Women's Labor Force Participation in Chile, 1854-2000[1].

Working Paper

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Abstract

This work studies the evolution of women's labor force participation in Chile along history (1854-2000), with a macroeconomic standpoint and using statistical methods. The general framework is a simple model of labor supply, which is estimated by OLS and by the instrumental variables method. The main results show that the effect over women's labor force participation is positive and significant for the case of wages, and negative and significant for the cases of consumption, fertility, and life expectancy, while the urbanization rates don't seem to have a significant nor robust effect.

Based on these results, and controlling for methodological changes in the measurement of labor in the 1930's census and for the age structure of society, it is possible to contribute to the understanding of the fundamental changes in the history of women's participation rate. The strong fall in feminine labor that starts at the end of 19th century may be attributed to a large increase in consumption and to a reduction in wages. The fall that may be observed in the 1950's may be attributed to an increase in the life expectancy, in consumption, and in the birthrate. Lastly, the recovery that may be observed in women's labor participation since 1970 would be related to a strong increase in wages and to a decrease in birthrates.

JEL Classification Number: J16, J2, N36, and N39

I. Introduction

1. Purpose and relevance of this research.

The purpose of this investigation is to construct a simple analytical framework for studying long term matters regarding women's labor force participation in Chile, with a macroeconomic point of view, and using statistical instrumental. More specifically, the aim is to assess the direction and significance of the principal factors that affect the total female labor supply, in order to explain the evolution of women's labor force participation along Chilean history.

In general, there is a sort of consensus about women's labor force participation in Chile being low in the last decades, when comparing to developed or even to Latin American countries, and when controlling by educational level and by age. Moreover, the historical evolution of the participation of Chilean women in the labor force has a very pronounced U-shape that differs from that of developed countries (see Pardo, 1988). In the literature, the reasons why Chilean women work little and why women's participation has been fluctuant, remains as a puzzle.

To study why Chilean women work less than their international counterparts, we would require international data that is not available in such a long term. This is why the focus of this paper is not to solve the first part of this puzzle but to solve the second one, i.e. to explain the evolution of women's labor force participation in Chile in the long term. Nonetheless, the mystery of the low participation of Chilean women in the labor force adds interest to the investigation.

But to study women's labor force participation in Chile is not interesting only from the point of view of the comprehension of our history, for it is relevant, as well, from the point of view of public policies.

From a purely economic standpoint, the participation of women at work affects the level of per capita income, even in steady state. In addition, when the PGB is stopping to grow because population growth is coming to a standstill, the incorporation of women to the labor force can become a solution (see Cerda, 2008). The importance of women's labor force participation in income and growth is also supported by empirical cases. For instance, Bloom *et al* (2009) affirms that the increase on women's participation was crucial for the economic growth of the Asian and Irish miracles.

In addition, the participation of women in work has plenty of other social benefits. In first place, the introduction of women into the labor force can help to largely reduce poverty. The reason is that it makes it easier to overpass the poverty line, because it provides the single income in households compounded by one parent, and doubles the income in households compounded by two parents (see Arriagada 1998). Secondly, there is empirical evidence on working women suffering less domestic violence (see Rico, 2001). Finally, in Chile an important part of economic inequality can be explained by differences in labor supply, very much associated to women's labor force participation. This is why raising women's labor force participation rates can help to reduce social inequality (Mizala *et al*, 1999).

2. Place of the research in the literature.

The evolution of women's labor force participation rates in the long term in Chile has been studied in several works with a historical or sociological approach. Nevertheless, from an economic and statistical standpoint it has been studied in depth only since 1957, when the employment survey of Universidad de Chile started (see Contreras *et al.*, 2000; Larrañaga, 2006). Before that, women's participation in work was studied by Gálvez and Bravo (1992), who studied the period between 1854 and 1920 – focusing in a careful analysis of the Chilean population Census –, and by Pardo (1988), which considers the period between 1907 and 1982. Both of these works only use descriptive statistical analysis and do not use more sophisticated techniques, as for example regressions.

This work analyses the period starting in 1854 – year of the first Census that distinguishes working population by gender – and finishing in 2000. Besides, this work uses econometric methods, particularly estimations by ordinary least squares and by instrumental variables method.

Naturally, working based on such a long-term reduces dramatically the availability of data. In this case, we only count with aggregated data for the country level. This implies that we just can try to explain how the average level of several variables affect women's labor force participation rate taken as a whole, but not why a woman with a particular set of characteristics decides to offer a certain number of hours to the labor force. Consequently, this work has a macroeconomic point of view.

In contrast, almost all of the economic literature on women's labor force participation has a microeconomic or disaggregated approach, working directly with individual agents. For instance, in the case of Chile, Larrañaga (2006) uses a probit type model, in which the dependent variable is a dummy being 1 for working women. Contreras *et al*. (2000) applies the technique of synthetic cohorts, distinguishing the effect of the year, the corresponding cohort, and the age of the woman.

In the international literature, the microeconomic approach prevails as well. For example, in Killingworth and Heckman's survey of female's labor supply measurement (1986), none of the nearly 30 articles presented have a macroeconomic standpoint. In fact, most of them use the number of hours of work offered per woman as the dependent variable, focusing in the estimation of wage and income elasticities. In the rest of the literature looked through, the only case in which women's labor force participation was studied econometrically as a whole was Bloom *et al*. (2009). However, its purpose was specifically to measure the effect of fertility over women's participation.

To sum up, this work could be a contribution to the understanding of women's labor force participation in Chile because of the utilization of econometrical techniques in a very long term. At the same time, it could be a contribution to the understanding of women's labor force participation as an overall, because of being one of the first attempts to analyze the problem with a macroeconomic approach.

II. Motivating Theory.

In this part we will look through the theory that underlies this work. This theory motivates our estimations and encloses the discussion of our results. However, we do not believe that it adjusts perfectly to reality, and therefore, our purpose is not to try to estimate the model, but to use the model in order to construe our estimations.

The adoption of a macroeconomic point of view implies that our variable of interest is an aggregate variable for all the economy. In our case, this variable will be women's labor force participation rate. In order to clean up women's labor supply from the effect of changes in the society's age structure, our dependent variable will be, more precisely, female labor force over female population in working age (15-64). This variable is constructed by aggregating the individual dichotomic decision of working or not of all women. Therefore, we will only be able to perceive when a woman incorporates or withdraws the labor force, but not when she varies the amount of working hours she is offering to the market. In other words, our analysis is less sensible to small changes in female's labor supply compared to a microeconomic analysis.

In any case, with the purpose of providing a simple theoretical framework for analyzing women's labor force participation with a macroeconomic approach, we have taken a crucial assumption: the one of a representative individual. This means that we will treat women's labor force participation rate as if it were the percentage of time that either the unique woman of society or all of the identical women of society decide to offer to the labor market. Of course this assumption is a simplification of reality, and does not mean that all women along Chile between 1854 and 2000 have decided in the same way the amount of hours to offer to the labor market. However, this assumption allows us to enclose the problem of how women decide whether to work or not in a simple economic model.

1. The basic model.

In first place, we will assume that in each period of one year long, the representative woman decides the amount of hours to offer to the labor market. This decision arises from a rational process of maximization of utility, in which the women allocates a part of her total time to working (l_t), and the rest to leisure (h_t)[2].

In each period *t*, the woman has preferences for consumption and for leisure, in accordance to a utility function of the following type:

$$u_t = \frac{{c_t}^{1-\sigma}}{1-\sigma} + \delta \frac{{h_t}^{1-\gamma}}{1-\gamma}$$

[2] It is important to note that in this model, leisure corresponds to all of the time that the woman is not setting aside for work. Leisure therefore includes, for example, housework or childcare.

Where, for every period of time, c_t is the consumption of the woman, h_t is the fraction of her time set aside for leisure, l_t is the fraction of her time in which she works ($h_t + l_t = 1$), and σ and γ are parameters of the function.

This utility function is increasing in consumption and leisure, but at decreasing rates. In other words, it satisfies $u'(c) > 0$, $u'(h) > 0$, $u''(c) < 0$ y $u''(h) < 0$. In addition, the importance or weight in preferences of consumption and leisure is determined by the factor δ, which is equivalent to:

$$\delta = e^{x\beta}$$

In each period, a matrix of variables named *x* affects the relative weight of leisure in preferences in an amount of β. This means that the value of leisure in relation to that of consumption is not constant along time, because it depends of a number of factors that may vary. In our estimations, these factors correspond to children under six years old, life expectancy and the urbanization rate. The way in which they affect the relative weight of leisure will be explained in section 2.

In every period, the total earnings of the representative woman must exceed the expenditure in consumption. Thus, the budget constraint for period *t* is:

$$c_t \leq w_t(1 - h_t) + M_t$$

Where w_t stands for the wage and M_t stands for the non-working income, which is exogenous to our model.

The langrangean of the maximization problem is:

$$\max \frac{{c_t}^{1-\sigma}}{1-\sigma} + \delta \frac{{h_t}^{1-\gamma}}{1-\gamma} + \lambda \left[w_t(1 - h_t) + M_t - c_t\right]$$

And therefore, the first order conditions are:

$$c_t^{-\sigma} = \lambda$$

$$\delta h_t^{-\gamma} = \lambda w_t$$

Making both λ equal, we arrive to the equilibrium optimum condition, which posits that the relative price between leisure and consumption[3] must be equal to the marginal rate of substitution between them[4].

$$w_t = \frac{\delta h_t^{-\gamma}}{c_t^{-\sigma}}$$

[3] Considering that the price per unit of consumption is equal to one, the relative price between leisure and consumption is equivalent to wage.

[4] Of course this optimum condition will not be satisfied in the case of a border solution, i.e. when a woman decides not to work. However, we are working with the representative individual assumption, which means that we do not have border solutions.

Clearing up leisure from this optimum condition, applying logarithms and replacing δ, we get to:

$$h_t = \left[\frac{w_t c_t^{-\sigma}}{\delta}\right]^{1/-\gamma}$$

$$\ln h_t = \frac{1}{-\gamma}\ln w_t + \frac{\sigma}{\gamma}\ln c_t + \frac{1}{\gamma}x\beta$$

Additionally, we now have that $h_t = 1 - l_t$, and that $t_t \in [0,1]$. Therefore,

$$\ln h_t \approx -\mathrm{t_t}$$

In order to account for individual heterogeneity of the real world, we add an error term, and our estimating equation will be of the following form[5]:

$$\mathrm{l_t} = \alpha_0 + \alpha_1 \ln w_t + \alpha_2 \ln c_t + x\beta' + \varepsilon$$ [6]

It is important to note that this is a model of labor supply. This means that every movement in the demand for female labor has its effect over labor force participation ($\mathrm{l_t}$) through wages. In other words, the demand side changes produce movements along the female's labor supply curve but do not change its position. Consumption and the factors that affect leisure's weight in preference are the ones that determine the position of the labor supply curve. Therefore, when consumption or any of the factors of matrix *x* vary, shifts in female's labor supply are generated.

