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The rise and fall of income inequality in Chile

Francisco Parro[1] · **Loreto Reyes**[2]

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Abstract This paper presents evidence on a rise and fall in income inequality in Chile during the past two decades. We show that income inequality rises from 1990 to 2000 and then falls from 2000 to 2011. We perform simple but informative decompositions to figure out the contributing factors behind that dissimilarity in the behavior of inequality across those two subperiods. Our results are consistent with a story in which economic growth increases the demand for more educated workers, initially increasing inequality. However, those higher returns to education encourage agents to invest in higher education, producing a subsequent human capital deepening that reduces inequality at later stages of the development process.

Keywords Inequality · Labor markets · Skills

JEL Classifications J21 · J31 · J24

1 Introduction

This paper presents evidence on the evolution of income inequality in Chile during the past two decades. We observe that income inequality rises from 1990 to 2000 and then falls from 2000 to 2011. The only exception is from 2006 to 2009, when income inequality increases. To empirically disentangle the main forces behind the

✉ Francisco Parro
francisco.parro@uai.cl

Loreto Reyes
ldr2132@columbia.edu

[1] Universidad Adolfo Ibáñez, Santiago, Chile

[2] Columbia University, New York, USA

dissimilarity in the behavior of income inequality across the pre- and post-2000 periods, we carry out a series of simple but informative decompositions to separate the contributions of the different components of income inequality. The measure of income inequality analyzed in this paper is the 80/20 ratio of per capita income. While several other measures of inequality are used in the literature (for instance, the Gini coefficient), the 80/20 ratio allows us to build our decompositions in an easy and clearly interpretable way.[1]

We first show that labor income inequality accounts for most of the changes in inequality observed during the whole period. Non-labor income inequality plays a minor role. Then, we decompose labor income inequality into its three main components: employment, hours worked conditional on being employed, and hourly wages. We show that the employment gap between the richest and poorest quintiles is particularly relevant for explaining the rise in income inequality from 2006 to 2009. Without changes in the employment gap, the trend of labor income inequality would resemble a perfectly inverted U-shaped curve. That is, we would observe a continuous rise of labor income inequality before 2000, followed by a continuous fall after 2000. Moreover, we show that the inverted U-shaped movement of labor income inequality among employed agents is almost entirely accounted for by a rise and fall in hourly wage inequality during the pre- and post-2000 periods, respectively. Inequality in hours worked has no relevant role.

Changes in hourly wage inequality could be explained by differences in observable characteristics, such as experience and education; different prices for different skills in the labor market; and unobservables, that is, differences in prices and skills within groups. To disentangle the relative importance of those components of hourly wage inequality, we perform a decomposition in the spirit of Juhn et al. (1993). We show that both observable prices and quantities are important forces behind the rise and fall of hourly wage inequality. We discuss the forces moving the supply of and demand for different skills in the labor market. The evidence and discussion presented in this paper are consistent with a story in which several forces inherent to economic growth increase the demand for more educated workers and, therefore, the returns to education and inequality in earnings. As the supply of educated workers—especially those from more vulnerable groups—begins to respond, the rise in income inequality is moderated or even reversed. Our results point to education policies as the most effective way of reducing income inequality levels in the long term.

Most of the evidence on income inequality for Chile is concentrated on the pre-2000 period, when income inequality slightly increased. The exceptions are some regional studies that mainly provide evidence on the contribution of price and

[1] In general, the conclusions of studies using different inequality measures are not significantly dependent on the inequality measure used (see, for instance, Lustig et al. 2013 and Azevedo et al. 2013a). Therefore, given the consistent results obtained by others using different inequality measures, we decided to report results for only a single inequality indicator. We decided to use the 80/20 measure as the main engine of our analysis because of the proportionality property of this ratio. It allows us to dissect, step by step and within a unified framework, several of the forces behind the evolution of overall income inequality. The use of alternative inequality measures would not significantly alter our main conclusions and would come at the cost of sacrificing the clarity with which we present and interpret our main results.

quantity effects to the changes in the distribution of hourly wages (for instance, Azevedo et al. 2013a). Among the articles looking at inequality in Chile, only a fraction of them center the discussion on the forces that could explain the evolution of income inequality (Cowan and Gregorio 1996; Bravo and Marinovic 1997; Solimano and Torche 2007; Eberhard and Engel 2008). Other articles point to different issues that are related to inequality but not directly to its determinants. For instance, Contreras et al. (2004), Denis et al. (2007), and Sapelli (2013) study inter- and intragenerational mobility, Engel et al. (1999) and Bravo et al. (2001) quantify the redistributive effects of tax and social policies, Ruiz-Tagle (2007) forecasts future trends in income inequality, and Contreras and Ruiz-Tagle (1997) present evidence on inequality at the regional level in Chile.

Moreover, those studies analyzing the determinants of income inequality in Chile mainly focus on the reasons why income inequality was high and relatively stable during the pre-2000 period in the context of the rapid growth of the Chilean economy. Our paper provides a more complete picture of the forces driving both the rise and fall of income inequality in Chile, through the use of simple decompositions based on the 80/20 ratio. As far as we know, no other study on Chile provides the type of analysis that we perform in this paper.

The rest of the paper is organized as follows. Section 2 summarizes and discusses the available evidence on income inequality in Chile as well as other countries of the region. Section 3 documents trends in income inequality over the past two decades and analyzes the importance of labor markets for understanding its evolution over time. Section 4 dissects labor income inequality into its three main components: wages, hours worked, and employment gaps. Section 5 decomposes changes in hourly wage inequality into observable quantities, prices, and unobservables, and discusses the main forces behind the documented evolution of the returns to higher education. Section 6 concludes.

2 Related literature

In this section, we summarize and discuss the main findings of the literature that analyzes income inequality in Chile and other Latin American countries. This broader discussion, not exclusively focused on Chile, allows a better understanding of both the common elements in the evolution of income inequality between Chile and the region and the particularities of the Chilean case. We start by discussing articles that study the evolution and determinants of income inequality for a group of Latin American countries. Then, we summarize the evidence for Chile. We conclude by discussing how this article fits with and contributes to the existing literature explored in this section.

Lustig et al. (2013) provide evidence on a rise and fall in income inequality in Latin America during recent decades. The authors document that, after rising in the 1990s, income inequality declined in 13 of 17 Latin American countries during the period 2000–2010. To understand the post-2000 decline of income inequality in the region, the authors carry out an in-depth analysis of the experiences of Argentina, Brazil, and Mexico. From the analysis of those countries, the authors extract several

conclusions: (1) labor income inequality played a major role in the decline in overall inequality, especially in Argentina and Mexico; (2) changes in hourly wages were equalizing during the post-2000 period in the three countries they analyze[2]; (3) changes in the distribution of hourly wages were mainly driven by a price effect, that is, by a fall in the skill premium; and (4) more progressive government transfers were the main equalizing force behind the decline in non-labor income inequality in the three countries. Other studies for specific countries extract similar conclusions [Gasparini and Cruces (2010) and Bergolo et al. (2011) for Argentina; Barros et al. (2010) for Brazil; Esquivel et al. (2010) and Campos et al. (2012) for Mexico, among others].

Additional evidence documenting a decline in income inequality in the region during the post-2000 period is provided by Azevedo et al. (2013b). To understand the main forces behind this phenomenon, the authors perform a parametric decomposition in the spirit of Juhn et al. (1993) for 14 Latin American countries. The authors conclude that changes in labor income were the most important contributor to the decline in inequality across countries in Latin America. Changes in non-labor income were also equalizing but, in general, their relative contribution to the decline in income inequality was smaller than that of labor income. The authors report that the main factor behind the decline in non-labor income inequality was the increase in public transfers.

Azevedo et al. (2013a) use a Juhn–Murphy–Pierce methodology to quantify the relative contribution of a quantity effect and a price effect on changes in hourly wages. The results of the decomposition show that the falling returns to skills, for both education and experience, were, on average, the main force behind the post-2000 decline in labor income inequality in Latin America. The quantity effect, however, made a small contribution to reducing inequality. In addition, consistent with the conclusions in Lustig et al. (2013) and Azevedo et al. (2013b), the authors report that even though the contribution of labor income inequality to total household income inequality in Latin America has decreased, it remains the main contributor to inequality.

