; and, in the UK is 38 hours per week per person. Therefore, European men tend to work fewer hours than Mexican women. In the Mexican case, single women work more, 42 hours and represent, in the sample, about 5% from female working population. Moreover, single men are 4.4% in male's sample, and work nearly 47 hours, which is the lowest number of hours worked reported for any male group. Married men represent 64% of the sample population and work on average 48 hours, while married women stand for 23% and work on average 37 hours per week.

Recent papers have studied the decline of hours worked in Europe. Prescott (2004) noted that the difference in hours worked between the US and Europe can be explained by their different tax systems. Alesina and Glaeser (2005) have argued that this difference might be the result of an increase in people's utility resulting from leisure and that the social multiplier reinforced the decline. The notion of the social multiplier is based on the idea that Europeans have a predilection for leisure as the returns of leisure increase, as more people take longer vacations, Blanchard (2004).

The approach for estimating the labour supply is to account for wage endogeneity arising from the unobservable characteristics affecting both wage and hours worked or from measurement error. That is, a highly able individual might obtain a high wage and might choose to work long hours. Besides, hours worked and wages may be jointly determined or part of a package, therefore it is important to control the endogeneity of wages. Instrumental variable techniques will be applied using as instrument each state's per capita public spending on education. Furthermore, each state's procedure for deciding how much to spend on education is relevant for identification purposes, given the differences across and through time. Human Capital theory will be applied to argue that spending on education is an investment that will command future returns only at a cost, which are related to differences among states endowments, financial resources received from the federal government, educational attainment, development levels, population and regional situation.

The contribution of the paper is the method of dealing with the endogeneity of wages, since it is proposed to use public spending on basic education at the state level as an instrument to disentangle this issue. Therefore, the assumption that there is a correlation between wages and the per capita spending on education will enable the correct treatment of this endogeneity. Other empirical studies have tried to correct this endogeneity using different econometric techniques that might still have bias for omitted variables. In

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developed some time after the worker has entered the labour force and discovered that disutility from additional work lessens.

this paper the use of Instrumental Variable techniques helps to reduce measurement errors, bias for omitted variables and is fundamental to the identification process.

The structure of the paper is as follows. Section 2 is the Literature Review; Section 3 describes the Survey Data and the Expenditure Data that are the main sources of data in this paper. Section 4 provides a theoretical background and summary of the instrument, public spending on education, and its allocation across states over time. In Section 5, the Identification Strategy is explained; Section 6 provides the main results. In section 7, the main results are broken into categories to explain the heterogeneity implicit in the main results by regions, education level and age group. This is followed by the conclusion.

2. Issue and review of the literature

The basic model of a trade-off between consumption and leisure, which is the time not spent at work, gives the principal properties of the supply of labour that is a combination of a substitution and income effect, according to Cahuc and Zylberberg (2004). This combination leads to a non-monotonic relationship between wages and labour supply. For example, with a wage increase, the substitution effect implies a decrease in leisure. If leisure is a normal good, by the indirect income effect, the demand for leisure diminishes; therefore these two effects would increase labour supply. By the direct income effect, however, leisure is increased and a fall in labour supply occurs. The overall effect is ambiguous as the two direct effects operate in opposite directions.

Labour supply is generally estimated from cross-sectional data on a large population using a basic equation relating hours worked and hourly wage for a given individual at any determined time. In order to avoid the imposition of a monotonic function of the hours worked on wages, it is possible to introduce a polynomial form in the estimation. The objective is to estimate the wage elasticity, which can be interpreted in several ways depending on the hypothesis made and the model used. From theoretical models individual labour supply is a function of the hourly wage and other elements such as the expected wealth of agents. For example, his anticipated income from savings or work, non-wage income, or, as Gong and van Soest (2002) suggest, the partner's wage.

Blundell and MaCurdy (1999) pointed out that marshallian wage elasticity in the static model requires instrumental variable techniques to account for the endogeneity of wages, arising from unobservable characteristics affecting both wages and hours worked or from measurement error. Besides, they

indicated that if consumers can adjust their behaviour to account for factors in future periods, this coefficient offers no economic interpretation, as static regressions confuse shifts of wage profiles with movements along wage profiles. Cahuc and Zylberberg (2004) suggested a method of approaching the budget constraint by a derivable function, since the explanatory variables might not be independent of hours worked, then it is necessary to use instrumental variables. This strategy is useful when from the available data is not possible to obtain the net hourly wage, therefore having a potential source of measurement problems.

Cahuc and Zylberberg (2004) present several wage elasticities obtained from different studies where they mention that there is a consensus about the elasticity of labour supply of married women that is positive and larger than that of their husbands. Therefore, as wage elasticity is positive, the substitution effect dominates the income effect. Contrary to women, for married men wage elasticity is weaker and income effect is more significant. Consequently, within the household, married women would be more affected by fiscal reforms or other exogenous change since they have access to lower wages and have a comparative advantage for household production. Besides, the income elasticity, which measures the impact of a change in income on labour supply, is negative, meaning that leisure is a normal good.

There are many studies with different sets of conditions or control variables used in the estimation of labour supply. On the one hand, some estimate family labour supply with household production or intrafamilial decisions, such as Apps and Rees (2001) who model the cost of children in an individualistic formulation of the household and a formal treatment of household production. On the other hand, others estimate labour supply responses to tax reforms. This includes, for instance, Blundell, Duncan and Meghir (1998), who combined a structural approach with instrumental variables by exploiting the variability induced by the tax reforms. Furthermore, van Soest (1995) estimated a discrete labour supply for both spouses in the household by considering family composition, where he obtained compensated and uncompensated wage elasticities for Dutch families.

Labour supply has been estimated largely in the past decades. There are many studies related to the estimation of the labour supply and the international literature is vast. While for the Mexican case, however, there are some studies considering households. The literature related to the Mexican case focuses primarily on participation in the labour force. Gomez and Madrigal (2005) present a summary of the evolution of women's Labour Force Participation (LFP) and note that this participation declines during women's peak reproductive years; a factor that is influenced by external factors like marriage, education and fertility. They observe a decrease and

then an increase in the LFP during the period 1890-1980, which is the result of income effects reinforced by the decrease in the relative price of goods produced at home, as well as a decrease in the demand for labour in agriculture and manufacturing. Thus, they describe a U-shape to women's LFP, while for men this shape seems unaffected by external factors.

There are some other papers related to taxation and its effect on labour supply, including one by Melendez (1996) in which he found that income tax rates have no significant impact on hours worked, this study applied to Monterrey and its surrounding area. Another study, Valero and Tijerina (2006) examined how salaried workers in the formal sectors respond to changes in their marginal income, controlling for tax evasion, which in Mexico tends to be high. They found negative elasticities, from –0.10 to –0.283, and marginal tax rates in the range of 0.17 to 0.35. Additionally, for men, they found income elasticities lower than married women and single men.

There are only a few studies for Mexico that considers heterogeneous responses from different demographic groups across states and over time.There is one study by Gong and van Soest (2002) that considers the family structure. They estimate a structural model for female Labour Supply in Mexico City using the same survey as in this paper but considering only a quarter of the year 1992. They account for random preferences, its correlation of wage equations errors and fixed costs of working. They mention that family structure is a determinant of labour supply because the presence of other females in the household offers a potential substitute for childcare services. Therefore, they simultaneously analyse the impact of wages, other income, and family structure on labour force participation and hours worked, as these types of families influence people's behaviour. They used Maximum Likelihood estimation and obtain wage elasticity of about 0.87 and income elasticity of –0.17.

3. Data description

In this section the two main sources of data are explained: at the micro level the household survey and, at the macro level, each state's public spending on education. This last data was obtained from the states' public accounts for the period 1988-2002. These two sources will be matched by state and year to obtain a complete database.

3.1. Survey data

One of the data sources is Mexico's National Urban Employment Survey (ENEU is the acronym in Spanish), which provides household information for the period 1988-2002 and was conducted by the National Institute for Statistics, Geography and Information (INEGI). The ENEU is presented quarterly. There are 32 states in Mexico; however, from 1988-1995 only 80% of states were surveyed and only after 1996 were all states included. This survey is the source from which the official open unemployment rates are estimated and it gives information about the demographic characteristics of households. The questionnaire is designed for people aged 12 years and more. The survey provides information regarding the composition of households, member's income and relationship with the head of the family as well as information about economic activities, educational attainment, employment status and labour income. It does not report other sources of income. This survey has been used extensively for estimations related to labour market studies, such as Gong and van Soest (2002), among others.