III. Estimating Equations and Data.

1. Estimating Equations

a. The equation and relationship to the motivating theory.

Under the assumptions of our motivating theory, we will estimate women's labor force participation measured over female population in working age. The explicative variables will be wages, consumption, and a set of variables that are supposed to affect leisure's weight in preferences, and correspond to children, life expectancy, urbanization rate, and a dummy control for changes in Census methodology. The expected effects of each of these variables over women's labor force participation according to the literature are described in the following section.

Additionally, we will make a simple comparative analysis between women and men's labor force participation, using the same explicative variables. The purpose of this item is to analyze whether does there exist gender differences in the effects of certain variables over labor force

[5] σ and γ dissapear in this step. However, it is very simple to retrieve them, as it will be done later.

[6] Obtaining wages and consumption elasticities from our estimations is simple. In the first place, consider that the elasticity of labor regarding to variable *x* corresponds to $\varepsilon_{l,x} = \frac{\Delta l/l}{\Delta x/x}$, and that $\frac{\Delta x}{x} \approx \partial \ln x$. In consequence, $\varepsilon_{l,x} = \frac{\alpha_x}{l}$, where α_x stands for the estimated coefficient.

participation. However, it is necessary to keep in mind that these explicative variables have been chosen for a women's labor force participation model and, therefore, will be applied for the men's case only in an exploratory way.

b. Estimating Issues: Endogeneity.

When the dependent variable has an effect over some of the explicative variables, endogeneity problems emerge. In women's labor force participation literature, endogeneity is typically associated to the fact that the decision of whether working or not is usually simultaneously taken with other decisions, which implies that determining the direction of causality is not simple. As an example, a woman may cease to work because she has a baby, or may have a baby precisely because she is not working. In brief, in the first case it can be said that the baby causes not to work; while in the second case, not working causes the baby. In this way, some of our explicative variables may be affected by the variable we are trying to explain, generating an endogeneity problem.

In a similar way, the market wage is determined in order to equilibrate labor's supply and demand. As a result, wages are affected by women's labor supply and thus, definitively, they are not an exogenous variable to our model.

The problem of working with endogenous variables is that, when estimating by Ordinary Least Squares (OLS), the method is not able to distinguish both effects, i.e. the effect of the explicative variable over the dependent one and the effect of the dependent variable over the explicative one. In consequence, the parameters estimated by OLS are biased.

The standard solution to this problem is to make use of Instrumental Variables Method (IV). Concisely, this method replaces the endogenous variable by another variable named instrument, which is correlated to the variable it is replacing (excluded variable), but is exogenous. In other words, the IV method will only consider the exogenous part of the excluded variable. In a first stage, the IV method estimates the excluded variable by OLS using the instrument, plus the other explicative variables. In a second stage, it estimates the dependent variable by OLS using the estimated excluded variable plus the other explicative variables.

The instrument is supposed to be completely exogenous to the model, and is supposed to affect the dependent variable uniquely by its effect through the excluded variable. In addition, it must be significant in the first stage, because if not, it means that it is not really affecting the excluded variable[7].

Of course, finding a strictly good instrument is not an easy task. This gets even harder when working with social phenomena, because things are generally interrelated, and therefore, never completely exogenous. Besides, for our very long term case, data availability is low. Despite of this,

[7] The requirements for an instrument being good are a discussed issue in the literature. Some agree that a *t* statistical of $\sqrt{10}$ is adequate enough.

the IV method is still able to give an idea of the effect of the exogenous component of an endogenous variable.

In section 2.3 we will analyze which of our variables are considered endogenous, and we will explain the instruments utilized for the IV estimations.

2. Data Variables.

In this section we present the variables that will be used in our estimations and the way that, according to the literature, they are supposed to affect women's labor force participation. First we present dependent variables and then explicative variables. Among the latter, variables appearing in the model are shown in first place. Afterwards, we present the variables that affect the weight of leisure in preferences in our estimations, i.e. that are included in matrix x. Then we present a control variable and conclude explaining some variables not included in our estimations.

At the end of this part, a summary chart with statistics of variables and instruments will be presented. The evolution of these variables is shown with figures in Annex 1.

2.1 Dependent variable.

Women´s labor force participation rate.

The variable that we will use for analyzing the evolution of women's labor force participation is women's total labor force (working + unemployed) over total feminine population in working age (15-64). As we already said, the variable adjusts very well to the model and is net of changes in population's age structure. It can be interpreted as the probability of picking a woman who is whether working or unemployed from all of the women in working age.

Comparison between women and men's labor force participation rates.

In order to make our simple comparative analysis between women and men's labor force participation, we will use women's and men's total labor force (working + unemployed) over their respective total population. In this case we will not control for changes in the age structure of society for two reasons. In the first place, because the age structure is similar for both men and women, it will not affect the comparative analysis. Secondly, we want to test if our estimations are robust to small changes in the definition of the variable under analysis.

2.2 Explicative variables.

a. From the basic model

Wages.

As we saw in our model, all changes in labor demand affect women's labor supply through wages. An increase in wages has two opposite effects over the working decision of our representative woman. On one hand, it increases the alternative cost of leisure, generating a positive effect over labor supply (substitution effect). But on the other hand, as income per unit of work increases, the capacity of expenditure in any good – leisure or consumption – increases as well. According to our optimum condition, there must be equilibrium between the marginal utilities of both of these goods. Therefore, there is a positive effect over leisure to the detriment of labor supply (income effect).

However, substitution effect should prevail over income effect, as supported by the major part of the literature. This may be explained by the fact that the representative woman along Chilean history has worked little, making the income effect small as well.

For measuring this effect we will use a real wages index. The problem with this variable is that it is an average for all population and not for women's average wage. This would not be problematic if the gap between men's and women's wages were constant along time, but this has certainly not been true[8]. Therefore, we will not be able to entirely perceive changes that affect exclusively the demand for women's labor. For example, the process through which the tertiary sector grew in importance, leaded to an increment in the demand for women's labor, because women have a comparative advantage in works that do not require physical effort. In our model, this effect should act through wages, but as our data is an average for the whole population, we will not be able to capture it. However, long-term data on women's wages simply does not exist, and population's average wage turns out to be the best available proxy.

Consumption.

As our model shows, labor supply depends on the representative woman's level of consumption. From the equilibrium optimum condition we can infer a positive relationship between both goods –leisure and consumption–, which means that when consumption level increases, labor supply must shrink. In other words, when our representative woman starts to consume more, the marginal utility of consumption reduces and leisure becomes more attractive. Therefore, she will offer fewer hours to the labor force.

Unfortunately, the data of private consumption is available only since 1940. As a proxy, we will work with private consumption plus total investment, in per capita terms. As investment is generally more volatile than consumption, we will expect the effect of consumption to be

[8] See, for example, Montenegro and Paredes, 1999 or Larrañaga, 2006.

overestimated. Anyway, it is just what we have, and these are the costs of working with such a long term.

b. Variables that affect the weight of leisure in preferences

Children.

Children may affect the weight of leisure in the representative woman's preferences in several forms. On one hand, they depend economically on their parents for a long period of years, which through income effect, increases the marginal utility of consumption related to that of leisure, stimulating work. On the other hand, children depend more than economically on their parents, and childcare requires a lot of time. This increases the weight of leisure in preferences and therefore reduces labor supply. Usually, and especially in historical Chilean culture, childcare lies more strongly over women than men, which helps the latter effect to prevail over the former. In the literature looked through, a negative relationship between the number of children and women's labor supply is actually found.

In order to measure the effect of children over women's labor force participation, we will use the sum of the birth rates every one thousand inhabitants, of the actual and the last five years[9]. This variable pretends to pick up the effect of children under six years old every one thousand people. Of course children under one year are not as demanding as children under six, but we chose to put them all together because birth rate lags are very collinear and therefore they do not give significant enough coefficients, even though they maintain their sign. Besides, six years is a non arbitrary limit because is the historical age in which normally children start going to school. Finally, having children under six is a factor considered in an important part of women's labor force participation's literature.

Life Expectancy.

Life conditions have changed dramatically from mid XIX century until now. This includes important improvements in hygiene, health, and more generally, in life quality. The effect of all these changes over women's labor force participation is not clear. On one hand, they are associated to modern life conditions, in which work has a more positive value for women. Besides, health improvements reduce the cost of maternity and childcare, stimulating work[10]. But on the other hand, all of these improvements may be considered as a general income effect that reduces marginal utility of consumption, stimulating leisure and, therefore, reducing labor supply. Our estimations will tell which effect prevails. As a proxy for measuring the effect of health conditions and general life quality over women's labor force participation, we will use life expectancy.

[9] As infant mortality rates have changed drastically along Chilean history, we analyzed the possibility of subtracting from birth rates the deaths of children under one year. However, we did not have data of children dead between two and six years old, so we could not make the whole correction. In addition, we think that a child that dies before being one year old also affects the working decision of his mother, because she anyway goes through the pregnancy period, and probably is more reluctant to work during the mourning phase. This is why we decided not to control birth rates for infant mortality.

[10] See Albanesi and Olivetti, 2009.

Urbanization.

Women have a comparative advantage over men in works of the secondary and tertiary sectors because they require less physical effort. As manufactures and services are more prominent in urban zones, the demand for women's work is higher. In our model, this effect should act through wages, which is the variable that includes all of the demand side effects. Nevertheless, our wage variable corresponds to the population average instead of women's average, so we will not be able to identify this effect.

However, urbanization may as well directly affect women's labor supply. In rural zones, the household is at the same time a consumption and production unit, which facilitates to combine work with other activities such as housework and childcare. Besides, living in cities increases transportation costs, making it harder for people to do simultaneous activities[11]. In this way, higher urbanization rates are expected to increase the weight of leisure in preferences, reducing women's labor force participation.

c. Control Variable.

Changes in the labor measurement methodology.