Gasparini et al. (2011) focus their analysis on the skill premium. Using the canonical supply demand framework proposed by Katz and Murphy (1992), the authors estimate the relative contribution of supply and demand factors to the trends in the skill premium for tertiary and secondary educated workers. The decomposition performed by Gasparini et al. (2011) shows that supply side factors seem to have limited explanatory power relative to demand-side factors regarding the post-2000 fall in the wage premium. In addition they find that changes in labor regulations, such as legal minimum wages, also exhibit limited explanatory power.

The analysis of income inequality for Chile is heavily concentrated on the pre-2000 period, when income inequality slightly increased. The existing articles on income inequality study different dimensions of it: inter- and intragenerational

[2] However, the analysis for Argentina suggests that the expansion of employment as a consequence of the economic recovery after the 2002 crisis was also an important factor behind the decline in labor income inequality. For Brazil and Mexico, this was not the case.

mobility, the redistributive effects of tax and social policies, the determinants of income inequality, and their relation with poverty levels, among others.

A first group of articles analyze income inequality in a dynamic context by studying the degree of inter- and intragenerational mobility in the Chilean economy. Sapelli (2013) estimates different intragenerational mobility indicators for Chile with data extracted from three waves of the CASEN Panel Survey (1996, 2001, and 2006). The author documents evidence of high levels of mobility in Chile. Sapelli (2013) concludes that although the income distribution in Chile presents relatively high levels of inequality, individuals, indeed, move significantly along the distribution over time. Contreras et al. (2004) estimate intergenerational mobility by computing transition matrixes for different deciles of the income distribution. The authors use panel data from the CASEN Panel Survey (1996 and 2001). They find that mobility is high in the first nine deciles but low to and from the tenth decile. Related to these studies, Denis et al. (2007) use the CASEN Panel Survey (1996, 2001, 2006) to study mobility to and from a state of poverty. The authors find evidence of highly dynamic entry and exit from poverty.

A second group of studies focus on the distributional effects of tax and social policies. Engel et al. (1999) quantify the distributional impact of the Chilean tax system and assess the sensitivity of the distribution of income to changes in the structure of taxes and rates. The authors use data from the 1996 CASEN survey merged with information on incomes extracted from the Internal Revenue Service. The main finding of the study is that the tax system has a little effect on the income distribution. They also show that major changes in the tax structure do not significantly affect the income distribution either. Related to the issue explored by Engel et al. (1999) and Bravo et al. (2001) use data from the CASEN surveys for the years 1990, 1994, 1996, and 1998 to analyze how equalizing social policy was during the period 1990–1998. Their results show a positive short-term impact of social policy on the income distribution.

Contreras et al. (2008) use panel data for the years 1996 and 2001 and cross-sectional data for the years 1990 and 2003 to evaluate whether Chilean growth has been "pro poor". The authors find that economic growth has significantly reduced poverty during the period analyzed, but income convergence is found only for the poorest half of the income distribution.

A third group of studies directly address the determinants of income inequality. Most of them analyze the reasons why income inequality during the pre-2000 period was so stable or slightly increasing (depending on the inequality measure used) in the context of strong economic growth. Cowan and Gregorio (1996) document a slight increase in income inequality during the period 1992–1994 (a very short period of time). The authors attribute the rise in inequality during those years to changes in labor market conditions originating in cyclical movements of economic activity. In addition, they argue that despite the historically high inequality in Chile in the period analyzed, significant improvements in social indicators were observed during that decade: poverty diminished significantly, consumption by households rose, and quality-of-life indicators placed Chile in a privileged position among Latin American countries.

Bravo and Marinovic (1997) describe the evolution of wage inequality in the Chilean labor market using data for the city of Santiago in the period 1957–1996. The authors report an increase in wage inequality for most of the period of analysis, especially between 1957 and 1988. They conclude that long-run changes in relative wages can be mainly explained by observable variables.

Solimano and Torche (2007) analyze the evolution of income inequality during the period 1987–2006 using data from the CASEN surveys. They conclude that income inequality is largely explained by the impact of the tenth decile and, in general, by inequality between deciles rather than inequality within these groups. In addition, the authors conclude that the descending section of the Kuznets curve is not observed during the period analyzed. However, they speculate that the relationship proposed by the Kuznets curve could be observed in the future, although they recognize that it is difficult to establish when. The authors also confirm the sensitivity of the income distribution to inequality in access to a good-quality education. They show that the Gini coefficient decreases significantly if tertiary education expands.

Eberhard and Engel (2008) study wage inequality in Chile by decomposing the variance of log-wages into the sum of the within- and between-group variances. The data used were extracted from the annual Employment and Unemployment Survey conducted by the Universidad de Chile for the period 1975–2006. The authors show that most of the downward trend in inequality from 1995 onward were explained by the dynamics of the standard deviation between cohorts. In addition, they speculate that fluctuations in the between-group standard deviation during the last decade of their period of study can be attributed to a major increase in the share of workers with a tertiary education that originates with the deregulation of the higher education market in 1980.

Other studies on Chile approach inequality from a different perspective than the articles previously discussed. Contreras and Ruiz-Tagle (1997) study inequality in Chile but at the regional level. Their analysis reveals significant disparities in the behavior of the income distribution at the regional level. They attribute this result to the varying evolution of labor market demand in distinct geographical zones. Ruiz-Tagle (2007) deviates from the analysis of the determinants of income inequality and raises the question of what we can expect to happen with income inequality in the future. To do so, the author builds microsimulations to forecast future trends in income inequality. His main conclusion is that wage inequality will remain high for the next 10-year period (from that article's year of publication). The author argues that the structure of the Chilean labor market appears to imply that there is a high level of underlying wage inequality, although the labor market structure seems to prevent further increases in wage inequality.

In sum, the evidence for Latin American countries shows a rise and fall in income inequality in the region, mostly led by a decline in labor income inequality. In addition, for most of the countries, a fall in the skill premium is the main force behind the decline in labor income inequality. Whether market forces or institutional factors are the main contributing factor to the fall in the skill premium is still an open question, and the available evidence is heterogeneous across countries. For Chile, most of the evidence are concentrated on the pre-2000 period. The exceptions are regional studies that

Table 1 Sample size Source: CASEN 1990–2011

Year	Households
1990	25,793
1992	35,948
1994	45,379
1996	33,363
1998	48,107
2000	65,036
2003	71,321
2006	73,720
2009	71,460
2011	87,000

mainly provide evidence on the price-quantity contribution to changes in hourly wages. Studies focused on the Chilean case address different dimensions of inequality. Those studying the determinants of income inequality mainly concentrate on understanding the relative stability of inequality during the period 1990–2000, despite the rapid economic growth. Moreover, none of them provide a unifying picture of the phenomenon. In this paper, we implement simple decompositions based on the 80/20 ratio to dissect, step by step and within a unified framework, the forces driving the rise and fall of income inequality in Chile.

3 Income inequality trends

In this section, we document the path that income inequality followed during the past two decades. We use data from the The Socioeconomic Characterization Survey (CASEN). CASEN is a cross-sectional household survey conducted every 2 or 3 years by the Ministry of Social Development to characterize the population in terms of demographic, educational, health, housing, employment, and income issues. The information derived from CASEN is mainly used to estimate the magnitude of poverty and the income distribution and to evaluate the impact of different social programs targeted to the most vulnerable groups in the population. Since the first year in which it collected data, CASEN has increased the number of surveyed households, reaching 87,000 households in 2011. Table 1 describes the sample size for each of the years included in our analysis.

We first report the 80/20 ratio for per capita income for the period 1990–2011. We denote by $y_{i,a,j,t}$ the income of type i earned by agent a who belongs to quintile j at time t. In addition, we denote by $N_{j,t}$ the total number of agents in quintile j at time t. Then, we define the 80/20 ratio for per capita income at time t, $R_{\mathrm{TI},t}$, as[3]

[3] We follow the definition of quintiles provided by the CASEN surveys and compute the weighted average of the income of members of the respective quintile. According to CASEN, a national quintile is one-fifth or 20% of households in the nation ranked in ascending order according to per capita household income, where the first quintile represents the poorest 20% of households and the fifth quintile represents the richest 20% of households. In turn, the per capita household income is the ratio between the autonomous household income and the number of people that constitute that household.