The objective sample considers only the head of the household and his/her partner, and selects those who are aged 20-55 years old, regardless of their marital status. In Mexico it is common to find more than one family living in the same house. The sample considered only nuclear families because of the difficulty of matching every member with their corresponding family in the household - husband, wife and children-, as the relationship is determined with respect to the head of the family. Therefore, these observations were removed as well as non-responses and missing values. As a result, the objective sample is 2,537,423[3] observations for all the states in the period considered. From this total the 68.5% represents male and the remaining 31.5% are females. The average age for males is 36.57 and for females is 36.48 years old.

This paper does not consider the decision to participate in the labour market but observes the behaviour of those who are actually working so this is the objective sample. As Heckman (1993) has pointed out, the approach of concentrating only on workers has been criticised because the sample is no longer random and so has selectivity bias. This may be one weakness of the paper, especially for women since the participation in the labour force has been steadily increasing. Although, from the results obtained, the magnitude of the bias could be small.

Table 1 provides information for the period 1988-2002 regarding relevant characteristics of the head of the family, such as real hourly wage, schooling

[3] The objective sample represents 40.4% of the total sample including the four quarters per year throughout 1988-2002

years, and hours of work and percentage of the sub sample with at least one child. The sample is divided into four sub samples for single, married, married with partner reporting wage, and married with partner not reporting wage. This division is for descriptive purposes and more demographic characteristics will be considered in the econometric analysis. It will be focus only on singles and married or cohabitant, and leaves aside divorced, separated or widowed samples. As Table 1 shows, 72% are married females, either with or without children. This percentage is with respect to the females' total. For males 93.74% are married with respect to its correspondent total. From the total of married females, 93.1% have a husband or partner who is working and reporting a wage whereas for males, this figure is only 36.2%. On the other hand, only 6.9% are married females who provide the only source of income for the household, since the husband or partner is not reporting a wage either for refusal to answer or because he is not working. In the cases of males with a wife or partner who is not reporting wage is noticeably larger, 63.8%.

In general, married females obtain a lower hourly wage than males, different than in the case of singles. The schooling years are greater for single females than for single males and are slightly larger for the total of married males but distinguishing by the status of the partner, men have higher schooling levels than females. Note that the proportion of females that have at least one child is lower for females, and work fewer hours than males. This reflects the fact that having children is a determinant of the choice of what hours to work, especially for females. It is more common that females devote more time to look after their children compared with males. Besides, the number of children for single males is not available from the survey as this question is asked only to women. Only in the case of married[4] men it was possible to obtain this variable with the information of the female partner in the household.

Now considering the sub samples, married males with wife reporting wage and single females obtain the highest hourly wage (in 2002 prices) compared to their correspondent sub samples. On average, males get $27 Mexican pesos per hour and this is slightly higher than females, who receive $25.7. This is a small difference as the gender wage gap, according to Artecona and Cunningham (2002), has increased after the trade liberalization for those in the manufacturing sector but has reduced for those in firms that became competitive following the North American Free Trade Agreement (NAFTA). Although, note that single females obtain, on average, a higher wage than single males. Table 2 shows more information about single female and male sub samples.

[4] or cohabitant

Compare all the sub samples for females, the difference between the highest and lowest wage is large across females, around $4.05, while for males it is $2.4. Therefore, from the descriptive data, we see a large variation in wages across females depending on their marital status and status of their husband.

The estimation of schooling years was made by matching the compulsory years of educational attainment with the level of education reported by the surveyed people. Therefore, its estimation is not completely unbiased, however, the quantities presented in this table are somewhat similar to the average reported in the President's Report 2005. Single females have more schooling years than single males, whilst married females have similar schooling. This is consistent with Artecona and Cunningham (2002), who detected that females are weakly more educated than males.

Regarding the hours worked per week, males work more hours than females. This is understandable, as women, especially those who are married, devote more of their time to household production. Single females and males work more hours than any other female sub sample. In contrast, married males work more hours than singles, more than 48 hours per week, especially those whose wives do not work. Single males work fewer hours looking at the male sub sample but more hours than any other female sub sample.

It is interesting to examine singles in more detail, as Table 1 shows that single childless females obtain a higher wage than males. Though the survey enquires into the objective sample's main cities in each state, this difference in wages might be the result of a selectivity bias in favour of skilled workers. For this reason, it was separated the single sub samples by skilled and unskilled workers, Table 2. The skilled workers are professionals, technicians, teachers, and directors in private and public sector. Those agriculture workers, craftsman, drivers, administrative assistants, in-store employees, travelling sales people, domestic and security workers are considered unskilled. It is evident that both unskilled and skilled females obtain lower wages than males, although the difference is greater when comparing skilled workers. A larger proportion of males is unskilled, around 70% of the total single male sample, while only 54% of females are unskilled workers.

The data for schooling years show that unskilled females are slightly more educated than unskilled males, but for skilled this does not hold. Regarding hours of work, in general, females work fewer hours than males, and unskilled works more hours than skilled workers. The composition of workers by skills is responsible for the high mean in real hourly wages in the single sub samples, since for females, the proportion of skilled and unskilled workers is even and, for males, unskilled workers represent the largest proportion.

3.2. Expenditure data

The information about public spending on education was obtained from the Mexican System of the National Accounts for state governments. The set of series was obtained by compilation of several documents and a measure obtained for the relevant variables. The INEGI carried on this target. In this series the reported data on government production, as the document declares, is equivalent to state government consumption, intermediary consumption, gross value added, remuneration to labour force, and the gross operation excess. These categories are sorted by expenditure purpose. In this case, it is possible to find classifications for health, education, public defence and others, using the same criteria for all the 32 states from 1988 to 2002. Specifically, the expenditures on education services, either basic or higher education, are known. Besides, it is presented for every category of expenditure: the average remuneration of the workers in this category, teachers, and the number of people employed per state.

It was a change in the law concerning the compulsory education level, in 1992, the new arrangement of basic education included primary and junior school levels; the objective was to increase the schooling years from 6 to 9 years of education. In the high level type are included: high school, college, graduate, and postgraduate levels. Another important reform was the decentralisation in the education system; the objective was to give responsibilities to the states of providing basic public education services, as well as administration and operational management in order to improve school quality by fulfilling directly local needs, although Mexico City was not concerned in this reform until 2005. The information about expenditures, presented in the document produced by INEGI, has incorporated these reforms and levels of education to have comparable measures from 1988 to 2002.

From this data, the state that spends more on basic education is Baja California Sur but it has one of the lowest proportions of the population aged 6 to 14 years. Another state in a similar situation is Nuevo Leon that spends the fourth largest amount on education; however, only 19.1% of population are aged 6-14. On the contrary, Mexico City, which has the lowest proportion of this population and spends the lowest amount on basic education -in part because its spending is centralised and made by the federal government. Another state with a high concentration of the industrial activity is Estado de Mexico although it spends very little on basic education.

The transfers received from the Federal Government to the states, which are allocated specifically for basic education, Basic Education Fund, (FAEB is the Spanish acronym), are already included in the reported expenditure by states; nevertheless this fund was created after 1998. The states that receive

more transfers as a proportion of their population are Mexico City, Baja California Sur, Campeche and Nayarit. Futhermore, states that receive less transfer from the Federation, such as: Estado de Mexico, Jalisco, Guanajuato, and Puebla, spend the lowest amounts on basic education, while others like Nuevo Leon spends a higher amount.

4. An instrumental variables approach

This section briefly explains the theory that supports the relationship between public spending on education and wages. The objective is to motivate the proposal of using it at the state level as an instrument. Besides, it describes how spending on education is distributed across states from federal government and provides a short description of the evolution of this spending through time across states.

4.1. Theoretical background

The theory of investment in human capital proposed by Becker (1964) can be used to explain why state governments want to finance education and its relationship with wage. Moreover, the theory of human capital set up the hypothesis that education is an investment producing higher remuneration in the future by providing educated workers with skills and knowledge that enable them to increase their productive capacity and thus receive higher earnings. However, future productivity can be increased only at a cost, in the sense, that those resources could have been used in producing current output instead of investing to raise future output.