The techniques applied for the collection of data in the population censuses in Chile have changed along history. Since the first census that distinguishes gender in 1854, until the first *statistically modern* census, in 1930, the censuses were *progressively making narrower their definition of work*[12]. Initially, the purpose of the censuses was not to measure the country's productivity but to know the identity of population, so the point was not if a woman was certainly working in a precise moment of time, as it is nowadays. Thus, in 1854 the question was simply for *occupation*, in 1920 it was for the *occupation of the major part of the year*, and only in 1930, for the first time, the census put a time limit when asking for occupation. For this reason, labor force data up to 1920 is overestimated because it includes women that worked only for a small period of the year.

Besides, according to Hutchinson (2000), most of women's occupations in the mid XIX century were somewhat like extensions of domestic work, such us cooks, seamstress or weavers. This made the limit between working and not working vague. Therefore, as the definition of work narrowed, women who worked at home were gradually being excluded of the labor force.

Following the author, these progressive changes in census methodology had their maximum effect in 1930 census. In that year, women who worked at home or in small workshops were considered as inactive when depending on the head of household. Picking only one example, domestic employees fell from more than 100,000 to 0.

All of these changes in the measurement of women's labor force might have contributed to the negative tendency of women's labor force participation up to year 1930. They probably

[11] See Bloom et al., 2009.
[12] Hutchinson, 2000.

contributed as well to the drastic reduction of women's labor force participation in 1930, which had been traditionally explained by the Great Depression or by technological changes in textile industry.

In order to solve this data problem in a non-arbitrary way, two measures were taken. In the first place, some of the specifications of the empiric analysis included a dummy variable with value 1 for all of the years in which the data considered 1930's census to be estimated, i.e. for the period 1921 - 1939. The coefficient of this dummy had the expected sign (negative), and was significant at the 99% level in almost all of the cases. Thus, it is perfectly possible that the 1930's census was certainly a break point in the way of measuring women's work.

In second place, we tried including a dummy variable with a tendency for all of the years before 1920 in order to report for the progressive narrowing of the definition of work. This dummy did not have the expected sign, so we decided not to present it. Whether the narrowing of work definition was not relevant enough, or this control variable was capturing another effect.

d. Variables not included in our estimations.

Family structure.

Marriage or non-marital co-habitation may affect women's decision of work. In the first place, living with someone else usually raises non-working income, which allows having a higher consumption. This reduces the marginal utility of consumption, so leisure must be increased in the optimum, which means a reduction in labor supply. Besides, living as a couple allows a better distribution of duties between childcare, housework and wage-earning work, which may affect the weight of leisure in preferences for women[13]. Anyway, these effects had to be omitted because of lack of data.

Education.

Education level is supposed to affect marginal productivity, which increases the demand for labor, raising the market wage. Thus, education may affect women's labor force participation through a movement along women's labor supply curve. However, this effect works through wages, so it does not need a specific variable in order to be measured.

But there is another kind of effect that education may have over women's labor force participation, because it may change women's attitude to work. The available variable for measuring this effect is average years of schooling. This variable is not separated by gender, and we cannot assume the gap to be constant along time. Besides, years of schooling do not control for quality in education, which may have varied dramatically. Moreover, years of schooling has an increasing tendency, with very few variations in speed. Therefore, when including it in our estimations, its effect may include that of any other variable with a rather constant tendency. Finally, the education decision is not independent of the working decision, so this variable is

[13] See, for example, Albanesi & Olivetti, 2009.

endogenous. From a methodological standpoint, this may be conflictive because, as we will see, we already have two more endogenous variables.

For all the latter reasons, it is hard to know if the years of schooling variable will be able to pick the effect we want it to. Along the investigation, we tried several specifications that included years of schooling either in levels or in logarithms. When applying IV, the instruments were the government's expenditure in education lagged in ten years. In consequence to all of the problems, the effect of years of schooling was neither significant nor robust. For these reasons, we decided not to include a variable for education, letting this effect to be captured by wages.

2.3 Instruments for endogenous variables

In this part, we will analyze which variables are endogenous and we will explain the instruments used when applying IV method. The results of the first stages of the IV method are presented in Annex 3.

Life expectancy was assumed exogenous. Even though it might be affected by the development of the country, which is not absolutely independent of women's labor force participation, it depends mainly on medical progress and sanitary and health policies, which are indeed exogenous. Regarding urbanization, it was assumed exogenous as well, for migration from rural areas to cities in Chile was provoked by several reasons that might have been related to men's work but not to women's. Finally, the control variable for data originated by the 1930's census is clearly exogenous.

As we already said, wages is definitively an endogenous variable for it is determined in order to equilibrate labor's supply and labor's demand. We used terms of trade as instrument for wages. When the price of imports relative to that of exports is high, the value of the marginal productivity of internal production falls, and so do market wages. Therefore, terms of trade affect wages directly.

Regarding the exogeneity of this instrument, we can say in first place that international prices of goods are determined in international markets which are not affected by women's labor force participation of a small country as Chile. In relation to the rest of the variables, it is simple to assume that terms of trade neither affect birth rates, nor life expectancy, nor urbanization rates. Consumption's case is rather more complex, because changes in terms of trade may produce an income effect that might have an effect over consumption. However, following Milton Friedman's permanent income theory, we will suppose that consumption is determined in relation to permanent income and that permanent changes in terms of trade do not exist, thus, terms of trade should not affect consumption. In this way, terms of trade have an effect over women's decision of work only through wages, so it is a valid instrument for this variable.

In the first stage of IV, terms of trade had the expected sign (negative) and were significant enough (t statistical between -3.76 and -4.68, depending on the specification).

Regarding consumption, it might be endogenous to some extent, because it depends on production, and production is affected by women's labor force participation rate. In order to decide whether it is endogenous or not, we applied Durbin, Wu and Hausman's test (DWH), which tests the null hypothesis of the excluded variable being exogenous. As instrument for consumption we used the country's commercial openness[14]. This variable affects consumption because when a country opens to the international market, it may benefit from its comparative advantages, increasing income and therefore consumption. In addition, commercial openness is exogenous, because along Chilean history, it has been determined mainly by government policies. Besides, we can assume that commercial openness does not affect in a direct way neither women's labor force participation, nor the rest of the variables included in our model. In the first stage of IV, this instrument had the expected sign (positive) and was very significant (t statistical between 6.62 and 7.78). DWH's test showed a p-value of 0,043, so at 95% level we reject consumption's exogeneity, and consequently we replaced consumption with its instruments in our IV estimations.

Finally, as we already said, the decision of having children is not completely independent of that of working, so children under six years old might be considered an endogenous variable as well, as it is done in an important part of the literature. However, even though children and working decisions may be taken at the same time, they are progressively less related as we separate them on time. For instance, the effect of the working decision of five more years has a rather small effect over the decision of having a baby right now, because most of the people do not plan their lives in such a long time, or if they do, they may change their minds in the meantime. And this is exactly the case when we are considering up to five years lags of birth rates. Besides, we are working with data starting in mid nineteenth century. In those days, birth control was considerably less important and the access to capital markets was very limited. Consequently, the decision of having children was not easily managed over time. As a final idea, we already have two variables that are endogenous, and it is never recommendable to use instruments for too many variables because an excess of instruments may make too much noise in the first stage.

For all this, there are serious theoretical reasons that allow considering children as exogenous in our estimations. Anyway, in order to be sure that this methodological decision would not be a mistake, we applied DWH's test. As instruments for children, we used two variables. In the first place, we used infant mortality rate, defined as deaths of children under a year every one thousand inhabitants. It is correlated to birth rates because when more kids are being born, probably more kids under one year will die. We assumed that infant mortality rate is not affected by women's decision of work, at the same time that it does not affect directly the women's decision of work. The rest of the variables of the model were supposed not to be affected by infant mortality rate as well. The only conflictive case is that of life expectancy, however, life expectancy data was estimated from a total of 6 data, while infant mortality has annual frequency. For this reason, our life expectancy variable will not pick up the short-term effects of changes in infant mortality. Therefore, and for simplicity, we assumed infant mortality as exogenous. As a second instrument, we used a dummy variable with values one for all of the years of USA's baby boom (1946-1965). When the Great Depression and World War II were ended, economic prosperity and somewhat like a faith in the future leaded to an important increase in birth rates in many countries, being the US the

[14] Corresponding to (Imports + Exports)/PGB.

emblematic case. This baby boom ended because the generation that had suffered the war left its fertile age and because contraceptive pills were introduced. For some reason, this will of having more children arrived to Chile as well, therefore, we can take it as an exogenous shock. In the first stage of IV, both instruments had the expected sign and were significant enough. DWH's test showed a p-value of between 0,47 and 0,73, depending on the specification, so we cannot reject that children under six years old is an exogenous variable.

2.4 Problems with the data.

a. Interpolation

Some of the series of our data – in particular those corresponding to labor participation rates, life expectancy, and urbanization rates – were generated from information coming from censuses that were carried out every ten or even more years. The data between censuses was estimated with diverse interpolation techniques. The problem that arises from interpolation is that when applied to different variables in a similar way, spurious correlation may be generated. This problem is especially important when working with lags of explicative variables estimated through interpolation, which is not our case. Anyway, we tried specifications including an eleven period lag as a mechanism of control for the interpolation effect. Results practically did not change, and the control was not significant, thus, we opted not to include it.

b. Length of series.

The source of all of our data is "Chile: 1810-2000. La República en Cifras" (2005), by José Díaz, Rolf Lüders and Gert Wagner. Most of the data series we used start at the beginning of the period under analysis, in 1854. However, some of them were incomplete, so we used the following methods for filling them.

Infant mortality rate: this variable was available since 1907. For estimating the missing years (1854-1906), we assumed the relation between infant mortality and total mortality rate to be constant to the average of that of the ten-year period between 1907 and 1916.

Life Expectancy: this variable was available only since year 1900, for census' years. Data for years between censuses were estimated assuming a constant rate of growth. Besides, in year 1900, life expectancy was 29 years, an already extremely low value, and it is possible to say that health and general life conditions were similar to those of the second half of XIX century. For those reasons, we assumed life expectancy to be constant in 29 for the period 1854-1899.

Urbanization rate: this variable was available since 1865 to 1992, only for the census' years. Data for years between censuses were estimated assuming a constant rate of growth. For the missing years (1854-1864 and 1993-2000), we assumed a constant urbanization rate.

Women's population in working age (15-64): this variable was available from year 1865 for total population, and from 1920 separated by gender, only for census' years. We assumed women's

population in working age between 1865 and 1919 to be equal to total population in working age. Data for years between censuses were estimated assuming a constant rate of growth. For estimating the missing years (1854-1864), we assumed the same rate of growth for period 1865-1875.