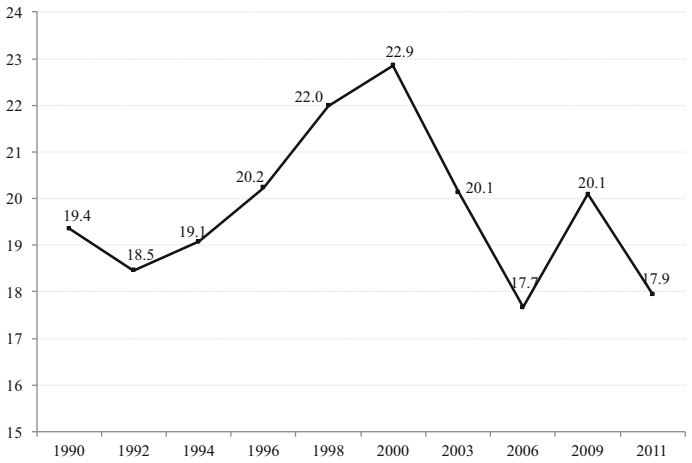

Fig. 1 80/20 ratio for total income

$$R_{\mathrm{TI},t} = \frac{\frac{\sum_{a=1}^{N_{5,t}} y_{\mathrm{TI},a,5,t}}{N_{5,t}}}{\frac{\sum_{a=1}^{N_{1,t}} y_{\mathrm{TI},a,1,t}}{N_{1,t}}}, \tag{1}$$

where TI denotes total income and $j = 1$ and $j = 5$ refer to the first quintile and the fifth quintile of the income distribution, respectively. Figure 1 presents the evolution of income inequality (i.e., the 80/20 ratio, $R_{\mathrm{TI},t}$) over the last 20 years.

We observe, in Fig. 1, a rise and fall in income inequality. The 80/20 ratio increases from 19.4 in 1990 to 22.9 in 2000, and then it falls from 2000 to 2011. The decreasing trend after 2000 is interrupted only by a rise in the 80/20 ratio from 2006 to 2009.

A first element that can influence the evolution of the ratio $R_{\mathrm{TI},t}$ is the fraction of agents that are not potential income earners in the richest quintile and the poorest quintile. For instance, if a rich and a poor household receive exactly the same level of income, but the number of children in the poor household is higher than that in the rich household, the ratio $R_{\mathrm{TI},t}$ will be higher than in the case where the same number of children is present in both households.

We define potential income earners as agents that are 18 years old or older. Figure 2 shows that the fraction of potential income earners is higher in the fifth than in the first quintile. However, a convergence is observed in Fig. 2. This convergence could possibly be related to the well-documented demographic transition, observed in most countries, in which fertility rates have fallen over the past decades, especially in more vulnerable socioeconomic groups.

To formally evaluate the importance of this element for understanding the trends observed in Fig. 1, we graph the 80/20 ratio $R_{\mathrm{TI},t}$ considering only agents who are 18 years old or older (potential income earners). Figure 3 exhibits the results. As expected, we observe that the level of income inequality is lower when we consider only agents who have a potential source of income. The higher fertility rate in the

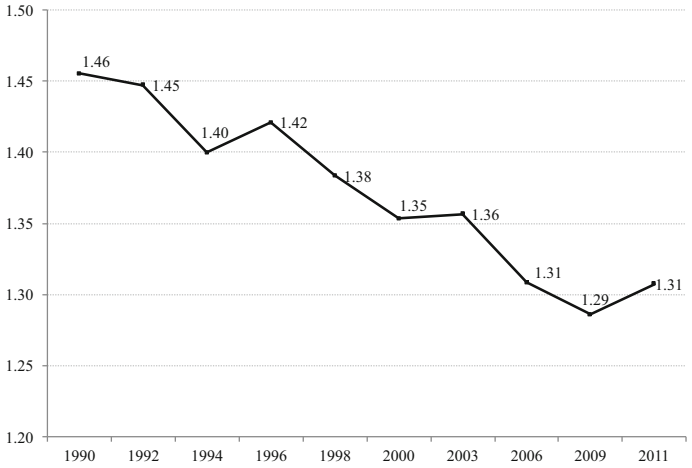

Fig. 2 80/20 ratio for the fraction of income earners

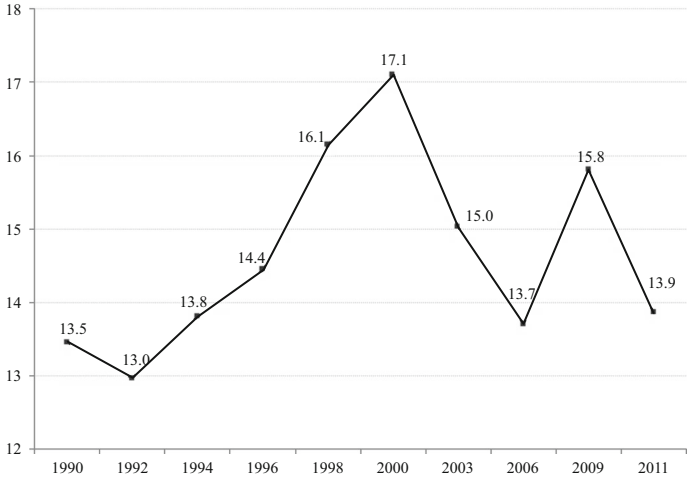

Fig. 3 80/20 ratio for total income of potential income earners

poorest households, compared with that in the richest households, explains this result. For instance, in 1990, the average number of children in a household belonging to the first quintile was 2.4, whereas in the fifth quintile, that figure was 1.3 children. In 2011, the difference in the average number of children in the first and fifth quintiles was 0.6. The trend seems to be roughly the same as the one observed in Fig. 1.

We can quantify the contribution of this type of demographic factor to the movement in overall inequality by expressing the 80/20 ratio as follows:

$$R_{\mathrm{TI},t} \approx R_{\mathrm{TI},t|\mathrm{age}\geq 18}\,\frac{\lambda_{5,t}}{\lambda_{1,t}}, \tag{2}$$

where $R_{\mathrm{TI},t|18\geq \mathrm{age}}$ is the 80/20 ratio for the per capita income of potential income earners, $\lambda_{1,t}$ is the fraction of potential income earners in the first quintile, and $\lambda_{5,t}$ is the fraction of potential income earners in the fifth quintile. Equation (2) produces a good approximation of $R_{\mathrm{TI},t}$ since the income earned by agents defined as potential non-income earners (those younger than 18) is close to zero.

From Eq. (2), we can compute the inequality level that would exist if there had been no difference in the fraction of income earners (that is, $\frac{\lambda_{5,t}}{\lambda_{1,t}} = 1$). Building that counterfactual, we can express the contribution of differences in the fraction of non-income earners to total income inequality in period t as:

$$C_{\mathrm{NIE},t} \approx \frac{R_{\mathrm{TI},t} - R_{\mathrm{TI},t|\mathrm{age}\geq 18}}{R_{\mathrm{TI},t}} * 100, \tag{3}$$

where $C_{\mathrm{NIE},t}$ denotes the contribution of the difference between quintiles in the fraction of non-income earners to total inequality.

Figure 4 presents the results. We observe that the contribution of the fraction of non-income earners to the income inequality level is decreasing over time. Specifically, it falls from 30.5% in 1990 to 22.8% in 2011. As explained before, this decreasing role of the relative fraction of non-income earners in explaining overall inequality trends could be related to the observed convergence in fertility rates among households from different socioeconomic groups.