Under the assumption of perfectly competitive markets, and in the absence of training, in equilibrium firms will pay wages equal to worker's marginal productivity. Tough if on-the-job training is added up, it is possible to have an association between future receipts and expenditures. This is, training might reduce current payments and increase current expenditures, thus expenditures do not need to be equal to receipts every period. The equilibrium condition states that the present value of the marginal product flow has to be equal to the present value of the wage flow. In the case that training is given in the first period only, the condition becomes:

$$\mathbf{MP_0 + G = W_0 + C} \qquad (1)$$

Where **G** is the excess of future receipts over future outlays and represents a measure of the return to the firm from providing training, while **C** represents the sum of the opportunity costs and outlays on training, MP_0 is the marginal productivity and W_0 is wage, both at the initial time. Therefore, from

equation 1, marginal product is equal to wages only if return equals costs, **G=C**. Besides, if return were lower than cost, marginal product would be larger than wage.

To apply this theory, one may think that government acts as the firm and provides training to its residents; therefore education can be seen as an investment that will make the labour force more productive and able to command higher wages in the future. Psacharopoulos and Woodhall (1985) suggested a criterion that should be taken in to account in the economic evaluation of educational investment projects. The benefits or future receipts for the government are benefits measured by increases in productivity of educated workers, potentially higher tax revenues[5], other indirect economic returns: positive externalities affecting other members of the society, among other benefits. On the cost side, the decision of every state to allocate spending on education reflect their opportunity cost of investing on education with respect to other budgetary issues such as health, industry, and infrastructure, and opportunity cost of student's time, measured as earnings forgone; as well as monetary costs for providing educational services, teacher's salaries, books, school maintenance, etc.

In general, the relationship between spending on education and wages may reflect the two dimensions of the educational investment, benefits and costs. Therefore, to reach the equilibrium: a positive relationship between spending on education and wages reflects positive net benefits of investing. While a negative relationship indicates that the net benefits of investing on education are negative, then costs of providing education are not compensated by the returns generated in the period considered. This situation reveals different costs of providing educational services, diverse opportunity costs across states, or large differences within states that in order to catch up, costs would increase even more than benefits.

4.2. How is public spending on education assigned?

During the analysed period, 1988-2002, one of the principal objectives has being the support given to Education in order to enhance development. Scott (2001) estimated that education spending accounts 59% of the federal transfers.[6] According to Guichard (2005) total spending on primary and secondary education increased by 36%, between 1995 and 2001; and total spending per student rose by 25%. These numbers reflected the interest of government to finance education; therefore, it is crucial to identify the

[5] Barceinas and Raymond (2003) found that public investment in education is highly profitable though returns are recovered in the long run

[6] Net of social security taxes

allocation and trend of spending on education to investigate how state governments decide the amount to spend on education given their own sources and grants received from federal.

The method of assigning public spending in Mexico is complex to understand since not only equity but also discretionary criteria are essential to evaluate the redistribution of resources. It is convenient to mention certain reforms that have directly affected the way of allocate education resources to the states: the decentralisation of the education system in 1992, and the reform of the Law on Fiscal Coordination in 1998.

4.3. The distribution of spending on education across states

According to Joumard (2005), before the decentralisation of the educational system, the allocation of educational spending was made by the central government on a discretionary basis. The amount of resources received by the states reflected former costs of the federation incurred in delivering educational services, as well as existing endowments and cyclical conditions.

In 1992 Federal Government, local states and the national trade union of teachers signed the National Agreement of the Basic Education Modernization[7], which was the start of the decentralisation in the Education system. The objective was to enlarge the resources to local governments and therefore improve education quality, school infrastructure and to provide a better organization of the schools by local governments. Moreover, in order to remedy the centralisation problem and set the responsibilities, the cooperation and coordination of the levels of governments was essential to accomplish the goal of responding to the local school needs. Though, Joumard (2005) suggested that the allocation of expenditure to states was more a delegation of federally controlled budget than a significant grant of autonomy in the programme design.

Since 1998 it was established the use of a formula to allocate earmarked grants to improve transparency and equity across states. The main earmarked grants are targeted at basic education, health care, social infrastructure and actions to strengthen local public accounts. The federal transfer for basic education is distributed to every state through basic education grant[8], which depends on the number of registered schools and number of teachers. States also receive other earmarked grants related to education such as, education infrastructure and school breakfasts[9], and technological and adult

[7] Diario Oficial de la Federación, May 1992
[8] FAEB, Fondo de Aportaciones para la Educacion Basica
[9] FAM, Fondo de Aportaciones Multiples

education[10]. However, the use of the formula still raise equity considerations existent previous the decentralisation, since the education spending per student differs across states.

Therefore, states have earmarked grants from federation to be spent exclusively on education; besides the extra resources they can get from state income, taxes, and federal participations to finance education. State governments had criticized the increasing pressure of the education spending had caused on their budget, crowding out investment on infrastructure and any other matters. The proposal to solve these problems included additional federal resources for basic education expenditures on state schools and it was suggested that these resources be distributed using a formula that assigned more participations to the states that spent more on education.

Graph 1 shows the public state spending on basic education per capita by State in prices of 2002. The tendency of the spending on basic education (in logarithm) by state, including transfers, participations and other sources are shown, every state assigns an important share of the total social spending to this account, but given income state differences and other factors, every state spends different amounts.

It is evident an increase in basic education spending after 1993 related to the agreement for modernization in the educational system, which was translated into more resources going directly to the states. However, some states showed higher rises than others, for example, one of the most developed states Nuevo Leon (19) this increase was not substantial because it was already higher; the change was very low as well for Estado de Mexico (15), Baja California (2), and Mexico City (9). However, among the states that this spending increased about 4 points are Quintana Roo (23) and Oaxaca (20), this last state with one of the lowest levels of development. Moreover, it is noticeable that, with the exception of Mexico City, all the states converge to a similar level of spending per capita after the year 1993.

5. Identification strategy

The aim of this paper is to estimate a labour supply for females and males in Mexico. It uses a complete set of household samples and corresponds with official information on spending on education across states and over the period 1988-2002. This objective is carried on by capturing the relationship between public spending on education and wages across states and use the first one as an instrument to estimate the labour supply, given the endogeneity of wages.

[10] FAETA, Fondo de Aportaciones para la Educacion Tecnologica y de Adultos

The approach to reach this goal is to account for endogeneity of the wage, arising from unobservable characteristics affecting both wage and hours worked or from measurement error. That is, the individual jointly considers wages and hours worked to decide to accept the job; though in this paper the participation decision is not studied, only the situation when the individual is indeed a worker. Moreover, the endogeneity might arise from the fact that more productive or more able workers might obtain higher wages, but at the same time they would choose to work more hours, therefore the error term is no longer uncorrelated to wages, for this reason ordinary least squares estimation might not be appropriate. It is of interest to identify the wage effects using the public spending on education, and consequently, separate the unobservable information that affect both wage and hours worked to estimate a labour supply for each set of data. The identification strategy consists in using as an instrument the per capita public spending on education, which differs across states and over time. This expenditure is the amount spent on education made by every state per year. Therefore, this instrumental variable will be used to identify the wage effects and then estimate the labour supply.

More explicitly, the equations to be estimated are the following:

$$Ln(hours) = \gamma_0 + \gamma_1 X + \beta Ln(wage) + \phi geog + \tau time + \varepsilon \qquad (2)$$

$$Ln(wage) = \delta_0 + \delta_1 X + \alpha Ln(pse) + \lambda geog + \theta time + \nu \qquad (3)$$

Equation (2) represents the labour supply estimation, where ***hours*** represents weekly hours of work; ***X*** is a set of control variables that might be different according to the sub sample utilized. The ***wage*** variable is the hourly real wage in prices of 2002.[11] The variable ***pse*** represents the per capita public spending on education. To avoid multicollinearity problems, it was used an official geographical classification given by INEGI to group the states. **Geog** is a dummy variable that identifies the geographical region; otherwise, it would be included 32 dummy variables for every state. Besides, the time variable consists of 15 dummies for every year, leaving the year 1988 in the constant.