2.5 Summary statistics of variables and instruments.

The following table summarizes the definitions and main descriptive statistics of our variables. The evolution of them in time may be observed in figures presented in Annex 1.

Variable	Abbreviation	Definition	Instrument	Frequency of data	Average	Minimum	Year of Min.	Maximum	Year of Max.	Standard Deviation
Net women's labor force participation	womens_part_aw	Feminine labor force over total feminine population in age of working	-	Census	34.9	22.9	1970	51.5	1885	9.3
Women's labor force participation	womens_part	Feminine labor force over total feminine population	-	Census	20.3	12.7	1970	29.4	1885	5.3
Men's labor force participation	mens_part	Masculine labor force over total masculine population	-	Census	51.8	44.8	1970	55.6	1907	3.0
Wages	lnwages	Wages real index (1996=100), in logarithms*	Terms of trade (TT)	Annual	31.3	11.4	1932	110.1	2000	25.2
Consumption	lncons_pc	Total private consumption plus investment per capita, 1996 pesos, in logarithms*	Commercial Openness (com_open)	Annual	680,525	195,663	1854	2,134,025	1998	409,335
Children under six	children_6	Sum of actual and last five years births rates (children born alive every 1000 inhabitants).	-	Annual	206.4	110.8	2000	255.2	1873	39.4
Life Expectancy	life_exp	Expected time to live when born.	-	Census	44.5	29.0	1854	75.6	2000	16.5
Urbanization Rate	urb	% of population living in urban areas	-	Census	54.0	29.0	1854	83.0	2000	17.6
1930 census control	census1930	Dummy with values 1 for period 1921-1939.	-	-	-	-	-	-	-	-

* This variables were included in logarithms in our estimations; however, the descriptive statistics correspond to the variable in levels.

IV. Empirical Results

1. Econometric Analysis

Women's labor force participation rates (over women's population in working age).

Table 1 presents the results of the estimations for women's labor force participation over women population in working age, through OLS and IV methods. In general terms, our results are significant at a 99% level, and they are coherent with the theory we presented[15].

The effect of wages over women's labor force participation is positive and big. This means that, as it was expected, substitution effect prevailed over income effect because the representative woman works little, and thus the income effect is small. In this way, women respond to incentives, working more when they receive a better wage for their work.

If we estimate the wage elasticity from our OLS, we have that when wages augment in 1%, women's participation increases between 0.24 and 0.37%. In terms of percentage points, this means an increase of between 0.085 and 0.13, starting from 34.9%, which is the average women's labor force participation for the period. If we estimate wage elasticities from our IV estimations, we have an important increase: when wages augment 1%, women's participation increases between 0.82 and 0.92%, corresponding to 0.28-0.32 percentage points when starting from the average. The difference between the effects of wages by OLS and IV estimations is enormous, but this has a theoretical explanation.

Initially, let us consider that women's labor market is in equilibrium, i.e. that there are no rigidities that make wages differ from those that equilibrate women's labor supply and demand, and therefore there is no unemployment. In this case, when labor demand increases exogenously, wages increase and so does labor supply. Graphically, labor demand's curve shifts to the north east, and because of a movement along labor supply's curve, women's work is higher in the new equilibrium; generating a positive relationship between wages and women's work. But when labor supply increases endogenously, for example because one of the variables of our model changes, labor supply's curve shifts to the east, and wages decrease; generating a negative relationship between wages and women's work.

When those two situations happen at the same time, OLS is not able to differentiate both effects. Part of the positive effect of wages over women's participations is cancelled with the negative endogenous relationship between them. Therefore, OLS estimators for wage elasticities are biased to zero.

IV method uses terms of trade as an instrument for wages. This instrument is supposed to affect directly women's labor demand and is supposed not to interact with other variables that affect women's labor supply. Thus, IV only considers the exogenous movements of wages, i.e. those that

[15] With the purpose of testing robustness of our results, we tried the same specifications of Table 1 for the dependent variable of female labor force as percentage of total labor force. The results maintained, presenting only slight changes. Therefore, it is possible to say that our estimations are robust to the definition of women's labor force participation.

are generated by demand shifts. For this reason, IV estimators of wage elasticity are larger than those of OLS.

Let us now consider that women's labor market is not in equilibrium, so there is unemployment. In this case, the actual wage will be higher to the equilibrium market wage, and the quantity of labor will be determined by labor demand. When labor demand increases, equilibrium market wage increases as well, but what happens with the actual wage depends on the kind of rigidities. As women's work is determined by labor demand, in this situation, women's work may increase regardless of what happens with actual wages.

IV considers the exogenous part of wages, attempting to account for exogenous labor demand shifts. Thus, IV is able to account for these kinds of effects, not as OLS. In this way, we have an additional reason for OLS estimators to be biased.

If we now look the results for consumption by OLS, we can calculate that a 1% increase in consumption reduces women's participation in between 0.073 and 0.24%. The negative sign of these coefficients is coherent with the equilibrium optimum condition we derived from our motivating theory. In a few words, an increase in consumption reduces consumption's marginal utility, and to be able to keep in an optimum, leisure's marginal utility must be reduced as well, which means that leisure increase, reducing women's work.

But when we look to IV's consumption results, we can see that in most of the cases, they keep their sign and reduce their magnitude, but their variances increase so much, that the effect of consumption is no longer significant.

This is rather weird, because ex ante one would expect the coefficient of consumption to become even more negative when estimating by IV. The reason is that when women's work increases, women's income increases, and so does consumption. Therefore, the endogenous component of consumption generates a positive relationship between women's labor force participation and consumption. In this way, OLS estimators should be biased to zero, which is not what we observe in our results.

One possible explanation for this sort of contradiction is that our model is not able to perceive the effect of the exogenous component of consumption, because it is too small and has low variability. This argument seems even more reasonable if we think that our consumption data includes total investment, which is an extremely volatile variable. In this way, our OLS estimators would be having much more sensibility because they are considering much more variable data.

Another hypothesis is that in our OLS estimations there may be some omitted variable that is biasing consumption upwards and biasing women's work downwards. This could be the case of some variable associated with men's work, because for a woman that lives with a man, an increase in his labor force participation may allow her to reduce her working hours and increment her consumption at the same time. However, in this case there should be some reason for this not to happen when applying IV. For example, it could be possible that commercial openness – our instrument for consumption – changes the relative wages of men and women, encouraging men's work. This could be the case if commercial openness enlarged economic sectors that are intensive in men's work. Thinking of Chile's historical exports, which are encouraged when opening the

country to international economy, we see that they mainly correspond to the primary sector, which is indeed intensive in men's work. Thus, it is possible that OLS estimators are biased because men's work affects consumption and women's work at the same time.

An additional explanation may be that our instrument is not good enough. Nevertheless, even though the IV coefficients of consumption have a very large confidence interval, in most of the cases, they do have the expected sign according to our theory. Besides, our theory is a motivating theory, and we do not attempt to estimate an exact model, but to enclose our analysis in an economic theory. Thus, not having robust enough IV estimators for consumption's coefficient does not invalidate our model.

Regarding the effect of children over women's labor force participation, we can tell that whether by OLS or IV, it is a very robust effect. For every one more child under six years old every 1000 inhabitants, women's labor force participation rates falls between 0.137 and 0.169 percentage points. In this way, and according to women's labor force participation literature, children reduce women's labor supply. This means that the negative effect of the increase of leisure's weight in preferences because of childcare prevails over the income effect because of the economic cost of children.

Life expectancy has an important negative effect over women's labor force participation, of around -0.463 and -0.947 by OLS, and around -1.398 and -1.772 by IV, for every increase of one year of life. Thus, better life conditions, associated to a higher life expectancy, would imply an important income effect, increasing leisure's weight on preferences, and consequently reducing women's work.

Comparing OLS and IV results for life expectancy, we can see that IV gives coefficients of nearly double the magnitude of those of OLS. One reason for this may be that when life expectancy increases, women's work reduces because labor supply's curve shifts to the North West. This generates an endogenous increase in wages that offsets part of the negative effect of life expectancy over women's labor force participation. Thus, as IV only considers the exogenous movements in wages, it does not account for the offsetting, and therefore shows larger effects than OLS.

Urbanization rate also has a negative effect over women's work, reducing women's labor force participation in about 0.351 - 0.486 percentage points, for every one percentage point increase for the OLS case. In this way, city life would increase leisure's value for women, reducing their labor supply. IV results are not significant enough, although they maintain their sign and magnitude.

Finally, the dummy for methodological changes in the 1930's census has the expected sign and is significant at least at a 90% level, producing a fall of 4 or even 7 percentage points in women's labor force participation rate. Hence, it is indeed plausible that the dramatic fall of women's work of that decade may be explained in part for a work measurement problem. However, it is possible as well that part of the effect of this variable is due to the existence of an omitted variable that is correlated to it.

Summing up our results for this part, we can tell that women's work depends positively on wages, and negatively on consumption, children, life expectancy, and the urbanization rate. Regarding the main differences between OLS and IV, we can tell that the effect of wages almost triples while that of life expectancy almost doubles; consumption, on its part, is no longer significant.

Comparison between men and women's labor force participation rates.

Table 2 presents the OLS results of the estimations for men's and women's labor force participation, over their respective populations, and for their difference. Table 3 does the same by IV. It is necessary to consider that our estimations were designed for women's and not for men's labor force participation, so this comparative analysis is just a first approach to the problem and does not pretend to be conclusive.

In order to analyze gender differences in labor force participation, we must consider that the average men's participation for the whole period has been 51.8%, while women's has been only 20.3%. This implies that along history, the mass of women that have been out of labor force has been enormous in relation to that of men. This is relevant because reaction to changes in variables differ considerably depending on whether someone is inside or outside the labor force. In our case, this is even more important, because we are working with the aggregation of dichotomic decisions (working/not working) and not with total hours offered to the labor market, so our data will only consider inclusions and withdrawals of labor force. Thus, in our model, people who already work are not able to respond to changes in variables that increase labor supply, because they are already working. Analogously, people who are not working are not able to respond to changes in variables that reduce labor supply, because they just cannot withdraw something they do not belong to. Therefore, different dimensions of women's and men's labor force should imply different sorts of replies to changing factors.