We can also compute what fraction of the change in inequality over a period is attributable to this type of demographic factor. To do so, we take the derivative with respect to time in Eq. (2):

$$\frac{\partial R_{\mathrm{TI},t}}{\partial t} = \frac{\partial R_{\mathrm{TI},t|\mathrm{age}\geq 18}}{\partial t}\left(\frac{\lambda_{5,t}}{\lambda_{1,t}}\right) + R_{\mathrm{TI},t|\mathrm{age}\geq 18}\frac{\partial\left(\frac{\lambda_{5,t}}{\lambda_{1,t}}\right)}{\partial t} \tag{4}$$

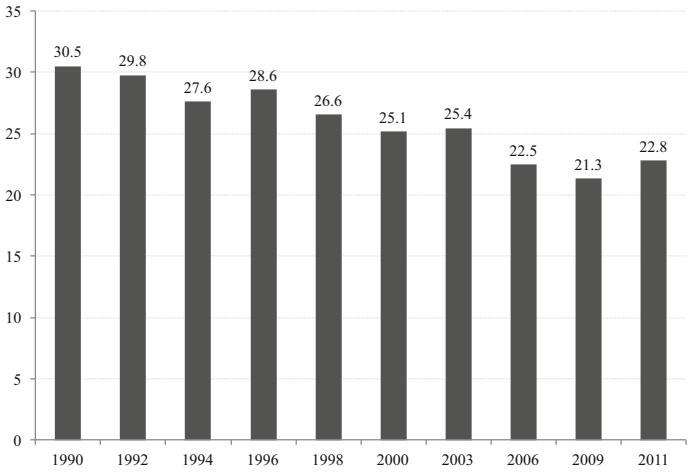

Fig. 4 Contribution of the fraction of income earners to total inequality level (%)

Then, using data from CASEN, we can decompose the total change in income inequality during the periods $t-1$ and t as follows[4]

$$R_{\mathrm{TI},t} - R_{\mathrm{TI},t-1} \approx (R_{\mathrm{TI},t|\mathrm{age}\geq 18} - R_{\mathrm{TI},t-1|\mathrm{age}\geq 18})\overline{\left(\frac{\lambda_{5,t}}{\lambda_{1,t}}\right)} + \overline{R}_{\mathrm{TI},t|\mathrm{age}\geq 18}\left(\frac{\lambda_{5,t}}{\lambda_{1,t}} - \frac{\lambda_{5,t-1}}{\lambda_{1,t-1}}\right), \tag{5}$$

where the overline represents the average value of the variable during the period. The first element of the right-hand side of Eq. (5) is the contribution of income inequality among potential earners to overall inequality. The second element is the contribution of the demographic factor (differences in the fraction of potential income earners across quintiles). Table 2 presents the results of the decomposition described by Eq. (5) in levels and percentages.

We observe that the demographic factor represented by $\left(\frac{\lambda_{5,t}}{\lambda_{1,t}}\right)$ makes a minor contribution to the total change in income inequality. In each subperiod, changes in the 80/20 ratio for per capita income of the population 18 years or older are what account for the total change in income inequality. Demographic factors are important for explaining the level of inequality (because of the different fractions of non-income earners in the poorest and richest quintiles) but are less important as determinants of changes in inequality.

The next step is to understand the sources of inequality behind the ratio $R_{\mathrm{TI},t|\mathrm{age}\geq 18}$. To simplify the notation, denote by $\mathrm{RP}_{\mathrm{TI},t}$ the 80/20 ratio for the total income of potential earners. We can decompose the total income of each agent a who belongs to quintile j as:

$$y_{\mathrm{TI},a,j,t} = y_{\mathrm{LI},a,j,t} + y_{\mathrm{NLI},a,j,t}, \tag{6}$$

where LI denotes labor income and NLI denotes non-labor income. Using Eq. (6), we can decompose the 80/20 ratio as the weighted sum of the 80/20 ratio for labor income and the 80/20 ratio for non-labor income.[5]

$$\mathrm{RP}_{\mathrm{TI},t} = \mathrm{RP}_{\mathrm{LI},t}\alpha_{\mathrm{LI},t} + \mathrm{RP}_{\mathrm{NLI},t}(1-\alpha_{\mathrm{LI},t}), \tag{7}$$

where $\alpha_{\mathrm{LI},t}$ is the share of labor income in the poorest quintile at time t.

Denote by $C_{\mathrm{LI},t}$ the contribution of labor income to total inequality at each period t. We can compute $C_{\mathrm{LI},t}$ as:

[4] t and $t-1$ refer to two arbitrary, not necessarily consecutive, years—for instance, 1992 and 1990 for the first subperiod of analysis.

[5] We derive Eq. (7) as follows. First, we start from the definition of $\mathrm{RP}_{\mathrm{TI},t}$ in an analogous formulation to the one used in Eq. (1) for the total income 80/20 ratio. Then, we split the right-hand side into the components corresponding to the labor income and the non-labor income of the richest quintile. After that, we divide the numerator and denominator of the first term (the per capita labor income of the richest quintile over the per capita total income of the poorest quintile) by the per capita labor income of the poorest quintile. Analogously, we divide the second term (the per capita non-labor income of the richest quintile over the per capita total income of the poorest quintile) by the per capita non-labor income of the poorest quintile. Defining the share of labor income in the poorest quintile at time t as $\alpha_{\mathrm{LI},t} = \sum_{a=1}^{N_{1,t}} y_{\mathrm{LI},a,1,t} / \sum_{a=1}^{N_{1,t}} (y_{\mathrm{LI},a,1,t} + y_{\mathrm{NLI},a,1,t})$ we get Eq. (7).

Table 2 Decomposition of changes in total income inequality

Period	Levels		Percentages (%)	
	R(≥18 years old)	λ_5/λ_1	R(≥18 years old)	λ_5/λ_1
1990–1992	−0.70	−0.19	78.25	21.75
1992–1994	1.18	−0.56	191.53	−91.53
1994–1996	0.89	0.27	76.84	23.16
1996–1998	2.36	−0.60	134.01	−34.01
1998–2000	1.29	−0.43	149.25	−49.25
2000–2003	−2.79	0.08	103.07	−3.07
2003–2006	−1.73	−0.74	70.03	29.97
2006–2009	2.70	−0.27	111.27	−11.27
2009–2011	−2.50	0.36	116.74	−16.74

$$C_{\mathrm{LI},t} = \frac{\mathrm{RP}_{\mathrm{LI},t}\alpha_{\mathrm{LI},t}}{\mathrm{RP}_{TI,t}}. \tag{8}$$

Figure 5 shows that more than 80% of inequality in each period are attributable to the inequality in labor income.

From Eq. (7) we can derive a formula to formally decompose the change in the 80/20 ratio over a period into its three components: the change in the ratio of labor income, the change in the ratio of non-labor income, and the change in the share α. Taking the derivative of Eq. (7) with respect to t, we get:

$$\frac{\partial \mathrm{RP}_{\mathrm{TI},t}}{\partial t} = \frac{\partial R_{\mathrm{LI},t}}{\partial t}\alpha_{\mathrm{LI},t} + \frac{\partial R_{\mathrm{NLI},t}}{\partial t}(1-\alpha_{\mathrm{LI},t}) + \frac{\partial \alpha_{\mathrm{LI},t}}{\partial t}(R_{\mathrm{LI},t} - R_{\mathrm{NLI},t}). \tag{9}$$

Therefore, we can decompose the total change in income inequality during the period $t-1$ and t as follows:

$$\begin{aligned} R_{\mathrm{TI},t} - R_{\mathrm{TI},t-1} \approx {} & (R_{\mathrm{LI},t} - R_{\mathrm{LI},t-1})\overline{\alpha_{\mathrm{LI}}} + (R_{\mathrm{NLI},t} - R_{\mathrm{NLI},t-1})(1-\overline{\alpha_{\mathrm{NLI}}}) \\ & + (\alpha_{\mathrm{LI},t} - \alpha_{\mathrm{LI},t-1})(\overline{R_{\mathrm{LI}} - R_{\mathrm{NLI}}}). \end{aligned} \tag{10}$$

The first component of Eq. (10) shows the contribution to the change in total income inequality that is due to changes in labor income inequality. The second component represents changes that are due to non-labor income inequality. The third component is the change attributable to the variation in the labor income share. Dividing the right-hand side of Eq. (10) by $R_{\mathrm{LI},t} - R_{\mathrm{LI},t-1}$, we can get the percentage contribution of each component to the total change in income inequality. Table 3 presents these results.[6]

Table 3 suggests that the labor market has been the main force behind the rise and fall of income inequality during the last 20 years. For instance, from 1990 to 2000, labor income inequality, on average, accounts for practically all of the

[6] Unfortunately, the 2003 survey does not include data on labor income (only labor income in the main occupation). Therefore, for that year, we impute labor income simply as the average of the years 2000 and 2006.