The endogeneity problem between hours of work and wages causes the error, ***ε.***, no longer independent of wages, thus the classical assumptions about the error are not satisfied; subsequently the estimation by OLS is biased and inconsistent. As it was stated before, the technique applied is instrumental variables (IV) or two stage least squares (TSLS). Using this procedure, it is possible to test if this instrument is valid. The equation (3) is the equation

[11] It was used the Consumer Price Index base 2002

that will be estimated in the first stage to obtain the predicted wages and incorporate it into the equation (2) to explain the variation in the hour of work, and to obtain the wage elasticity.

To have a valid instrument it is necessary that public spending on education have no direct influence on hours worked but a direct effect through wages. Bound, Jaeger, and Baker (1995) have questioned the relevance of the instrument, ***pse,*** to explain the variation in the endogenous variable, ***wage***, because a weakly correlation between the instrumental variable and the endogenous variable can lead to a large inconsistency in IV estimates, even with a weak or inexistent correlation between the instrument, ***pse,*** and error, ε. They suggest the use of partial r-square and the F-statistic from the first stage estimation or equation 3, as indicators of the quality of the IV estimates.

Stock and Yogo (2005) provided quantitative definitions of a weak instrument and how to detect it based on a maximum IV estimator bias. They have obtained particular critical values that allow comparing to the first-stage F-statistic; if the value of this test is less than the critical value proposed the instrument is weak, otherwise is strong. Besides, they compared those critical values with the rule proposed by Staiger and Stock (1997) to find a weak instrument. In this test is used the F-statistic to test the null hypothesis that the instrument coefficients are zero in the first stage. Then, if the F-statistic is less than 10, it is a weak instrument. In the case of one or two instruments, Stock and Yogo (2005) found out that the use of Staiger and Stock's rule of thumb is not unreasonable as the maximum TSLS bias is no more than 10% with 95% of confidence level.

Murray (2006) discusses classic strategies for avoiding invalid instruments. In addition to the use of Stock and Yogo's critical values, he proposed to use alternative instruments and compare IV estimates with the finality to enhance credibility, this can be done by comparing labour supply estimates using different methods and observe how do they differ. In the result sections, it will be done the suggested tests for the validity of the instrument and compared them to the estimates from other studies.

For identification strategy purposes, the whole sample was divided in seven samples each for females and males, that is, there are fourteen small databases for the estimations. This separation is convenient to account the effects that different variables have over particular groups, for example, number of children is an important explanatory variable to decide how many hours to work for those who are married but the effect over singles may not be relevant. Moreover, the partition of the sample may facilitate the estimation of the income effect in sub samples. This is because of the

unavailability of information about non-labour income, thus the reported wage from the partner's will play an important role in the calculation of the income effect.

6. Main results

Section 6.1.1 presents the core wage and income elasticities for every demographic group or sub sample: singles, married, married either with or without children, and, for these last two divisions by those households where the head of family's spouse reporting his/her or wage. Section 6.1.2 discusses the issues regarding the first stage estimation, and finally Section 6.2, shows wage estimates including partner's wage.

6.1.1. Wage elasticities

Tables 3 and 4 show the main wage elasticies for females and males respectively, obtained by using both OLS and IV techniques, and the corresponding partial r-squares and F-statistics for the validity of the instrument. The estimated equations include explanatory variables such as: age, age square and cube, a dummy variable indicating any of the principal medical services IMSS, ISSSTE, other or none, schooling years, a dummy for every year and for every geographical region. In this section, for the case of married reporting partner's wage, wage variable was not included in the regressions; therefore there are no income effects.

From Tables 3 and 4 standard errors in OLS estimation are predominantly lower than those obtained from IV, therefore all the coefficients are highly significant, for both female and male's cases for all the sub samples. Third column of Table 3 shows female OLS wage elasticities, which are negative and are in the range of -0.17 and –0.28. Across female's sub samples there are apparently no major differences among the cases where married people have children either with husband reporting or not reporting wage; and for females without children, as they have almost the same coefficients and standard errors. From Table 4, male OLS wage elasticities are, in absolute value, lower than or equal to women and are around –0.15 and –0.19. This result means that income effect dominates and it is stronger in the case of females, which is consistent with Cahuc and Zylberberg (2004). The labour supply of females is more elastic, meaning that females would reduce hours of work in larger magnitude than males in the event of an exogenous increase in wages. However, given the endogeneity in wages and hours of work, these coefficients are neither unbiased nor consistent.

The IV coefficients are shown in the fourth column and differ depending on gender, marital status, children in the family and partner status, although several coefficients are insignificant. Wage elasticity becomes positive for single and married childless females whose husband is not reporting wage, and significant only for singles, which means that substitution effect dominates. For the rest of the sub samples this wage elasticity is negative and considerably lower than the OLS estimates, the same is observed in the males' case, except that singles keep the negative sign. The same coefficient, -0.086, was obtained for singles and childless married males, then it seems that neither marital nor partner status represent factors to differentiate responses. In order to assess the reliability of these estimates, it is necessary to check the results from the first stage.

6.1.2. First stage

In the fifth column of Tables 3 and 4, partial r-squares and t-statistics of the instrument are presented. Partial r-squares, which are shown in the first row of the column, are very small for both female and male sub sample suggesting the presence of a weak instrument; therefore, as Bound et al. (1995) pointed out IV estimates may lead to large inconsistencies. However, this is not the only condition to define a weak instrument. Following Stock and Yogo (2005) it is possible to test the weakness of the instrument by looking at the F-statistics[12], which are shown in the second row of the fifth column, and compare to their critical value, 8.96[13], with a size of distortion of 15%. Besides, using the criterion of a maximum TSLS bias of 10% from Staiger and Stock (1997) rule that states that F-statistic has to be larger than 10 to have a strong instrument. From tables the t-statistics are above 10 rejecting the hypothesis of weak instruments by using any of the above decision rules, except only for three sub samples. This provides evidence that public spending on education is a strong instrument for all male sub samples, except childless married men whose wife is not reporting wage, and strong for most of females samples but weak for married either with and without children whose husbands do not report wage.

Moreover, the instrument has a negative relationship with wages for all the sub samples, one may expect it would be positive as higher spending on education generates a better education workforce, than may be able to command greater wager, and therefore the net benefits of investing on education are positive. However, the negative coefficient reveals that greater spending on basic education has brought negative net benefits during the

[12] t-statistic in the case of only one instrument and one endogenous variable

[13] Critical value for the weak instrument test based on TSLS size, r=0.15, for one instrument and one endogenous variable, significance level of 5%, pp. 59.

period 1988-2002, since the sum of benefits of spending on basic education have not compensated the sum of costs of providing education, opportunity and monetary costs. For example, in states where education is low in absolute terms, the process of catching up other states levels can increase the cost of education, and benefits can be obtained in longer periods of time.

It is convenient to test the importance of using the instrumental variables technique to deal with the endogeneity problem. Otherwise, applying ordinary least squares can provide consistent estimators. A way to do this is to perform the Hausman test, in this case an application of the Wald statistic for comparison between efficient and inefficient estimators. Under the null hypothesis that OLS and IV estimators are both consistent estimators, the results of this test are shown in the first row of the last column. It is possible to observe that, for most of the sub samples, this hypothesis is rejected, which means that the IV estimator is the consistent estimator and that the IV technique should be used. However, for mothers whose husband is not reporting wage, OLS estimator might be the appropriate technique.

According to Wooldridge (2001) another way to check if the endogenous variable is indeed endogenous is by using a regression test to determine whether the differences between OLS and 2SLS are statistically significant. Thus if the error terms in the equations (2) and (3) are correlated then wage is an endogenous variable. To prove this, it is proposed to run the equation (3), obtain the residuals and include the residuals in the equation (2), if the estimated coefficient of the residuals is statistically different from zero or rejecting the null hypothesis, then conclude that wage is indeed an endogenous variable. Results are shown in the second row of the last column. This coefficient was different from zero for almost all the sub samples[14], except for mothers whose husband is not reporting wage, which is consistent with the inference obtained from the Hausman test for this sub sample, that OLS should be used instead of IV.