Related to this, we can tell that, from a sociological standpoint, there are cultural factors that should be considered as well. Throughout Chilean history, work has been considered as an obligation for men, while for women it can be an option. This means that men must work because they must maintain their families, but women can decide whether they want to work or not. Even further, whereas men are socially reproached when they do not work, for some social groups, in some periods, women have been socially reproached when they do work. For this reason, women would have permission to choose when they want to work, so they would work when conditions are better. Thus, women's labor supply would be less stable than men's. Indeed, in spite of men's labor force participation being more than twice that of women, the standard deviation of men's labor force participation is 3 while women's is 5.3.

Respecting the results of our gender comparison, in general terms, we can tell that they are significant at a 99% level, and coherent with the theory we presented. For this section women's labor force participations is measured over total women's population, while in the former section it was measured over women's population in working age. In this way, both dependent variables have the same numerator, but the denominator of this section is larger. Therefore, the effects of variables over women's work in this section will be smaller than those of the former.

According to our OLS estimations, a raise in wages would decrease men's work and strongly increase women's work, reducing dramatically the difference of men's and women's labor force participation. The effect of wages over men's work is no longer negative when estimating by IV, but we will anyway analyze why wages may have opposite effects on men's and women's labor supply. For this purpose, we will think in terms of the representative individual. Whenever wages increase, we will have a substitution effect that moves labor supply upwards and an income effect that moves it downwards. Which of these effects prevails depends on the size of them. For the case of our representative man, as he works a lot, income effect is rather large related to the substitution effect; for the case of our representative woman, as she works little, income effect is rather small related to the substitution effect. This means that when wages increase, he is richer and thus wants to consume more leisure, while she finds that leisure is much more expensive and thus wants to work more.

Besides, if we analyze the wages effect in terms of elasticities, we find that men's is between -0.03 and -0.045, while women's is between 0.24 and 0.38. Comparing both of them, we have that women's labor supply is around eight times more elastic than men's. This is coherent with women's labor supply being less stable than men's because of work being *optional* for women and *obligatory* for men.

In respect to the IV estimations of the wages effect, we find that in the case of women's labor force participation, for the same reasons of the former section, wages effect increases considerably. For the case of men's participation, we find that the effect turns positive and less significant. This means that when considering only the exogenous component of wages, substitution effect starts to prevail over income effect. One hypothesis for this is that as income effect is small for men, the endogenous effect of wages – the same described for women's case – turns out the wages effect to be negative. However, our IV estimators still show that the effect of wages over women's work is larger than that over men's.

According to our OLS estimations, consumption has an important positive effect over men's work and an important negative effect over women's work, so it increases the difference of men's and women's labor force participation. This may be explained by the fact that the endogenous component of consumption is much larger for the men's case. When work increases, income increases and therefore consumption increases endogenously, generating a positive relationship between consumption and labor force participation. And this relationship is certainly more important for the men's case, because they represent nearly 70% of labor force.

However, our IV estimators for consumption's effects show slightly larger effects for the men's case, and smaller and non-significant effects for the women's case. As in our former estimations, this is weird and may be due to one of the reasons we already presented.

In relation to the effect of children, whether by OLS or by IV, we have that one additional child under six every 1000 inhabitants reduces women's labor force participation in around 0.1 percentage points and reduces men's labor force participation in around 0.02 percentage points. The effect is around four or five times larger for women than for men, which is natural because in Chile

childcare has historically relied on women. This is why children significantly increase the difference between men's and women's labor force participation.

Life expectancy has a negative effect over men and women's labor force participation. However, its effect is larger for the women's case, so it increases the difference of participations. This means that the income effect associated to better general life conditions is larger for women than for men. This, again, is coherent with the idea of women being able to decide whether to work or not and thus deciding not to work when life conditions are better. As in the former section, the effects of life expectancy increase considerably when estimating by IV.

Regarding the effect of urbanization rates, we can tell that they are negative for both cases and of a similar size. Accordingly, the effect of urbanization over the difference of participations is little and not significant in all cases.

At last, the control dummy for methodological changes in the 1930's census increases significantly the difference between men and women's labor force participation. This is coherent with the idea of that census being biased in the measurement of women's work and not of men's, as it is said in the literature.

As a conclusion for this part, we will remark the main differences between estimating men and women's labor force participation by OLS. In the first place, wages have a positive effect over men's work and a negative one over women's. Besides, it has a much larger effect over the women's labor force participation. Second, consumption has a positive effect over men's work and a negative one over women's. Finally, children reduce more women's work than men's. Besides, when analyzing IV estimations for this gender comparison, we find that the principal differences that were found between OLS and IV on the former section are maintained, turning out the effect of wages over men's work to no longer be negative.

2. Comparison with other research about women's labor supply.

This work is very different to the typical women's labor supply work. In first place, we have a macroeconomic approach, while almost all of the literature has a microeconomic one. Secondly, we are using average wages instead of women's wages. Third, our data for consumption includes investment. And fourth, for several reasons, we did not include education in our estimations, which is a common variable in the literature.

For all of these reasons, we have considered that our results are not equivalent to those of other works, so we have decided not to attempt a deep comparison. However, we overlooked other results in order to see if we, at least, maintain the orders of magnitude.

In particular, we compared the results for wages and consumption elasticities with those found in the literature for Chile (Mizala *et al* 1999, Muchnik *et al* 1991) and for the rest of the world (Killingsworth & Heckman's survey 1986). For the case of wages, our elasticities have the same order of magnitude. For the case of consumption, we have assumed consumption elasticity to

be a sort of proxy of total income elasticity, which is the common variable estimated in the literature. Our consumption elasticities are similar to the total income elasticities in Killingsworth & Heckman, but quite larger than those for Chile. Anyway, we are not estimating exactly the same elasticity and, besides, they have the same sign.

Thus, even though we cannot completely guarantee that our results are exact, we have some external validity that shows that our results are, at least, reasonable.

3. Relative Importance of variables to the explanation of the fundamental changes in women's labor force participation along history.

In this section we analyze the evolution of women's labor force participation along Chilean history, explaining what would be, according to our estimations, the main causes of their principal changes. For this purpose, we used the most complete specification, both by OLS and IV[16]. We excluded consumption's effects for the IV case, because they were neither significant nor robust in any of the specifications. For the OLS case, consumption's effect was not significant for the most complete specification. However, its effect was significant and slightly robust for the other two specifications, so we decided to include consumption's coefficient in this analysis.

Regarding the evolution of women's labor force participation, in a few words, we can say that it begins the period, in 1854, in a high level. At the end of the 19th century, particularly in 1885, it starts to decrease, getting to a peak in 1930. Afterwards, it starts to recover, but it falls again in the fifties, arriving in 1951 to a lower value than in 1938. Since 1970 up to 2000, it had a strongly increasing trend. Therefore, we will analyze (1) the large fall of women's work comparing periods of 1854-1885 and 1886-1930, (2) the smoother fall between 1932-1950 and 1951-1970, and (3) the important growth between 1970 and 2000. It is important to note that episodes (1) and (3) are the ones that generate a U-shape of women's labor force participation in Chilean history.

The results of these comparisons are presented in Table 4. The first part shows the average values of variables for the periods and their difference. Then we present the coefficients of the variables for each period[17]. The "explained change" row corresponds to the predicted change in women's labor force participation according to the change of each explicative variable between periods, expressed as a percentage of the effective change in the dependent variable. The values in this row may be negative if their effect goes on the opposite side of the effective change in women's work in the period. As well, they may be larger than 100% if their predicted effect is larger than the effective one. This means that this effect must have been offset by the counteracting effects of other variables, whether included in the model or not. Finally, "relative contributions" is calculated as a percentage of the total sum of the absolute values of the "explained change". If the relative contribution is negative, it means that the effect of that variable counteracted the effect of the others.

[16] Corresponding to columns 3 and 6 of Table 1.
[17] Elasticities differ among periods because they depend on average women's labor force participation, which varies between periods. See note 4.

The large fall: 1854-1885 versus 1886-1930[18].

According to our estimations, the main cause for the deep fall in women's labor force participation that started at the end of the 19th century and reached its peak in 1930 would have been an important increase in urbanization rates. This agrees with part of the literature that associates the fall in women's work with the large waves of rural-urban migration of those days.

If we consider OLS estimators, the second main cause of the depression of women's work is an increase in consumption. As Chile was a richer country, women could allow themselves not to work. Another contributive factor was a slight decrease in wages that reduced incentives of working. This latter effect grows considerably when considering IV estimators.

In any case, the slowdown in birthrates counteracted part of the decrease in women's work, but the effect of having less children could not prevail over the effect of a higher urbanization rate, a higher consumption, and lower wages.

Besides, the control dummy for methodological changes in the 1930's census contributes around 10-13% to women's work fall. Thus, according to our estimations, we can attribute part of the fall of women's labor force participation to a measurement effect. However, its effect is rather small, so we cannot assure there was nothing else besides a measurement effect.

Second and smoother fall: 1938-1950 versus 1951-1970.

Regarding the second important fall of women's labor force participation in history, the principal causes would be an increase of life expectancy and of urbanization rates. In this way, an income effect associated to better general life conditions reduced women's work, at the same time that city life made it harder to work.

Besides, between 1955 and 1966, considered as a baby boom period for Chile, birth rates grew up to an average of 37 born alive for every 1000 inhabitants, in comparison to only 31 in 1950. The consequent increment of children under six years old had an important negative effect over women's work.

An increase on consumption also contributed slightly to the reduction on women's work. Conversely, the increase in wages importantly counteracted part of the described effects.

The recovery: 1970-2000.

Finally, the recovery of women's labor force participation since 1970 to 2000 may be mainly attributed to a reduction in small children. While in 1970, 26 babies were born every 1000 inhabitants, in 2000 this number was just 17. This stimulated women's work, because childcare

[18] We did not consider life expectancy for this comparison, because we did not have data of life expectancy for the 19th century, so we assumed it to be constant.

makes it much more difficult to work. Secondly, wages grew around 46%, which strongly promoted work.

The factors that counteracted this episode of women's work growth were an increase of life expectancy, and to a lesser extent, a marginal increase of urbanization rates and a rise in consumption. Thus, women decided to work more in spite of being richer, whether in terms of life quality or in terms of consumption.

Overall women's labor force participation's history.

We will now summarize the explanations we have given to the principal changes in women's work a long history. In the first place, women's labor force participation started to decrease at the end of the 19th century because of an increase of urbanization rates, an increase of consumption, and a reduction in wages. Afterwards, it somewhat recovered, but had a second fall around the fifties due to increases in life expectancy, urbanization, children and, to a lesser extent, consumption. Finally, women's labor force participation had a growing trend since 1970 that may be attributed to women having fewer children, and to higher wages.