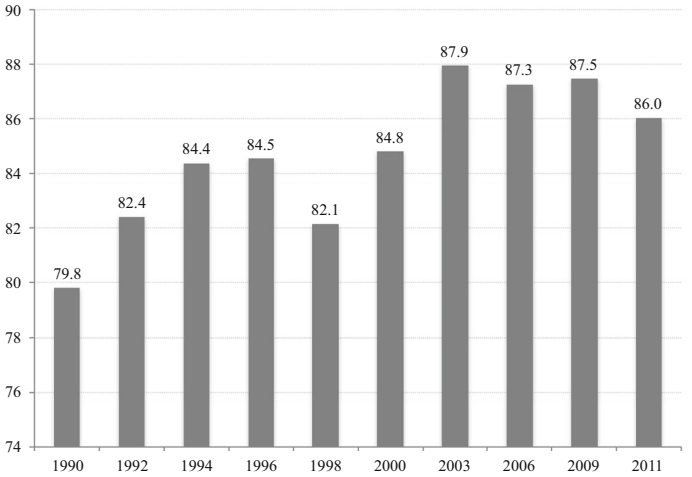

Fig. 5 Contribution of labor income to the income inequality level (%)

Table 3 Decomposition of changes in total income inequality among potential earners

Period	Levels			Percentages (%)		
	Labor	Non-labor	Share	Labor	Non-labor	Share
1990–1992	−0.39	0.07	−0.17	80.04	−13.89	33.84
1992–1994	1.13	−0.34	0.06	133.90	−40.73	6.83
1994–1996	0.39	0.30	−0.05	60.48	46.77	−7.25
1996–1998	1.35	0.27	0.09	78.91	15.54	5.55
1998–2000	1.02	−0.07	−0.06	113.90	−7.45	−6.45
2000–2003	−0.96	−1.06	0.00	47.42	52.60	−0.03
2003–2006	−0.94	−0.30	−0.08	71.03	23.07	5.90
2006–2009	2.31	−0.05	−0.16	109.62	−2.17	−7.45
2009–2011	−1.78	−0.12	−0.05	91.24	6.25	2.50

increase in the 80/20 ratio of total income within each subperiod. From 2000 to 2011, 80% of the variation in the 80/20 ratio is accounted for by changes in labor income inequality.

Summing up, income inequality, measured as the ratio of the per capita income in the richest quintile over that in the poorest quintile, behaves differently over the two different subperiods. The 80/20 ratio rises from 1990 to 2000 and then falls from 2000 to 2011. Decomposing changes in inequality into a demographic factor (changes in the fraction of potential income earners in each quintile) and changes in the per capita income received by potential income earners, we find that the latter factor is the most important for understanding the rise and fall of income inequality in Chile. In addition, we present evidence that labor income, not other types of

income, is the main contributor to the income inequality trends in Chile during the last 20 years. Therefore, labor markets play a big role. The next section dissects labor income inequality into its two main components: wages, hours worked, and employment gaps.[7]

4 Inequality in the labor market: wages, hours worked, and employment gaps

To further understand the sources of inequality in the labor market, we decompose the average monthly per capita labor compensation of the poorest and richest quintiles into their three main components: employment levels, hours worked conditional on being employed, and hourly wages.

We first compute the average per capita labor compensation derived from the main occupation (this type of income represents nearly 90% of total labor income) for agents ages 18 or older (potential income earners). Defining $y_{\text{LIMO},a,j,t}$ as the labor income in the main occupation of potential income earner a in quintile j at time t, and $N_{j,t|\text{age}\geq 18}$ as the total number of agents ages 18 or older, we can define the per capita labor income in the main occupation of quintile j at time t as:

$$R_{\text{LIMO},t} = \frac{\frac{\sum_{a=1}^{N_{5,t|\text{age}\geq 18}} y_{\text{LIMO},a,5,t}}{N_{5,t|\text{age}\geq 18}}}{\frac{\sum_{a=1}^{N_{1,t|\text{age}\geq 18}} y_{\text{LIMO},a,1,t}}{N_{1,t|\text{age}\geq 18}}}. \tag{11}$$

Figure 6 shows that the 80/20 ratio for this type of income follows a similar pattern as total income inequality.

Per capita labor income can differ between quintiles because of differences in employment levels, differences in hours worked conditional on being employed, and differences in the average hourly wage earned by agents in each quintile. To understand the relative importance of each of those factors, we start computing the 80/20 ratio for per capita labor income by considering only individuals who report positive hours worked (specifically, those who report a positive labor income in their main occupation); that is, the ratio between the average per capita labor income of workers belonging to the poorest quintile and the richest quintile. Defining $\text{RE}_{\text{LIMO},t}$ as the 80/20 ratio for the labor income of only agents with positive hours worked (employed agents), we have:

[7] We must note that most surveys are weak at capturing different sources of non-labor income. This is a common problem in all the articles discussed in Sect. 2 that use as their data source the same type of survey as the one used in this article. In addition, non-labor income is a very heterogeneous concept. Some of its components, such as profits, interests, and rents, tend to be concentrated at the top of the income distribution, whereas other components, such as remittances and government transfers, are concentrated in the middle and lower ranges of the income distribution. Therefore, it is difficult to establish the direction of the bias produced by survey data in the estimates of the contribution of non-labor income to overall inequality. Recently, a growing literature has combined survey data with national accounts and tax registries to measure both labor and non-labor income inequality (see Lawson et al. 2014; Bricker et al. 2016; Meyer and Mittag 2015; Meyer et al. 2015, among others).

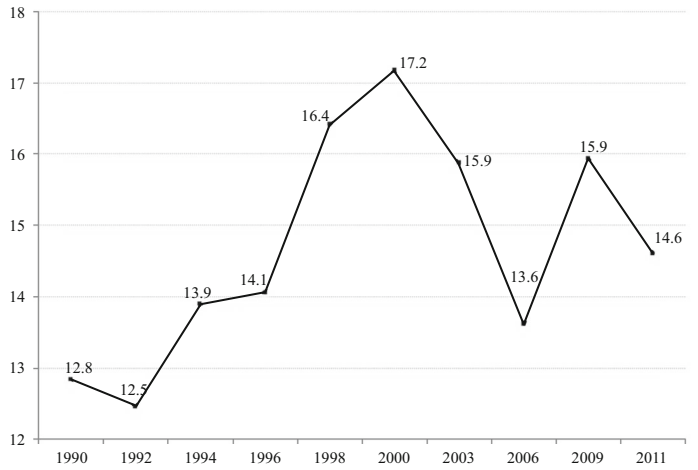

Fig. 6 80/20 ratio for labor income in the main occupation

$$\mathrm{RE}_{\mathrm{LIMO},t} = \frac{\frac{\sum_{a=1}^{N_{5,t|\mathrm{age}\geq 18\&h>0}} y_{\mathrm{LIMO},a,5,t}}{N_{5,t|\mathrm{age}\geq 18\&h>0}}}{\frac{\sum_{a=1}^{N_{1,t|\mathrm{age}\geq 18\&h>0}} y_{\mathrm{LIMO},a,1,t}}{N_{1,t|\mathrm{age}\geq 18\&h>0}}}. \tag{12}$$

Figure 7 presents the results. We again observe a rise in income inequality during 1990–2000 and a fall during 2000–2011. However, two main facts distinguish the evolution of inequality exhibited by Figs. 6 and 7. First, the rise of inequality during the period 2006–2009 does not appear when we consider only agents with positive hours worked. Second, the fall in inequality is much more pronounced in Fig. 7 than in Fig. 6.

Employment gaps between the richest and poorest quintiles are particularly relevant for understanding the deviation from the increasing trend of inequality during the 1990–2000 period and from the decreasing trend during the 2000–2011 period. For instance, employment gaps account for most of the increase in labor income inequality from 2003 to 2009. Therefore, when keeping constant the inequality in access to employment, the pattern of the rise and fall of income inequality becomes clearer.