In general, females wage elasticities are insignificant for most of the samples while in the male's case four sub samples have significant wage elasticities. These results might be modified with the inclusion of partner's wage because of the income effects that can affect spouse's behaviour.

[14] Comparing to the classical critical values, 1.96 for 95% and 1.645 for 90% of confidence level.

6.2. Income elasticities

This section will analyse the labour supply elasticity in the presence of other income in the household, given by the partner's wage. Income effect can be estimated by including the wage reported by the head of the family's partner in the estimation. This data is available only for married, since singles do not live with a partner, otherwise they were considered in the group of married or cohabitant. Thus wage and income elasticities are shown for these groups only. The corresponding test for differences of the coefficients including and excluding partner's wage confirm that those coefficients are statistically different for every case, female and male either with children or without children, though these results are not shown.

Table 5 presents wage and income elasticities including in the estimation of the partner's wage. Comparing OLS wage elasticities coefficients with the ones obtained in 6.1.1 they become smaller for both cases and keep the same signs. Looking at the IV estimators there are some differences as in Table 5 wage elasticity for married females, with or without children, becomes positive and in absolute value slightly larger in magnitude. In Table 3, for these sub samples, the income effect dominates, while with the inclusion of the husband's wage the substitution effect dominates. Besides, IV estimators are lower in absolute value than those obtained by OLS. In the male's case, IV wage elasticities become positive only for fathers but these elasticities are still lower in magnitude than females. For all these cases wage elasticities are still insignificant. Moreover, IV wage elasticities for mothers and fathers are alike; a different situation occurs to childless women and childless men where it is observed huge differences and the effect is stronger for women, this is consistent with van Soest (1995) where he mentioned the stylised fact that family composition affects the wife's labour supply more than the husband's. Besides, it is consistent to Blundell, Duncan and Meghir (1998) about women with children have the highest wage elasticities, as it is evident from table 5, females with children have the highest wage elasticities than childless.

Income elasticities are highly significant and negative for both men and female. Mothers' income elasticities seem to be stronger in absolute value than fathers', this can be related that to what Gong and van Soest (2002) found regarding cross-wage elasticities of the husband with respect to his wife tend to be small. Besides, they have a negative sign confirming that leisure is a normal good.

Regarding to the validity of the instrument, from the first stage estimation, t-statistics show that the instrument is not weak, since the maximum TSLS

bias is less than 10% in every case[15]. The public spending on basic education coefficients are also shown; the negative sign indicates that the costs of providing basic education are not yet compensated by the benefits of more education. Therefore, more spending on basic education would increase more the costs than benefits, in order to reach the equilibrium condition that the flow of marginal benefits equal the flow of marginal costs, wages would be reduced, and then depending on the effect that dominates, workers would decide to reduce or increase hours of work.

Comparing the wage coefficients for married, either with or without children, from Table 4, they did not show any apparent significant difference, however by including the partners' wage seems that men and women would react increasing the hours of work instead of reducing them, except for childless males, and more particularly that this decision would be stronger for those with children, especially females with children as they become more elastic.

7. Heterogeneous responses

The exercise in the previous section has shown that wage elasticities are highly sensitive depending on the sample or group considered. Therefore, different responses are observed depending on particular characteristics of the sub sample considered.

This section will explain the results obtained from estimating wage and income elasticities, while controlling for demographic characteristics, and, more importantly, comparing these elasticities by geographic regions, education level and age groups. Though the data available are repeated cross-section over time, the objective is to analyse the heterogeneous responses from a different set of samples: childless singles, childless married and married with children. In the models concerning married the income of the head of family's partner is included, therefore the results only show income elasticities for sub samples where females and males report their partner's wage. This coefficient will be interpreted as income elasticity and the corresponding results will be shown in the following sections.

[15] Based on t-statistic larger than 10

7.1. OLS results

This section summarises OLS wage elasticities, the corresponding tables are not shown since for every sub sample and group there are no remarkable differences especially by region and age group, although by education level the variation is somewhat larger, the coefficients are highly significant. Besides, these OLS coefficients are in the range of those obtained in Table 5. Wage elasticities are negative for both men and women indicating that the income effect dominates, that is, an exogenous increase in wages may lead to reduce hours of work. Male least square wage elasticities are similar to females but less strong. Because it could not be found differentiated responses, least squares wage elasticities are not capturing the different responses of the labour supply by sub samples and groups. That is, these estimates do not explain the diverse responses of hours worked when a change in wages occurs, since it is expected that a married women will react in a different way to single women or even differently from men. Cunningham (2001) quoted that labor supply behavior may be more subject to the constraints imposed by household roles rather than gender. Moreover, it would be expected differentiated responses from regions, education levels, and age groups. Therefore, least squares estimates are biased and inconsistent and need to be controlled for the wage endogeneity.

7.2. IV Estimates by region

Table 6 shows females IV wage elasticities coefficients, and Table 7 the corresponding coefficients for males. The number of observations and instrument coefficients in the first stage of the estimation are shown in Tables 8 and 9. Looking at the wage elasticities by region, the coefficients are large in magnitude compared to the main results, Table 3 and Table 5, where most of them were insignificant. From Table 8 and 9, it is evident a positive relationship between the public spending on basic education and wages, which suggests that the net benefits of investing on education are positive in the North Border and Pacific. Though, a negative relationship is found in North Centre, Centre and Gulf, thus the cost flow of spending on basic education has not been compensated by the flow of receipts or benefits of having a better educated labour force.

In the north centre region, female married groups with or without children have highly significant and larger positive elasticities than any other region. It is evident that the largest wage elasticity estimated is for mothers in the North Centre, 2.57, its positive sign reveals that the substitution effect dominates and that women would have preference for work given a rise in wage. Furthermore, given the increasing tendency of spending on education and its negative correlation with wages, women would reduce hours of work

in the North Centre more than any other region. The same effect is observed for childless married, which is nearly 1.

In North Border and Pacific, IV wage elasticities for mothers are alike and still high; more interesting, they are equivalent to the one obtained by Gong and van Soest (2002) for a similar sample in Mexico City, 0.87. Therefore given these results, one can argue a small selectivity bias from using a sample of workers only; such bias for women is more relevant since their increasing participation in the labour market, Heckman (1993). Besides, following Murray (2006) comparing estimates is another strategy to prove the validity of the instrument. Moreover, in the North Border and Pacific, the per capita spending on education has a positive relationship with wages, then more spending is positive related to higher wages: if wages increase in 10%, mothers in this region would increase hours worked in about 8.7%, given that the substitution effect dominates. Singles and childless married in North Border show smaller responses to change in wages, 1.4% and 2.2% respectively, evidently larger than wage elasticities presented in Table 5.

On the contrary, in Gulf the spending on education has a negative correlation with wages, since the substitution effect dominates, women would react working fewer hours. For example, with a reduction in wages of 10%, the reduction in hours worked would be about 6.7% for mothers and 5.3% for childless married women. Finally, in the Centre[16], wage elasticities are the lowest for all the sub samples compared to other regions, although they are all insignificant.

The wage elasticities coefficients for males are shown in Table 7. Overall, most of the male wage elasticities are lower in absolute value than females'; this is expected according to Cahuc and Zylberberg (2004). For example, with a rise of 10% in wages in the North Border, fathers would increase in about 4% hours worked while the increase in hours worked for mothers would be 9%; this reveals that women are relatively more elastic than men. However, men and women, in the North Border, have similar labour supply elasticities, their responses to changes in wages are around 1% for singles and 2% for childless married. In general, mothers and fathers have wage elasticities larger than childless and singles' in any region, since they have to bear child costs, which takes the form of parental time according to Apps and Rees (2001).

[16] It was carried out a Robustness check excluding Mexico City, wage elasticities became slightly larger and significant and kept the same sign.

Considering only the significant coefficients from Table 7, substitution effect dominates. The relationship between public spending on education and wages is in the same direction to the females' case: in the North Border and Pacific is positive and negative in the rest. In the North Centre, married men show clearly lower responses to wage changes than females, if there is an exogenous wage increase of 10%, they would increase hours worked in about 5%, contrasting to 9.8% and 25% of women's response. In the Gulf, fathers have the largest men response; they would increase labour supply in 6.15%.