This brief story of the evolution of women's labor force participation in Chile may be related to Claudia Goldin's theory (1994) of a U-shaped female labor force function in economic development and economic history. According to her, in the first stages of development women's works are usually of a manual type and have a negative stigma. As the economy develops, production passes from households to markets, making it more difficult to take care of children and housework and work at the same time. For these reasons, as people get richer, women's work is less attractive, and women may allow themselves not to work, avoiding the stigma. Thus, women's labor force participation decreases on these first development stages.

But as the economy keeps on developing, women are more educated and may access white collar works that do not carry with the stigma. At the same time, wages grow, and work becomes more attractive. Therefore, women's labor force participation should start to recover at some point of the economic development.

This could be exactly what happened to Chilean women: at the beginning of economic development, they withdrew work as they could. But in some point, work started to be attractive.

V. Conclusion

In general, our results whether by OLS or by IV are significant and consistent with the theory and literature. In this way, regardless of the simplicity of our model, we provide a coherent analytical framework for analyzing long-term matters regarding women's labor force participation rate.

This means that, even though Chile may be an uneven country, an even though the situation of women has changed dramatically from 1854 to nowadays, in some way, there is an historical and geographical continuity in Chilean women's behavior, because it is possible, at least in aggregate terms, to represent their working decision as a function of a couple of aggregate variables. Although the representative individual assumption is a very strict assumption, it seems to have a lot of power.