The perfectly inverted U-shape of the ratio $\mathrm{RE}_{\mathrm{LIMO},t}$ could be explained by two factors: a gap in wages and a gap in hours worked. To disentangle the contribution of those factors, we compute the average per capita hours worked in the respective quintile for agents ages 18 or older who earn a positive income in their main occupation. With that information, we can compute the average hourly wages of agents belonging to each quintile as follows:

$$w_{j,t} = \frac{ye_{\mathrm{LIMO},j,t}}{he_{\mathrm{LIMO},j,t}}, \tag{13}$$

where $ye_{\mathrm{LIMO},j,t}$ is the per capita income earned by agents 18 or older in their main occupation (conditional on earning a positive income), and $he_{\mathrm{LIMO},j,t}$ is their per

Fig. 7 80/20 ratio for labor income in the main occupation ($h > 0$)

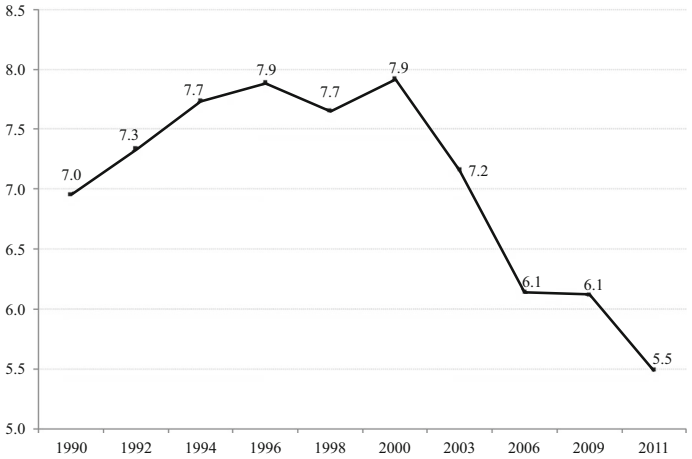

Fig. 8 80/20 ratio for wages

capita hours worked. Figures 8 and 9 exhibit the 80/20 ratio for wages and hours worked, respectively. We observe that the gap in hours worked remains relatively stable during the whole period. In contrast, the wage gap shows a similar pattern to the one exhibited by labor income inequality.

As we did before, we can formally decompose the total change in labor income inequality into changes derived from wages and from hours worked. The 80/20 ratio for labor income can be expressed as:

$$\mathrm{RE}_{\mathrm{LIMO},t} = \frac{w_{5,t}}{w_{1,t}} \frac{he_{5,t}}{he_{1,t}} = R_{w,t} R_{h,t}. \tag{14}$$

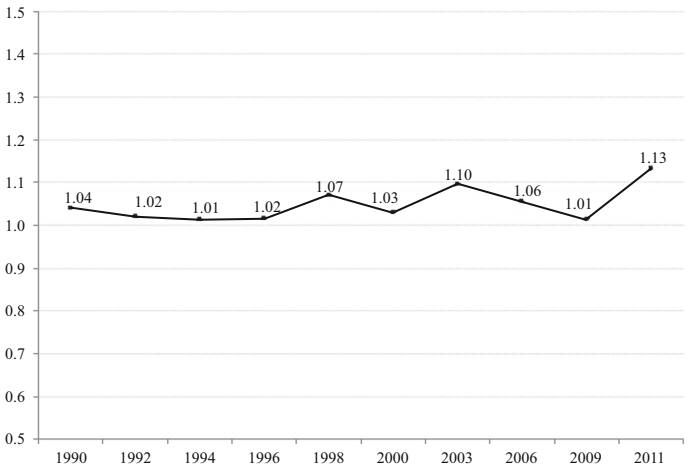

Fig. 9 80/20 ratio for hours worked

Taking derivatives with respect to t, we obtain the following expression:

$$\frac{\partial \mathrm{RE}_{\mathrm{LIMO},t}}{\partial t} = \frac{\partial R_{w,t}}{\partial t} R_{h,t} + \frac{\partial R_{h,t}}{\partial t} R_{w,t}. \tag{15}$$

As before, we can use the following approximation of Eq. (15):

$$\mathrm{RE}_{\mathrm{LIMO},t} - \mathrm{RE}_{\mathrm{LIMO},t-1} \approx (R_{w,t} - R_{w,t-1})\overline{R_h} + (R_{h,t} - R_{h,t-1})\overline{R_w}. \tag{16}$$

Dividing Eq. (16) by $\mathrm{RE}_{\mathrm{LIMO},t} - \mathrm{RE}_{\mathrm{LIMO},t-1}$, we get the percentage contribution of wages and hours worked to changes in labor income inequality. Figure 10 presents the results of that decomposition. During the period 1990–2000, changes in relative wages account for the entire change in labor income inequality. During the period 2000–2011, the narrowing wage gap observed in Fig. 8 accounts for 135% of the change in total income inequality, which means that hours worked was a source of higher and not lower inequality during that period.

Therefore, we can conclude that a widening gap between the wages of the richest and poorest quintiles is the main contributor to the increase in labor income inequality during 1990–2000. The narrowing wage gap from 2000 to 2011 accounts for most of the decrease in labor income inequality during that period. The following section discusses some potential explanations for that phenomenon.

5 Decomposing the changes in hourly wage inequality

From the previous section, we can extract two main lessons. First, labor markets have been the main source of inequality over the last 20 years in the Chilean economy. Second, a widening of the gap between the hourly wages earned by the richest and the poorest quintiles pushed inequality up during the 1990–2000 period,

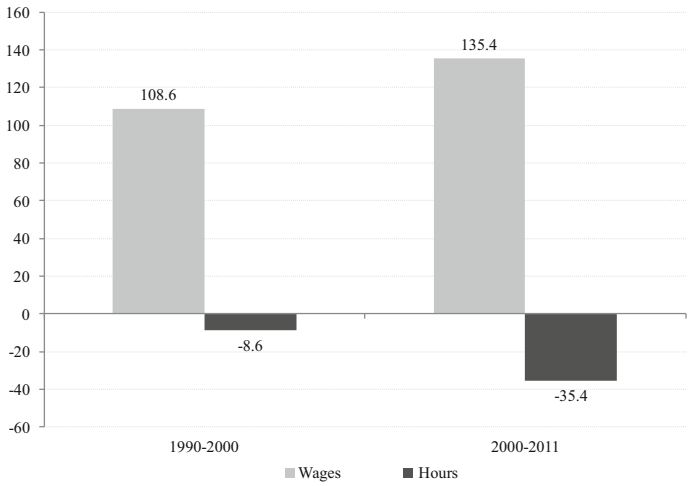

Fig. 10 Contribution of wages and hours worked to changes in labor income inequality (%)

whereas a narrowing gap decreased inequality during 2000–2011.[8] Particularly, striking is the strong decrease in relative hourly wages during 2000–2011. In this section, we discuss some possible explanations for the observed pattern of wages over the last two decades.

The hourly wage earned by agents in the labor market mainly depends on two factors: first, the endowment of skills and, second, the market prices of those skills. Experience and education are the main observable skills that affect hourly wages in the labor market. There could also be unobservable differences among individuals within those categories. For instance, given some level of education and experience, individuals could differ in soft skills, such as perseverance and motivation. In addition, relative prices of different skills will also affect the hourly wages that agents earn in the labor market. Even though the relative endowment of skills remains constant over time, changes in the relative prices of those skills will affect the relative wage that agents receive in the labor market.

In this section, we decompose the change in hourly wage inequality into changes in inequality across observable dimensions of skills (experience and education, and their prices) and changes in inequality within schooling and experience groups. We first graph the evolution of the average hourly wages that agents in the fifth quintile earn relative to those earned by agents in the first quintile. We define the hourly wage of each agent as the ratio between the monthly labor income in the main occupation over the average monthly hours worked. Notice that this definition is slightly different from the one used to build Fig. 8, which allowed us to perform the decomposition described by Eq. (16) (Fig. 11).

[8] The gap in employment levels accounts for some deviations of labor income inequality from the increasing trend before 2000 and the decreasing trend after 2000. For instance, a rise in the employment gap (in favor of the richest quintile) accounts for the whole increase in labor income inequality during 2006–2009.