7.3. IV Estimates by education level

This section examines wage elasticities by education level. No education means that individuals reported nil approved years of education[17]; basic education when reported that last degree completed was secondary or junior school; technical education when reported curriculum-focused instruction; and higher education when reported at least high school education.

From Tables 6 and 7, married women and men with basic and higher education have the only significant wage elasticities as well as singles women with higher education and single men with basic education. The coefficients are positive for those with higher education, although for mothers and men sub samples with basic education are negative. Moreover, public spending on education has a negative relationship with wages for those with basic and higher education, and a positive or negative relationship for the rest of the sub samples although in the cases where the instrument coefficients were positive, they resulted insignificant. It is evident that for married with technical studies and no education wage elasticities are extremely large, especially for childless males, though they are not significantly different from zero.

Women and men with children would react in different ways depending on the substitution or income effect that dominates and the level of education they hold. For those with basic education, the income effect dominates for singles, mothers and all men sub samples. Therefore, if government increases public spending on education, given its negative relationship with wages, it would make these groups to increase their hours of work. Assuming a reduction in wages of 10%, mothers would increase hours of work in 3.4%, while fathers in 1.23%; however single and childless married men would increase worked hours in 4% and 4.6% respectively, which are larger than mothers' response.

[17] Observations where people refuse to report their last degree completed were excluded.

On the contrary, wage elasticities are mostly positive for workers with higher education. Thus, substitution effect dominates for mothers, single women and fathers with higher education; they would react by working additional hours as wages rise. This is consistent with the findings in Gong and van Soest (2002) suggesting that highly educated individuals tend to have higher wages and work more hours and, therefore, prefer to work. Women with children and higher education are more elastic than single women and fathers with the same level of education. For instance, with a drop in wages of 10%, mothers and single women would reduce hours of work by 6% and 1.3% respectively, while fathers by 2.4%. Then, it is evident that the response of mothers and fathers with higher education is stronger or relatively more elastic than those with basic education. This result means that married women and men with high education would work much fewer hours than those with basic education when a reduction in wage occurs.

Comparing these estimates with the main results, it is evident that the lowest coefficient presented in this section, single females with higher education, has a larger coefficient than estimates in Tables 3-5.

7.4. IV Estimates by age

Tables 6 and 7 show the wage elasticities by three age groups, 20-30, 31-44 and 45-55 years old. The finality of this partition is to observe the hours worked responses to changes in wage; akin to previous estimations, wage endogeneity is identified by the public spending on basic education made at the state level that may affect differently these groups. From first stage estimations, Tables 8 and 9, the relationship between the instrument and wages is negative for any age group, which suggest that not even breaking the population by age it is possible to find positive net benefits of investing on basic education during 1988-2002.

Wage elasticity coefficient of single women in the first age group, 20-30 years old, is near to the one obtained for married childless, -0.04, from Table 3 where it was excluded the husband's wage, and alike with a different sign to the one obtained in Table 5 when this partner wage was included. Similar to the estimates mentioned, it was insignificantly different from zero. Singles and mothers aged 31-44 years old would have diverse responses, given that for singles income effect dominates while for married the substitution effect dominates, although coefficients are not statistically different from zero. It is interesting to point out that as married childless females get older, wage coefficients become relatively more elastic. In other words, given a reduction in wages, women would respond by working fewer hours as they get older, but once again these responses are not significant. Moreover, wage elasticity of single female aged 45-55 years old is significant and positive, indicating

that substitution effect is stronger. Given a reduction of 10% in wages, single women in this group would react working more hours by 2.3%, thus inelastic since the response is less than proportional. Childless married show larger responses of 7.8%, though it is insignificant.

Table 7 shows wage elasticities for men, which differ from females' case. It is observable mixed responses, for example, single men aged 20-30 years wage elasticity is the same as fathers' response of aged 31-44 years old though with different sign. Then, with an exogenous reduction in wages of 10%, singles would increase hours worked by 1.7% while fathers would reduce them by 1.7%. On the other hand, single men in the group 45-55 have marginally stronger and negative response to wage changes; they would increase hours worked by 2.1% and it is the largest wage elasticity estimated for men. Contrasting single men and women in the same age group, 45-55, women are relatively more elastic than men; nevertheless women would reduce their hours worked by 2.3%. Therefore, it is evident different responses to changes in wages by gender and age.

Moreover, the wage elasticity for fathers aged 20-30, is slightly larger but with a different sign than the one obtained in Table 5. Then, if there is a reduction of 10% in wages, fathers instead of reducing hours of work by 6.2% because of the substitution effect fathers aged 20-30 would increase hours of work by 7.3%, almost the same magnitude as was predicted in the main results.

Nevertheless, only some of the wage elasticities obtained by age groups are close in magnitude but different in sign to the ones estimated in the main results where partner's wage was excluded. Therefore, it seems that the inclusion of the partner's wage and age group partition in the estimation can help to differentiate responses from different sub samples and demographic characteristics.

7.5. Income elasticities from heterogeneous responses

To complement the analysis, it will be shortly described the income elasticities.[18] As it has been explained, they are available only for those married either with or without children who have partner reporting his/her wage. All income elasticities are negative so this indicates that leisure is a normal good and, at the same time, that if the partner's wage rises, the hours of work of the surveyed people would be reduced as a consequence of an income effect.

[18] The tables are available by request

Only for married with children income elasticities coefficients for males are lower than females, Gong and van Soest (2002) obtained a similar result for the Mexican case. Although for childless it is not always the case. Significant female income elasticities are around –0.04 and –0.37, while for males the range is around –0.006 and –0.4. For mothers living in the North Border and Pacific, income elasticities are close to the income elasticity, -0.17, obtained by Gong and van Soest (2002).

7.6. Summary IV estimates

Table 10 presents a summary of the income and substitution effect that dominate for every category or observable attribute: region, education level and age. The substitution effect dominates for most of the cases and generally for married, either females or males with children, especially, in the North Border where wage elasticity coefficients for all the sub samples were significant. Whilst the income effect dominates for males sub samples such as, singles, married either with and without children all holding basic education and singles by age structure; for females the income effect dominates only for mothers with basic education.

Conclusion

The results of the labour supply analysis in Mexico across states over the period 1988-2002 show that the instrument, the per capita spending on basic education, is suitable for controlling the endogeneity between wages and hours of work because wage effects can be identified by the differences in spending on education at the state level. It is observed a convergence of the per capita spending on education by states after 1993; this tendency contribute to reduce the disparities across states. Moreover, the results suggest that Instrumental Variables should be used given that least square estimations do not capture the different responses of the labour supply by sub samples and groups; that is, it is expected that a married woman will react in a different way than a single woman or even differently from men or women of different regions, education levels or age groups.

The results obtained from the first stage of the estimation reveal a negative relationship between the public spending on basic education and wages in most of the models, except in North Border and Pacific. Following the theory of human capital[19] spending on education is an investment that will generate future productivity only at a cost. Therefore, the results suggest that the present value of the receipts of investing on education are not yet

[19] Becker (1964)

compensated by the present value of the costs of providing basic education. This effect does not mean that investing on education is not a profitable investment but that a longer period of time should be considered, since 15 years analysed in this paper are not enough time to show positive net benefits. Barceinas and Paredes (2003) have found that basic education is highly profitable in Mexico from government's point of view; and that the initial investment can be recovered in about 22 years for primary education.

The inclusion of the partner's wage in the estimation can help to differentiate responses from different sub samples and demographic characteristics. The wage elasticities are sensitive to the group considered and to the status of the husband or wife in the household and whether or not they have children. In general, it is possible to observe that female wage elasticities are larger than males' in terms of absolute value. Moreover, females with children are more elastic than any other female group; for males this is true for some cases. The effect on wages is highly significant although the coefficients are small in the main results but when differentiated by region, the level of education and age become larger and stronger. Therefore, a public policy of increasing the spending on basic education had a positive or negative association with wages and different responses in the choice of hours worked can be observed, depending on whether or not there are children as well as other characteristics of the head of the family. For example, given the positive correlation between per capita state spending on education over wages in the North Border and Pacific, and given that the substitution effect dominates, women and married men, living in these regions, would choose to work more hours as wages rise. However, in the North Centre, as this correlation is negative with wages, the result would be reducing the hours worked, given lower wages.