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Annex 1: Figures

Figure 1

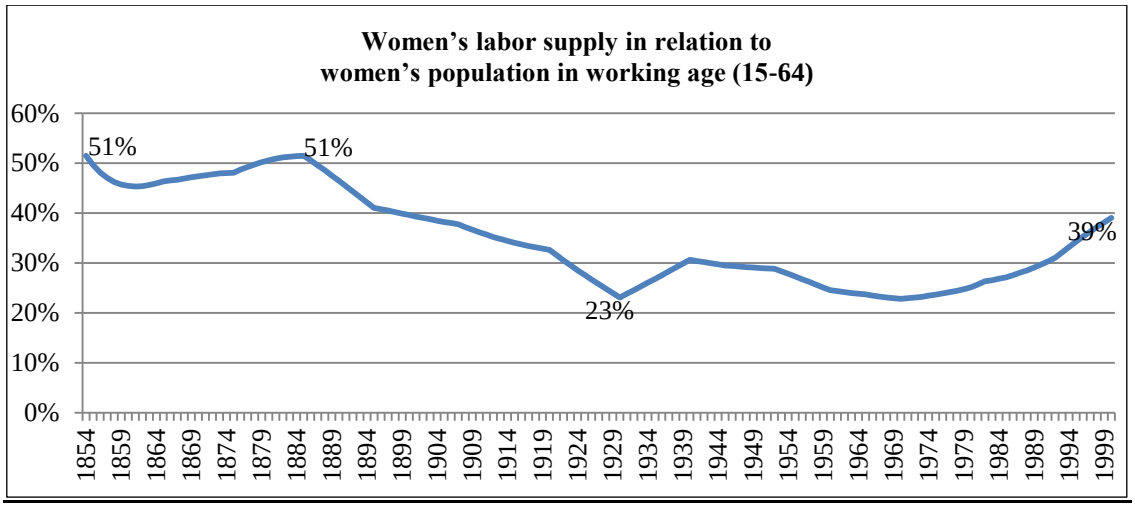


Figure 2

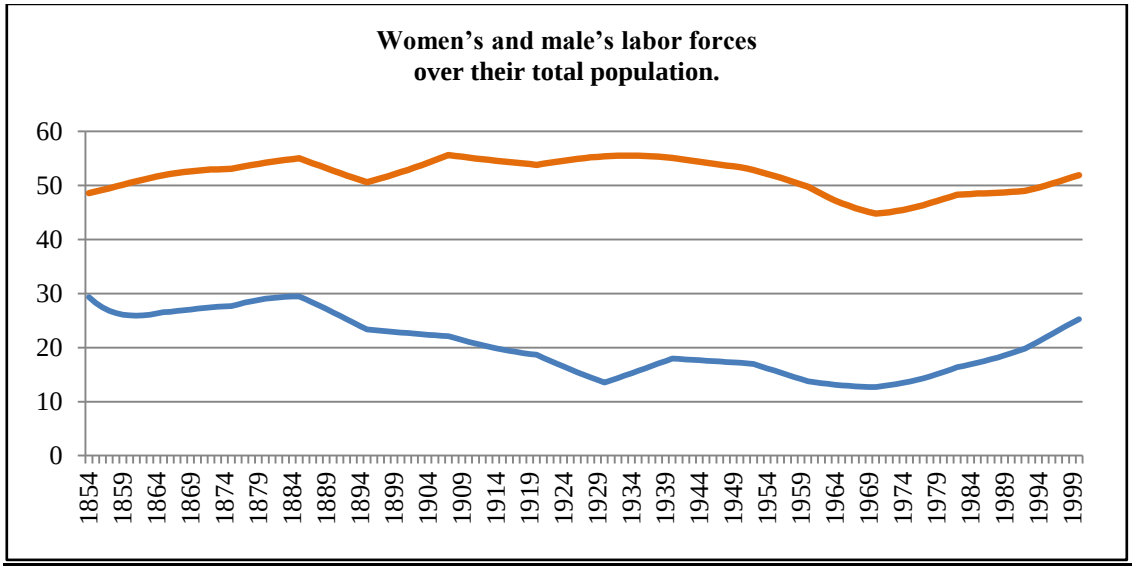


Figure 3

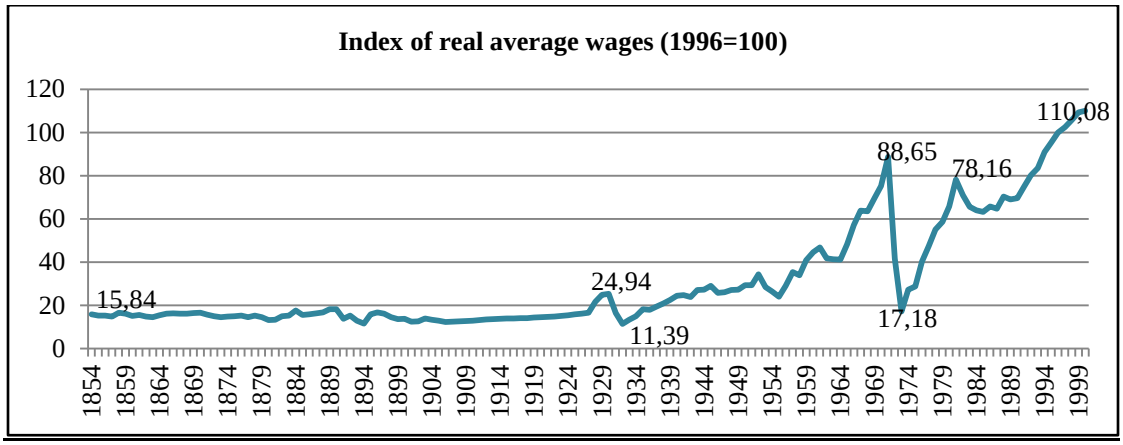


Figure 4

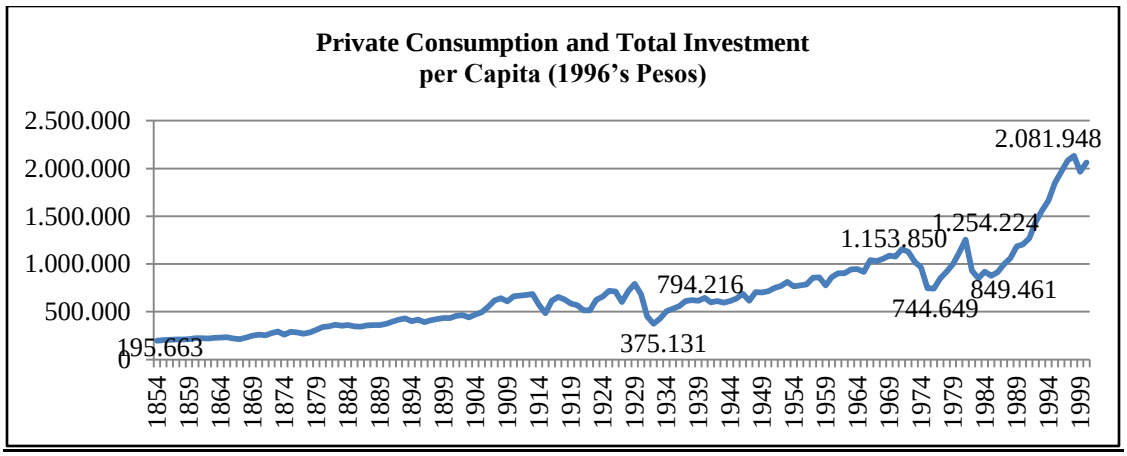


Figure 5

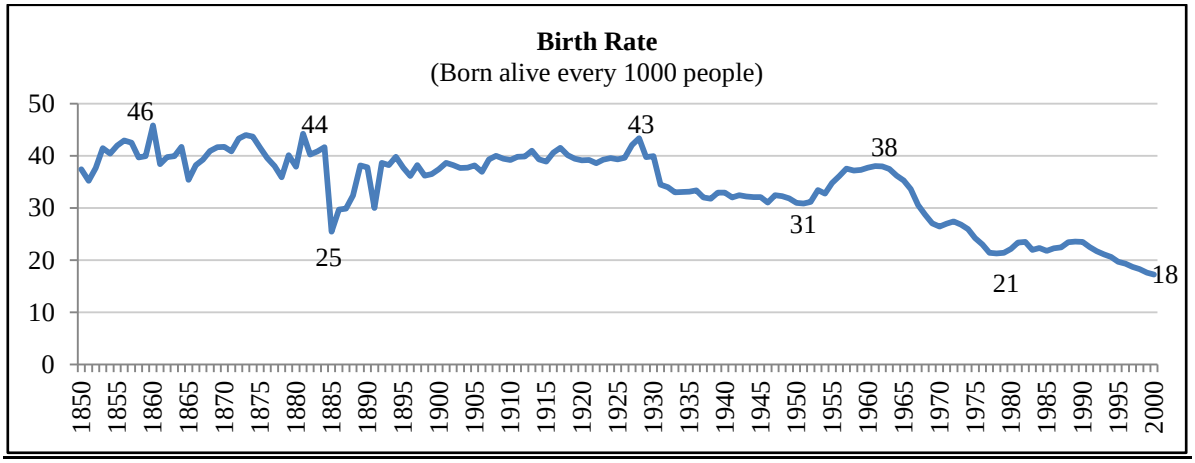


Figure 6

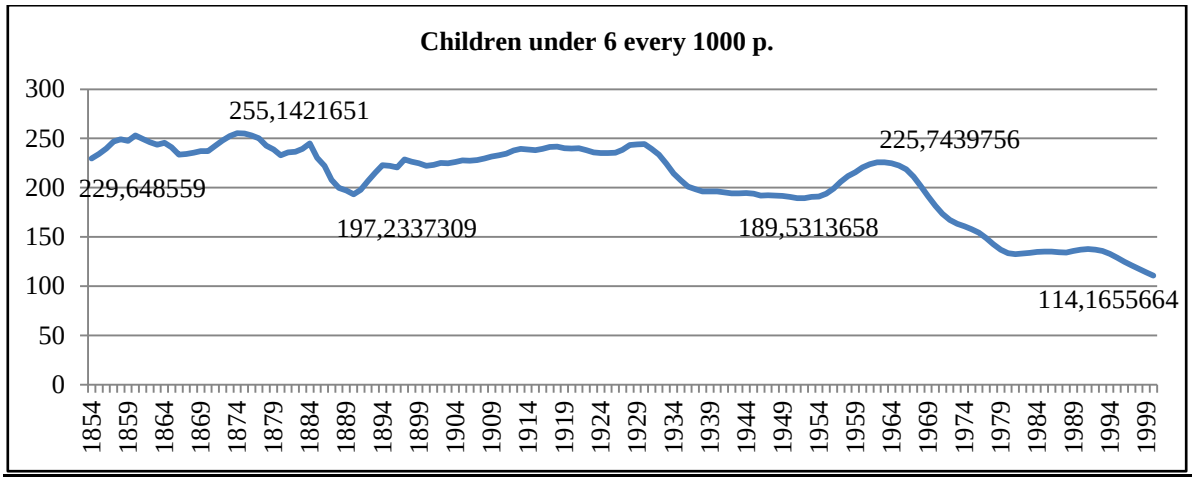


Figure 7

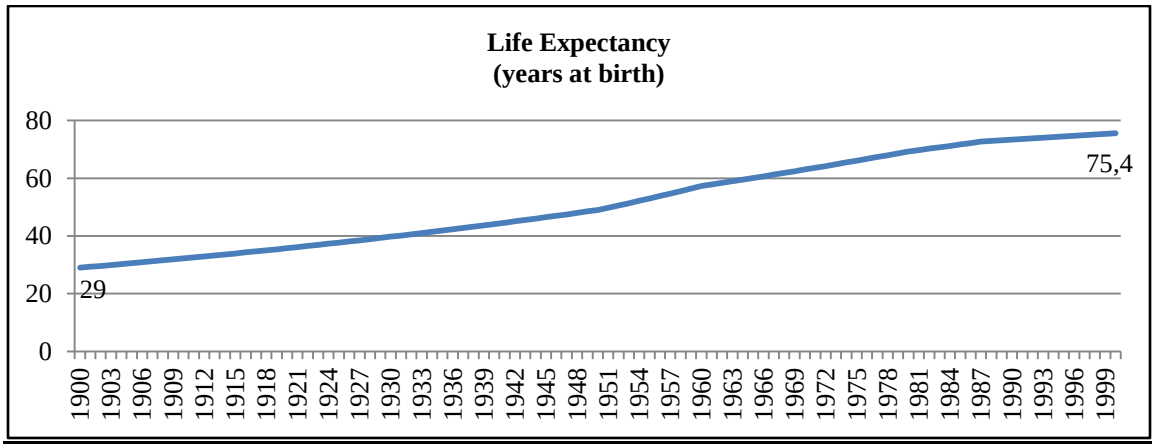


Figure 8

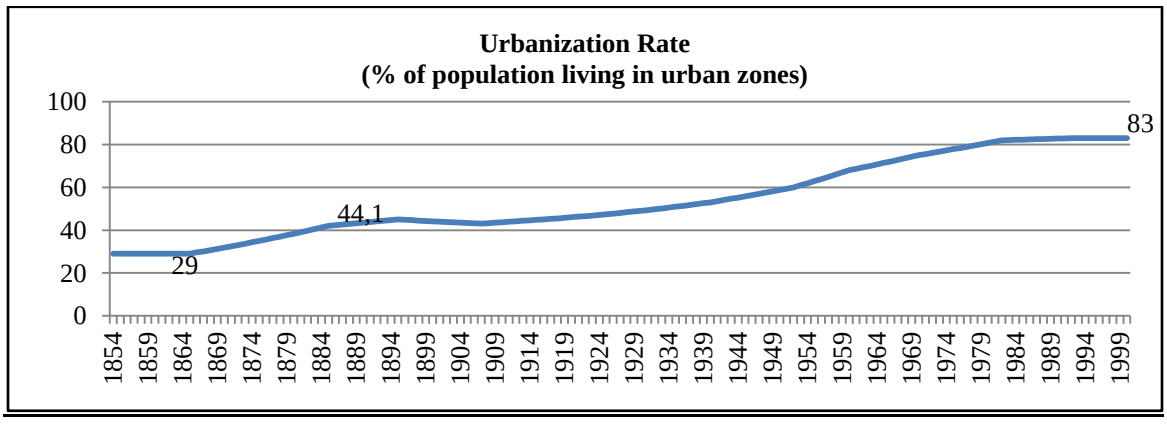
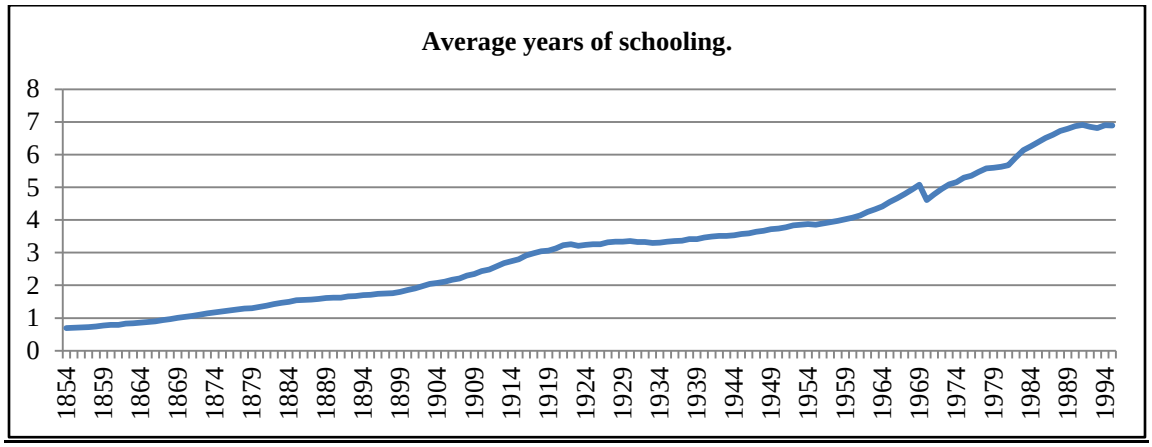


Figure 9


Average years of schooling.
8
7
6
5
4
3
2
1
0
1854
1859
1864
1869
1874
1879
1884
1889
1894
1899
1904
1909
1914
1919
1924
1929
1934
1939
1944
1949
1954
1959
1964
1969
1974
1979
1984
1989
1994

Annex 2: Tables

Table 1

Estimations for women's labor force over women's population in working age.

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
lnwages	12.93***	11.90***	8.493***	32.00***	30.55***	28.67***
	(1.803)	(1.809)	(1.662)	(7.284)	(7.348)	(7.647)
lncons_pc	-8.264***	-5.257***	-2.539	-3.667	-2.397	0.102
	(1.398)	(1.785)	(1.612)	(2.784)	(3.267)	(3.212)
children_6	-0.153***	-0.169***	-0.152***	-0.137***	-0.149***	-0.141***
	(0.0209)	(0.0214)	(0.0189)	(0.0289)	(0.0302)	(0.0284)
life_exp	-0.947***	-0.669***	-0.463***	-1.772***	-1.525***	-1.398***
	(0.0954)	(0.141)	(0.127)	(0.316)	(0.375)	(0.398)
urb		-0.351***	-0.486***		-0.245	-0.367*
		(0.134)	(0.118)		(0.211)	(0.222)
census1930			-7.329***			-4.016*
			(1.098)			(2.123)
Constant	176.9***	150.2***	120.5***	88.26**	80.74*	53.52
	(18.24)	(20.56)	(18.51)	(41.31)	(42.17)	(37.96)
Observations	147	147	147	147	147	147
R-squared	0.753	0.765	0.822	-	-	-

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.