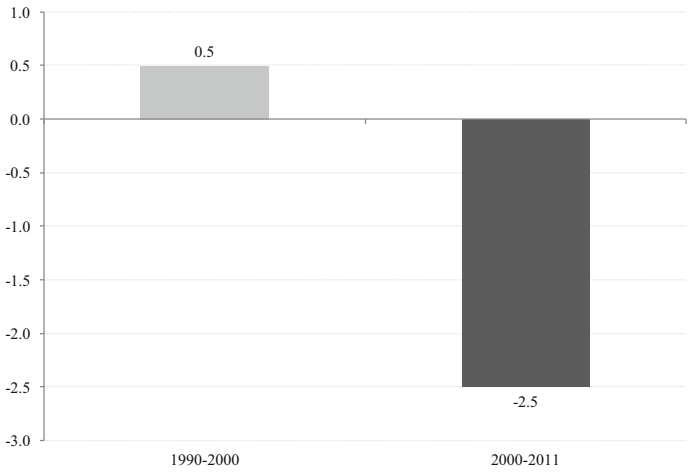

Fig. 11 Change in the 80/20 ratio for hourly wages

We observe that the average hourly wage gap shows a moderate rise during 1990–2000 and a steep drop during 2000–2011. To shed some light on the forces behind the evolution of relative hourly wages (especially on the drop in the wage gap during 2000–2011), we use some variations on the methodology proposed by Juhn et al. (1993). We start by writing a wage equation as:

$$\ln w_{a,t} = X_{a,t}\beta_t + u_{a,t}, \tag{17}$$

where $\ln w_{a,t}$ is the log hourly wage for agent a in year t, $X_{a,t}$ is a vector of individual characteristics (education and experience,[9]) and $u_{a,t}$ is the component of wages accounted for by the unobservables. We assume that $u_{a,t}$ satisfies standard OLS assumptions.

It is useful to think of the residual of Eq. (17) as two components: an individual's percentile in the residual distribution, $\Theta_{a,t}$, and the distribution function of the wage equation residuals, $F_t()$. Let $F_t(./X_{a,t})$ be the conditional cumulative distribution of the residuals for year t. Then, Eq. (17) can be expressed as:

$$\ln w_{a,t} = X_{a,t}\beta_t + F^{-1}(\Theta_{a,t}/X_{a,t}), \tag{18}$$

where $F^{-1}(\Theta_{a,t}/X_{a,t})$ is the inverse cumulative residual distribution for workers with characteristics X_t in year t.

Then, changes in inequality come from three sources: (1) changes in the distribution of individual characteristics (education and experience), that is, changes in the $X's$; (2) changes in the prices of observable skills (changes in the $\beta's$); and (3) changes in the distribution of the residuals.

[9] Data from CASEN do not allow us to collect information on the actual experience of an individual, so we decided to use potential experience instead. Potential experience was built as age-years of schooling-6.

Using this framework, we can simulate the distribution of earnings for each period t by keeping some components fixed. First, define $\overline{\beta}$ to be the average prices for observables over the whole period and $\overline{F}(./X_{a,t})$ to be the average cumulative distribution. With fixed observable prices and fixed residual distribution, wages would be determined as:

$$\ln w^1_{a,t} = X_{a,t}\overline{\beta} + \overline{F}^{-1}(\Theta_{a,t}/X_{a,t}). \tag{19}$$

If we want to allow both observable prices and observable quantities to vary over time, then we can generate wages by:

$$\ln w^2_{a,t} = X_{a,t}\beta_t + \overline{F}^{-1}(\Theta_{a,t}/X_{a,t}). \tag{20}$$

Finally, by allowing observable prices and quantities and the distribution of residuals to change over time, we compute wages as:

$$\ln w^3_{a,t} = X_{a,t}\beta_t + F^{-1}(\Theta_{a,t}/X_{a,t}) = \ln w_{a,t} \tag{21}$$

Then, we can compute the 80/20 ratio of $w^1_{a,t}$, $w^2_{a,t}$, and $w^3_{a,t}$ as follows:

$$R^1_{w,t} = \frac{\exp(\ln w^1_{5,t})}{\exp(\ln w^1_{1,t})}, \tag{22}$$

$$R^2_{w,t} = \frac{\exp(\ln w^2_{5,t})}{\exp(\ln w^2_{1,t})}, \tag{23}$$

$$R^3_{w,t} = \frac{\exp(\ln w^3_{5,t})}{\exp(\ln w^3_{1,t})}. \tag{24}$$

From Eqs. (22) to (24), we can compute the contribution of quantities, prices, and unobservables to total inequality in period t as follows:

$$R_{X,t} = R^1_{w,t}, \tag{25}$$

$$R_{\beta,t} = R^2_{w,t} - R^1_{w,t}, \tag{26}$$

$$R_{u,t} = R^3_{w,t} - R^2_{w,t}, \tag{27}$$

where $R_{X,t}, R_{\beta,t}$, and $R_{u,t}$ are the contribution of quantities, prices, and unobservables, respectively, to total hourly wage inequality (the 80/20 ratio) in period t. Notice that:

$$R_{w,t} = R_{X,t} + R_{\beta,t} + R_{u,t}. \tag{28}$$

Next, we quantify the contribution of quantities, prices, and unobservables to changes in the 80/20 ratio over time. To do so, we use two different methodologies.

We use the approach proposed by Juhn et al. (1993) and the adaptation proposed by Azevedo et al. (2013a).

Juhn et al. (1993) attribute the change over time in inequality as measured by the 80/20 ratio for $w^1_{a,t}$ to changes in quantities of observables. Then, they attribute any additional change in inequality in $w^2_{a,t}$ to a change in prices of observables. Finally, they attribute any additional changes in inequality in $w^3_{a,t}$ beyond those found for $w^2_{a,t}$ to changes in the distribution of unobservables (changes in prices and quantities of unobservables). Formally, taking time differences for $R_{X,t}, R_{\beta,t}$, and $R_{u,t}$, we get:

$$R_{X,t} - R_{X,t-1} = R^1_{w,t} - R^1_{w,t-1}, \tag{29}$$

$$R_{\beta,t} - R_{\beta,t-1} = \left(R^2_{w,t} - R^1_{w,t}\right) - \left(R^2_{w,t-1} - R^1_{w,t-1}\right), \tag{30}$$

$$R_{u,t} - R_{u,t-1} = \left(R^3_{w,t} - R^2_{w,t}\right) - \left(R^3_{w,t-1} - R^2_{w,t-1}\right). \tag{31}$$

Notice that:

$$R_{w,t} - R_{w,t-1} = (R_{X,t} - R_{X,t-1}) + (R_{\beta,t} - R_{\beta,t-1}) + (R_{u,t} - R_{u,t-1}). \tag{32}$$

To implement the methodology of Juhn et al. (1993), we first estimate Eq. (17) using OLS for each year. We consider a traditional Mincer specification by including as covariates the average years of schooling and years of potential experience in linear and squared forms. Next, we rank the regression residuals in ascending order for each year and divide them into percentiles. Then, to estimate the average distribution during the periods $t-1$ and t, we perform the same procedure but use the regression residuals of the estimates for years $t-1$ and t. For each percentile, we estimate the mean to create a discrete approximation of $\overline{F}^{-1}(\Theta_{a,t}/X_{a,t})$. Then, to construct wages in Eqs. (19) and (20), we assign to each percentile in the residuals distribution in year t the mean value in the distribution $\overline{F}$. Finally, $\overline{\beta}$ in Eq. (19) is built as the simple average of the estimated coefficient for the reference period.[10]

Azevedo et al. (2013a) propose the following adaptation. Denote by s a fixed time period (for instance, 1990). We can rewrite Eqs. (19)–(21) as:

$$\widetilde{\ln w}^1_{a,t} = X_{a,t}\beta_s + F_s^{-1}(\Theta_{a,t}/X_{a,t}), \tag{33}$$

$$\widetilde{\ln w}^1_{a,t} = X_{a,t}\beta_t + F_s^{-1}(\Theta_{a,t}/X_{a,t}), \tag{34}$$

$$\widetilde{\ln w}^3_{a,t} = X_{a,t}\beta_t + F^{-1}(\Theta_{a,t}/X_{a,t}) = \ln w_{a,t}. \tag{35}$$

After computing Eqs. (33)–(35), we follow the same steps as in Juhn et al. (1993). Tables 4 and 5 present the results.

[10] We also perform the same exercise using quintiles instead of percentiles. The main conclusions remain under this alternative methodology.