On the contrary, income effect dominates for mothers and fathers with basic education. Lower wages would make them to increase their hours of work. However, lower wages for those with higher education imply the opposite as the substitution effect dominates, therefore mothers and fathers would react by working fewer hours, and this effect is stronger for females. Therefore, having higher education is more significant for females than it is for males, and makes married women more elastic than singles, especially mothers. This is consistent with the fact that the cost of time devoted to non-working time is high, particularly for females with higher education

Finally, the results of the IV estimates show that the substitution effect dominates in four of the five regions considered, which means that the corresponding sub samples of women and men have a preference for working after an increase in wages. This fact does not completely match to the definition of workaholism. Nonetheless, those with at least high school education show a preference working as the substitution effect dominates;

this is observable only for fathers, mothers, and single females. This may suggest because of workaholism, however, considering the low average wages, it is not possible to assure that this effect occurs. The predilection of working may reflect the fact that average hourly wages are still low, meaning that a reduction in wages would make people work more hours, income effect, in order to meet family expenses, especially people with basic education.

References

Alesina, A., Glaesser, E. and Sacerdote, B. (2005), "Work and Leisure in the United States and Europe: Why So Different?", Harvard Institute of Economic Research, Discussion paper 2068.

Angrist, J.D, and Krueger, A.B. (1991), "Does compulsory School Attendance Affect Schooling and Earnings?, Quarterly Journal of Economics, Vol. 106, pp. 979-1014.

Artecona, R. and Cunningham, W. (2002), ""Effects of Trade Liberalization on the Gender Gap in Mexico." Policy Research Report on Gender and Development, Working Paper 21. World Bank, Washington, D.C.

Apps, P. and Rees, R. (2001), "Household Production, Full Consumption and the Costs of Children", Labour Economics, 8, pp. 621-648.

Barceinas, F. and Raymond, J. (2003), "¿Es rentable para el sector publico subsidiary la educacion en Mexico?, Investigacion Economica, UNAM, No. 244.

Becker, G. (1964), "Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education", National Bureau of Economic Research, distributed by Columbia University Press.

Bound, J., Jaeger, D. and Baker, R. (1995),"Problems with Instrumental Variables Estimation When the Correlation Between the Instruments and the Endogenous Explanatory Variable is Weak", Journal of the American Statistical Association, Vol. 90, No. 430, pp. 443-450.

Blanchard, O. (2004), "The Economic Future of Europe," Journal of Economic Perspectives", Vol. 18, pp. 3-26.

Blundell, R., Duncan, A. and Meghir, C. (1998),"Estimating Labor Supply Responses Using Tax Reforms", Econometrica, Vol. 66, No.4, pp. 827-861.

Blundell, R. and MaCurdy, T., (1999) “"Labor Supply: A Review of Alternative Approaches," Handbook of Labor Economics, Volume 3. North-Holland Publishing Co, Amsterdam.

Cahuc, P. and Zylberberg, A (2004), “Labor Economics”, the MIT Press.
Consumer Price Index. Mexican Central Bank.

Cunningham, W. (2001), “Breadwinner or Caregiver? How Household Role Affects Labor Choices in Mexico”, World Bank Working Papers.

Gomez, A. and Madrigal, L. (2005) “The Evolution of Women’s Labor Force Participation in Mexico during the 20th Century: An Economic Perspective”, Documento de Trabajo CIDE, No. 334.

Gong, X. and van Soest, A. (2002),“Family Structure and Female Labor Supply in Mexico City”, The Journal of Human Resources, Vol 37, No.1, pp. 163-191.

Guichard, S. (2005), “The Education Challenge in Mexico: Delivering good quality Education to all”, Economics Department Working Papers, No. 447, OECD Publishing.

Hamermesh, D., and Slemrod, J. (2005) “The Economics of Workaholism: We Should Not Have Worked on This Paper”, NBER Working Paper No. 11566.

Heckman, J. (1993), “What Has Been Learned About Labour Supply in the Past Twenty Years?, The American Economic Review, Vol. 83, No. 2, pp. 116-121.

Joumard, I. (2005), “Getting the Most Out of Public Sector Decentralisation in Mexico” OECD Economics Department, Working Paper No. 453.

Meléndez-Barrón, J. (1996), "Elasticidad de la oferta de trabajo en el Area Metropolitana de Monterrey: el tratamiento de los problemas de sesgo por ´seleccción´en la regla de participación laboral y por ´endogeneidad´ del salario", Ensayos. Vol. XV, Núm. 1, Mayo. pp. 1-32.

Mexican System of the National Accounts for state governments, National Institute for Statistics, Geography and Information, INEGI.

Murray, M. (2006), “Avoiding Invalid Instruments and Coping with Weak Instruments”, Journal of Economic Perspectives, Vol. 20, Number 4, pp. 111-132.

National Agreement of the Basic Education Modernization (1992). Diario Oficial de la Federacion.

National Urban Employment Survey, 1988-2002, National Institute for Statistics, Geography and Information, INEGI.

Prescott, E.C. (2004), "Why Do Americans Work So Much More Than Europeans?", Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 28, No. 1, pp. 2-13.

Presidential Report (2005), Presidencia de la Republica Mexicana.

Psacharopoulos, G., and Woodhall, M. (1985), "Education for Development: An Analysis of Investment Choices", Oxford University Press for the World Bank.

Scott, J. (2001) "Who benefits from Social Spending in Mexico?", Programa de Presupuesto y Gasto Publico, Centro de Investigacion y Docencia Economica, CIDE.

Staiger and Yogo (1997), "Instrumental Variables Regression with Weak Instruments", Econometrica, Vol. 65, No. 3, 557-586.

Stock, J. and Yogo, M.,(2002) "Testing for Weak Instruments in Linear IV Regression", National Bureau Of Economic Research, NBER, Technical Working Paper 284.

Valero, J. and Tijerina, A. (2006), "Labor supply response to personal income taxation in Mexico", Economic Analysis Working Papers, Vol.6, Issue 11.

Van Soest, A. (1995), "Structural Models of Family Labor Supply: A Discrete Choice Approach", The Journal of Human Resources, Vol. 30, No.1, pp 63-88.

Wooldridge, J. (2001), "Introductory Econometrics: A Modern Approach", South-Western College Pub, Second Edition.

Table 1
Descriptive statistics of the household samples

FEMALES	**Total**	**Single**	**Married**	**Married with partner reporting wage**	**Married with partner not reporting wage**
Observations	**800,214**	**40,017**	**576,261**	**536,678**	**39,583**
real hourly wage (dollars)	$25.73	$28.4	$26.8	$27	$24.35
hours worked	38.1	42	37	36.9	38
schooling	9.5	11.4	9.85	9.92	8.8
% at least one child		-	91.25	90.6	94.5
MALES					
Observations	**1'737, 209**	**76,327**	**1'628, 547**	**589,834**	**1'038, 713**
real hourly wage	$27	$26.8	$27.08	$28.6	$26.2
hours worked	48.0	46.8	48.08	47.19	48.58
schooling	9.3	10.2	9.32	10.2	8.83
% at least one child		-	91.9	88.2	94.1

Source: Own calculations from ENEU-INEGI 1988-2002.

Table 2
Skilled and unskilled single childless workers

	Observations	Real hourly wage	Total hours of work	Schooling years
Single females				
Unskilled	21,505	18.6	44	9.5
Skilled	18,512	39.7	39.7	13.8
Single males				
Unskilled	53,821	19.1	48.2	8.8
Skilled	22,506	45.2	43.4	14.1

Source: Own calculations from ENEU 1988-2002, INEGI.