Comparison between women and men's labor force participation rates.
Method: OLS

VARIABLES	(1) Men	(2) Men	(3) Women	(4) Women	(5) Women	(6) Difference	(7) Difference	(8) Difference
lnwages	-1.588**	-2.350***	7.640***	6.786***	4.889***	-9.229***	-9.136***	-6.107***
	(0.745)	(0.706)	(1.112)	(1.093)	(1.028)	(1.310)	(1.346)	(1.149)
lncons_pc	4.197***	6.424***	-4.468***	-1.971*	-0.458	8.665***	8.395***	5.979***
	(0.578)	(0.697)	(0.862)	(1.078)	(0.997)	(1.016)	(1.328)	(1.115)
children_6	-0.0225**	-0.0345***	-0.105***	-0.119***	-0.109***	0.0829***	0.0844***	0.0688***
	(0.00865)	(0.00836)	(0.0129)	(0.0129)	(0.0117)	(0.0152)	(0.0159)	(0.0131)
life_exp	-0.236***	-0.0298	-0.570***	-0.339***	-0.224***	0.334***	0.309***	0.126
	(0.0394)	(0.0551)	(0.0588)	(0.0853)	(0.0787)	(0.0693)	(0.105)	(0.0880)
urb		-0.260***		-0.291***	-0.366***		0.0314	0.151*
		(0.0521)		(0.0807)	(0.0733)		(0.0994)	(0.0819)
census1930					-4.080***			6.516***
					(0.679)			(0.759)
Constant	16.34**	-3.420	102.3***	80.14***	63.58***	-85.95***	-83.56***	-57.11***
	(7.542)	(8.026)	(11.25)	(12.42)	(11.45)	(13.26)	(15.30)	(12.80)
Observations	147	147	147	147	147	147	147	147
R-squared	0.603	0.663	0.706	0.731	0.786	0.578	0.578	0.723

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.
Comparison between women and men's labor force participation rates.
Method: IV

VARIABLES	(1) Men	(2) Men	(3) Women	(4) Women	(5) Women	(6) Difference	(7) Difference	(8) Difference
lnwages	6.424**	5.451*	21.49***	20.09***	19.27***	-15.07***	-14.64***	-11.83***
	(3.016)	(2.932)	(4.890)	(4.829)	(5.135)	(4.226)	(4.379)	(4.118)
lncons_pc	5.680***	6.531***	-0.723	0.500	1.584	6.403***	6.031***	2.296
	(1.153)	(1.304)	(1.869)	(2.147)	(2.157)	(1.615)	(1.947)	(1.729)
children_6	-0.0155	-0.0234*	-0.0939***	-0.105***	-0.102***	0.0784***	0.0818***	0.0709***
	(0.0120)	(0.0121)	(0.0194)	(0.0199)	(0.0191)	(0.0168)	(0.0180)	(0.0153)
life_exp	-0.568***	-0.403***	-1.181***	-0.943***	-0.888***	0.613***	0.541**	0.350
	(0.131)	(0.150)	(0.212)	(0.246)	(0.268)	(0.183)	(0.223)	(0.215)
urb		-0.164*		-0.236*	-0.289*		0.0719	0.254**
		(0.0843)		(0.139)	(0.149)		(0.126)	(0.119)
census1930					-1.741			6.004***
					(1.426)			(1.143)
Constant	-15.62	-20.65	33.13	25.89	14.09	-48.74**	-46.54*	-5.841
	(17.10)	(16.83)	(27.73)	(27.71)	(25.49)	(23.96)	(25.13)	(20.44)
Observations	147	147	147	147	147	147	147	147

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4

Relative contribution of explicative variables to main changes
in women's labor force participation in Chile.

Period 1854-1885 versus 1886-1930.

Averages	Women's labor force pption.	Wages	Consumption	Children	Urbanization	1930's Census
1854-1885	48,15	15,40	262.885	242,58	33,05	0,00
1886-1930	36,70	14,84	534.579	228,12	44,87	0,22
Difference	-11,45	-0,57	271.693	-14,46	11,83	0,22

	Method	Wages Elasticity	Consumption Elasticity	Children	Urbanization	1930's Census
Coefficients	OLS	0,1764	-0,0527	-0,152	-0,486	-7,329
	IV	0,5954	**	-0,141	-0,367	-4,016
Explained Change (%)	OLS	2,72	22,91	-19,19	50,19	14,22
	IV	9,54	**	-17,80	37,90	7,79
Relative Contribution	OLS	2,49	20,97	-17,57	45,95	13,02
	IV	13,07	**	-24,37	51,89	10,67

** not significant

Period 1938-1950 versus 1951-1970.

Averages	Women's labor force pption.	Wages	Consumption	Children	Life Expectancy	Urbanization
1938-1950	29,64	25,82	643.280	193,73	45,99	55,31
1951-1970	25,29	43,49	894.328	206,72	56,43	67,63
Difference	-4,35	17,68	251.049	12,99	10,43	12,32

	Method	Wages Elasticity	Consumption Elasticity	Children	Life Expectancy	Urbanization
Coefficients	OLS	0,2865	-0,0856	-0,152	-0,463	-0,486
	IV	0,9671	**	-0,141	-1,398	-0,367
Explained Change (%)	OLS	-133,66	22,77	45,39	111,03	137,67
	IV	-267,82	**	42,10	335,25	103,96
Relative Contribution	OLS	-29,67	5,06	10,08	24,65	30,56
	IV	-35,75	**	5,62	44,75	13,88

** not significant

1970 versus 2000.

Averages	Women's labor force pption.	Wages	Consumption	Children	Life Expectancy	Urbanization
1970	22,86	75,24	1.078.411	181,19	63,00	75,00
2000	39,03	110,08	2.062.050	110,57	75,60	83,00
Difference	16,16	34,84	983.640	-70,61	12,60	8,00

	Method	Wages Elasticity	Consumption Elasticity	Children	Life Expectancy	Urbanization
Coefficients	OLS	0,3715	-0,1111	-0,152	-0,463	-0,486
	IV	1,2540	**	-0,141	-1,398	-0,367
Explained Change (%)	OLS	24,33	-14,33	66,41	-36,10	-24,06
	IV	56,14	**	61,60	-108,99	-18,17
Relative Contribution	OLS	14,73	-8,67	40,19	-21,85	-14,56
	IV	22,92	**	25,16	-44,50	-7,42

** not significant

Annex 3: First Stages of the IV Estimations.

First Stage Simplest Specification.

```
      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  4,   142) =  343.15
       Model |  57.0578674     4  14.2644668           Prob > F      =  0.0000
    Residual |  5.90287378   142  .041569534           R-squared     =  0.9062
-------------+------------------------------           Adj R-squared =  0.9036
       Total |  62.9607412   146  .431237953           Root MSE      =  .20389

------------------------------------------------------------------------------
     lnwages |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |   .0023801   .0011877     2.00   0.047     .0000323    .0047278
    life_exp |   .0416879   .0025843    16.13   0.000     .0365793    .0467965
          TT |  -.0030293   .0006471    -4.68   0.000    -.0043086   -.0017501
    com_open |   .0067743   .0025022     2.71   0.008     .0018279    .0117207
       _cons |   1.023997   .3503234     2.92   0.004     .3314738     1.71652
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  4,   142) =  312.42
       Model |  43.4541159     4   10.863529           Prob > F      =  0.0000
    Residual |  4.93768305   142  .034772416           R-squared     =  0.8980
-------------+------------------------------           Adj R-squared =  0.8951
       Total |   48.391799   146  .331450678           Root MSE      =  .18647

------------------------------------------------------------------------------
   lncons_pc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |    .000168   .0010862     0.15   0.877    -.0019793    .0023153
    life_exp |   .0310351   .0023636    13.13   0.000     .0263627    .0357074
          TT |   .0021791   .0005919     3.68   0.000     .0010091    .0033491
    com_open |   .0151527   .0022885     6.62   0.000     .0106287    .0196767
       _cons |   11.13913   .3204048    34.77   0.000     10.50575    11.77251
------------------------------------------------------------------------------
```

First Stage Intermediate Specification.

```
      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  5,   141) =  279.93
       Model |  57.1985309     5  11.4397062           Prob > F      =  0.0000
    Residual |  5.76221022   141  .040866739           R-squared     =  0.9085
-------------+------------------------------           Adj R-squared =  0.9052
       Total |  62.9607412   146  .431237953           Root MSE      =  .20216

------------------------------------------------------------------------------
     lnwages |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |   .0018493   .0012118     1.53   0.129    -.0005465     .004245
    life_exp |   .0496976   .0050204     9.90   0.000     .0397726    .0596227
         urb |  -.0087145   .0046972    -1.86   0.066    -.0180005    .0005715
          TT |  -.0027747   .0006561    -4.23   0.000    -.0040719   -.0014776
    com_open |   .0071082   .0024875     2.86   0.005     .0021906    .0120258
       _cons |   1.206625   .3610285     3.34   0.001     .4928963    1.920354
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  5,   141) =  430.08
       Model |  45.4140608     5  9.08281216           Prob > F      =  0.0000
    Residual |   2.9777382   141  .021118711           R-squared     =  0.9385
-------------+------------------------------           Adj R-squared =  0.9363
       Total |   48.391799   146  .331450678           Root MSE      =  .14532

------------------------------------------------------------------------------
   lncons_pc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |   .0021493   .0008711     2.47   0.015     .0004271    .0038716
    life_exp |   .0011366    .003609     0.31   0.753    -.0059982    .0082714
         urb |   .0325293   .0033767     9.63   0.000     .0258539    .0392047
          TT |   .0012288   .0004717     2.61   0.010     .0002964    .0021613
    com_open |   .0139063   .0017882     7.78   0.000     .0103712    .0174414
       _cons |   10.45742   .2595316    40.29   0.000     9.944347     10.9705
------------------------------------------------------------------------------
```

First Stage More Complete Specification.

```
      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  6,   140) =  249.96
       Model |  57.5853051     6  9.59755085           Prob > F      =  0.0000
    Residual |  5.37543605   140  .038395972           R-squared     =  0.9146
-------------+------------------------------           Adj R-squared =  0.9110
       Total |  62.9607412   146  .431237953           Root MSE      =  .19595

------------------------------------------------------------------------------
     lnwages |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |   .0022325   .0011808     1.89   0.061     -.000102    .0045671
    life_exp |   .0512249     .00489    10.48   0.000     .0415571    .0608928
         urb |  -.0097089   .0045637    -2.13   0.035    -.0187316   -.0006861
  census1930 |  -.1674236    .052751    -3.17   0.002    -.2717151    -.063132
          TT |  -.0024291   .0006453    -3.76   0.000    -.0037048   -.0011534
    com_open |   .0079991   .0024274     3.30   0.001        .0032    .0127982
       _cons |   1.066286   .3527271     3.02   0.003     .3689259    1.763647
------------------------------------------------------------------------------

      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(  6,   140) =  356.16
       Model |  45.4164357     6  7.56940595           Prob > F      =  0.0000
    Residual |  2.97536332   140  .021252595           R-squared     =  0.9385
-------------+------------------------------           Adj R-squared =  0.9359
       Total |   48.391799   146  .331450678           Root MSE      =  .14578

------------------------------------------------------------------------------
   lncons_pc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_6 |   .0021794   .0008785     2.48   0.014     .0004425    .0039162
    life_exp |   .0012563   .0036381     0.35   0.730    -.0059364     .008449
         urb |   .0324514   .0033954     9.56   0.000     .0257386    .0391642
   census1930|  -.0131192   .0392459    -0.33   0.739    -.0907104    .0644719
          TT |   .0012559   .0004801     2.62   0.010     .0003068     .002205
    com_open |   .0139762   .0018059     7.74   0.000     .0104057    .0175466
       _cons |   10.44643   .2624231    39.81   0.000     9.927602    10.96525
------------------------------------------------------------------------------
```