Table 3
Female main results

Sub samples	Observations	OLS	IV	Partial R-square (x100) t-statistic	Hausman Wooldrigde tests
Singles without kids	40,009	-.17*** (.0024)	.072** (.036)	0.56 -15.07	45.39 -7.52
Married without kids	50,368	-.21*** (.0025)	-.024 (.043)	0.37 -13.74	18.77 -4.51
Married without kids & husband reporting	48,203	-0.21*** (0.0025)	-.04 (.043)	0.38 -13.53	15.68 -4.06
Married without kids & husband not reporting	2,165	-.22*** (.013)	0.44 (0.40)	0.24 -2.25	2.72 -2.5
Married with kids	525,814	-.28*** (.001)	-.034 (.049)	0.05 -16.69	25.43 -5.36
Married with kids & husband reporting	488,400	-.28*** (.0010)	-.023 (.050)	0.04 -15.29	26.43 -5.44
Married with kids & husband not reporting	37,414	-.28*** (.0037)	-.039 (.245)	0.03 -3.07	0.9678 -1.06

Standard errors in parenthesis
* Significant at 90% level of confidence
** Significant at 95% level of confidence
*** Significant at 99% level of confidence

Table 4
Male main results

Sub samples	Observations	OLS	IV	Partial R-square (x100) t-statistic	Hausman Wooldrigde tests
Singles without kids	76,317	-.17*** (.0017)	-.086** (.043)	0.16 -11.18	3.82 -2.06
Married without kids	93,855	-.15*** (.0014)	-.058* (.033)	0.19 -13.52	7.79 -2.84
Married without kids & wife reporting	52,426	-.15*** (.002)	-.086** (.038)	0.27 -11.95	2.84 -1.78
Married without kids & wife not reporting	41,429	-.15*** (.0022)	.021 (.0804)	0.08 -5.85	4.53 -2.29
Married with kids	1’534, 472	-.17*** (.00036)	-.053** (.024)	0.02 -19.35	23.77 -5.0
Married with kids & wife reporting	537,332	-.19*** (.00064)	-.033 (.031)	0.05 -16.14	25.66 -5.31
Married with kids & wife not reporting	997,140	-.16*** (.0004)	-.051 (.036)	0.02 -12.48	9.168 -3.04

Standard errors in parenthesis
* Significant at 90% level of confidence
** Significant at 95% level of confidence
*** Significant at 99% level of confidence

Table 5
Female wage and income elasticities

Sub samples	**Observations**	**OLS Wage elasticity**	**IV Wage elasticity**	**Income elasticity**	**1. Partial R-square (x100) 2. Instrument coefficient 3. t-statistic**
Females					
Married without kids & husband reporting	48,203	-0.18*** (.0026)	.043 (.051)	-.074*** (.0069)	0.30 -.037*** -12.08
Married with kids & husband reporting	488,400	-.23*** (.0010)	.072 (.055)	-.108*** (.0059)	0.04 -.015*** -14.36
Males					
Married without kids & wife reporting	52,426	-.12*** (.0020)	-.005 (.048)	-.076*** (.0093)	0.19 -.032*** -10.05
Married with kids & wife reporting	537,332	-.16*** (.00066)	.062 (.039)	-.08*** (.0058)	0.04 -.014*** -13.86

Standard errors in parenthesis
* Significant at 90% level of confidence
** Significant at 95% level of confidence
*** Significant at 99% level of confidence

Tabla 6
TSLS Female Heterogeneity Responses: wage elasticity

FEMALES IV	**Single without children**	**Married without children**	**Married with children**
By region			
North Border	0.14** (.063)	.22** (.096)	.87*** (.210)
North Centre	0.80 (0.51)	.98** (.50)	2.57** (.916)
Centre	.024 (.030)	-.026 (.044)	-.031 (.050)
Pacific	-.021 (.21)	.018 (.55)	.86** (.361)
Gulf	.97 (0.81)	.53** (.24)	.67*** (.115)
By Education level			
No education	-1.49 (1.63)	1.85 (3.41)	-.57 (.815)
Basic	-0.35 (.23)	.70 (1.02)	-.34*** (.073)
Higher	0.13*** (.039)	.079 (.0648)	.59*** (.133)
Technical	-0.0035 (.081)	-.146 (.109)	.44 (.835)
By age			
20-30 years old	-.043 (.066)	-.078 (.048)	-.033 (.075)
31-44 years old	-.0045 (.041)	.23 (.147)	.11 (.080)
45-55 years old	.23** (.084)	.78 (.718)	.035 (.162)

* Significant at 90% confidence level
** Significant at 95% confidence level
*** Significant at 99% confidence level
\+ Includes sub samples where the partner's wage is reported

Tabla 7
TSLS Male Heterogeneity responses: wage elasticity

MALES IV	**Single without children**	**Married without children**	**Married with children**
By region			
North Border	.113*** (.037)	.23** (.082)	.37*** (.056)
North Centre	.061 (.091)	.51*** (.16)	.54*** (.087)
Centre	-.037 (.037)	-.022 (.048)	.029 (.037)
Pacific	.132 (.149)	.604 (.42)	.202*** (.064)
Gulf	.41* (.235)	1.22 (1.56)	.615*** (.125)
By Education level			
No education	-.78 (.84)	-1.36 (1.506)	-.074 (7.05)
Basic	-.40* (.215)	-.46** (.215)	-.123** (.049)
Higher	-.021 (.039)	.035 (.053)	.24*** (.064)
Technical	-.17 (.250)	-54.06 (3472.3)	-1.02 (6.13)
By age			
20-30 years old	-.17* (.102)	-.098 (.067)	-.073 (.098)
31-44 years old	-.003 (.057)	.015 (.078)	.17** (.055)
45-55 years old	-.21** (.099)	.213 (.136)	-.077 (.075)

* Significant at 90% confidence level
** Significant at 95% confidence level
*** Significant at 99% confidence level
\+ Includes sub samples where the partner's wage is reported

Tabla 8
IV Female responses-first stage

FEMALES	**Single without children**	**Married without children**	**Married with children**
By region			
North Border	11,733 0.16***	15,625 0.102***	149,835 .036***
North Centre	6,907 -.043**	7,940 -.050**	89,194 -.018***
Centre	6,071 -.074***	7,331 -.046***	73,392 -.018***
Pacific	8,080 .058**	8,910 .025	101,358 .0226***
Gulf	7,218 -.046	8,397 -.10***	74,621 -.087***
By Education level			
No education	353 -.035	410 .031	12,150 -.0088
Basic	10,122 -.017**	11,828 -.0074	192,600 -.02***
Higher	18,384 -.08***	22,859 -.041***	148,438 -.015***
Technical	11,158 -.041***	13,117 -.027***	135,276 -.002
By age			
20-30 years old	19,993 -.043***	33,396 -.046***	128,786 -.022***
31-44 years old	14,214 -.076***	12,527 -.027***	288,509 -.014***
45-55 years old	5,802 -.073***	2,280 -.022*	71,105 -.013***

* Significant at 90% confidence level
** Significant at 95% confidence level
*** Significant at 99% confidence level
\+ Includes sub samples where the partner's wage is reported

Tabla 9
IV Male responses-first stage

MALES	**Single without children**	**Married without children**	**Married with children**
By region			
North Border	26,356 .17***	16,990 .108***	157,563 .071***
North Centre	9,751 -.10***	8,584 -.097***	97,670 -.054***
Centre	11,512 -.041***	7,438 -.035***	78,374 -.016***
Pacific	14,084 .077***	9,998 .045**	115,780 .057***
Gulf	14,614 -.071**	9,416 -.023	87,945 -.060***
By Education level			
No education	1,642 .024	453 -.046	11,457 -.0006
Basic	34,854 -.0094**	17,843 -.015**	255,695 -.015***
Higher	32,701 -.055***	28,567 -.038***	219,380 -.016***
Technical	7,130 -.016*	5,575 .00016	50,864 .00057
By age			
20-30 years old	40,793 -.018***	32,728 -.029***	125,586 -.0107***
31-44 years old	26,973 -.040***	16,928 -.033***	303,455 -.015***
45-55 years old	8,551 -.041***	2,770 -.059***	108,291 -.0158***

* Significant at 90% confidence level
** Significant at 95% confidence level
*** Significant at 99% confidence level
\+ Includes sub samples where the partner's wage is reported

Table 10
Heterogeneous responses summary

		Income effect		**Substitution effect**	
		Women	Men	Women	Men
By Region	North Border			A	A
	North Centre			MW, MC	MW, MC
	Centre				
	Pacific			MC	MC
	Gulf			MW, MC	S, MC
By Education level	None				
	Basic	MC	A		
	Technical				
	Higher			S, MC	MC
By age structure	20-30		S		
	31-44				MC
	45-55		S	S	

A-All sub samples; S-Singles
MW-Married without children; MC- Married with children

Graph 1
Public state spending on basic education per capita by state
(base 2002)