Table 4 Juhn et al. (1993) decomposition

Period	Levels			Percentages (%)		
	Observables	Prices	Unobservables	Observables	Prices	Unobservables
1990–2000	0.53	1.06	−1.07	102.45	204.22	−206.67
2000–2011	−2.15	−0.67	0.35	86.95	27.28	−14.23

Table 5 Azevedo et al. (2013a) decomposition

Period	Levels			Percentages (%)		
	Observables	Prices	Unobservables	Observables	Prices	Unobservables
1990–2000	0.54	1.23	−1.25	104.15	235.81	−239.97
2000–2011	−2.13	−0.47	0.13	86.15	18.99	−5.14

We observe in Tables 4 and 5 that observable characteristics (experience and education) and observable prices (returns to education and experience) are by far the most important factors that account for the rise in overall wage inequality in 1990–2000 and the subsequent fall after 2000. However, the relative importance of each factor varies in the two periods. Before 2000 the relative price of skills plays the main role, whereas after 2000, observable characteristics are the main factor behind the decline in income inequality.

Next, we analyze the trends in the main observable price and quantity: the education wage premium and the level of educational attainment. We first present the Mincerian "return to education" for the whole period.[11] The Mincer coefficient measures the average wage premium that agents receive in the labor market as their years of schooling increase. Figure 12 shows that the Mincer coefficient exhibits an inverted U-shape. The education wage premium rises before 2000 but falls after 2000. A rise in the education premium coincides with the period of increasing wage inequality, whereas its fall resembles the fall in wage inequality. This consistent pattern of the Mincer coefficient and inequality is, in part, explained by the big educational gap that exists between the fifth and first quintiles.

To study not only the movement of the average return to education (in Mincer's sense) but also the evolution of the wage premium for higher education, we estimate the following empirical model:

[11] "Return" is in quotation marks, because it is the ex-post average growth rate of earnings with schooling and not, in general, an internal rate of return or a marginal return that is appropriate for evaluating the optimality of educational investment. It communicates how much average earnings increase with schooling, but it is not informative on the optimality of educational investments, which requires knowledge of the ex ante marginal rate of return. Only under specific assumptions can this coefficient be interpreted as a rate of return (see Heckman et al. 2008 for a more detailed discussion). For simplicity, we use interchangeably the terms "returns to education", "Mincerian returns to education", and "skill premium", although the ex-post college wage premium and Mincerian returns to education might not be the relevant rate of return on which individuals base their education decisions, as noted by Heckman et al. (2008).

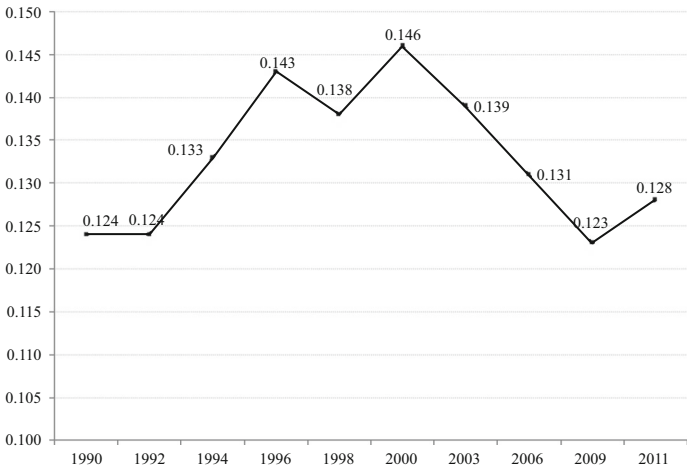

Fig. 12 Mincerian returns to education

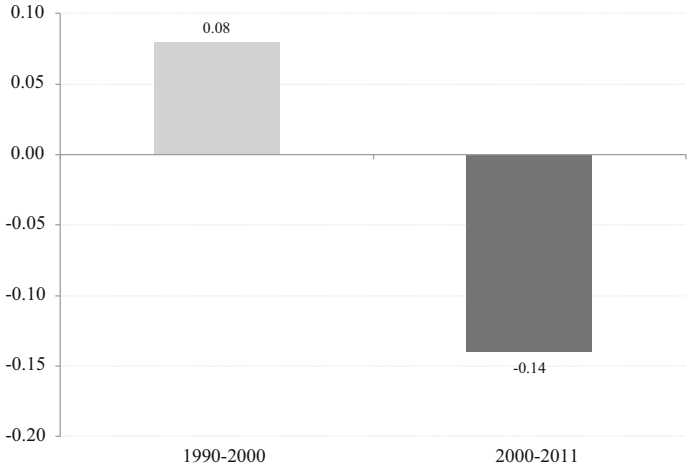

Fig. 13 Changes in returns to higher education

$$\ln w_{a,t} = \delta_{0,t} + D_{a,t}\delta_{1,t} + \exp_{a,t}\delta_{2,t} + \exp_{a,t}^2\delta_{3,t} + u_{a,t}, \tag{36}$$

where $\ln w_{a,t}$ is the log hourly wage for agent a in year t, $D_{a,t}$ is a dummy variable that equals 1 if agent a had 16 or more years of education at time t, $exp_{a,t}$ are years of experience, and $u_{a,t}$ are the regression residuals.

In the empirical model described by Eq. (36), $\delta_{1,t}$ measures the increase in wages that an agent with a college or higher education receives relative to an agent without a college education. Figure 13 shows the change in this coefficient over the pre- and post-2000 periods. We observe that this "return to higher education" increases

Table 6 Educational attainment, 1990–2011 Source: CASEN 1990–2011

Quintile/year	1990	1992	1994	1996	1998	2000	2003	2006	2009	2011
1st quintile	1.07	1.02	1.03	0.92	0.84	1.32	1.45	2.44	2.28	2.34
5th quintile	24.74	24.44	27.17	29.91	33.78	36.4	38.14	35.82	39.46	38.88
All	7.38	7.15	8.02	9.06	9.79	10.40	11.43	11.37	12.74	12.02

Statistics are the percentage of population age 18 years or older with 16 (or more) years of schooling over the population age 18 years or older, by quintile of per capita household income

Table 7 College enrollment rates, 1990–2011 Source: CASEN 1990–2011

Quintile/year	1990	1992	1994	1996	1998	2000	2003	2006	2009	2011
1st quintile	3.37	5.34	6.43	6.59	6.16	6.95	10.01	13.63	16.54	22.06
5th quintile	32.27	30.98	43.42	49.69	51.55	51.93	57.63	52.84	54.29	58.97
All	12.2	12.84	18.05	20.98	20.96	21.96	26.09	27.40	28.82	33.3

Statistics are the percentage of the population between 18 and 24 years of age enrolled in a higher education institution, by quintile of per capita household income

during the pre-2000 period. During 2000–2011, the return to education shows a decreasing trend.

Wage inequality depends not only on the changes in the education wage premium but also on what group of the population is supplying more educated workers to the labor market (the quantity effect). Table 6 presents the fraction of agents ages 18 or older who completed a college education in the first and fifth quintiles as well as in the whole population. We observe in Table 6 that the educational attainment of the poorest quintile slightly worsened until 1998; after that, the fraction of the population that attained higher education increased (even though its level was still low relative to that of the fifth quintile). The educational attainment level of the richest quintile shows a different pattern. The fraction of agents in the fifth quintile with a completed higher education strongly increases during 1990–2000 but is relatively flat after 2000. Therefore, we observe a strong rise of inequality in educational attainment during the pre-2000 period, which becomes more moderate during the post-2000 period. Table 7 presents the enrollment rates of the college-aged population. We observe that the enrollment rates of the richest quintile increase faster than those of the poorest quintile during the earlier decades of the period analyzed. The opposite fact is observed in the later decades. Thus, Table 7 also unveils a reverting trend in human capital inequality between the poorest and the richest quintiles over the period analyzed.

We end the discussion in next subsection by discussing potential explanations for the price effect, specifically, the rise and fall in the Mincerian return to higher education.

5.1 Discussion: the rise and fall of the skill premium

In this section, we discuss the forces behind the rise and fall of the skill premium in Chile. Based on the seminal work by Katz and Murphy (1992), we have that the movement in the premium on higher education reflects a race between supply and demand forces. In periods where the demand for education grows faster than the supply, the return to education (more precisely, the higher education wage premium in the labor market) rises. The opposite phenomenon occurs when the supply grows faster than the demand. In the context of the evidence presented in the previous section, the rising Mincerian return to education in the pre-2000 period reflects a faster relative increase of the demand for more skilled workers. Conversely, its decline during the post-2000 period reflects a relatively slower rise in the demand for more educated workers. In the rest of this section, we will discuss the potential forces behind the changes in the supply of and demand for skilled workers that could be consistent with the evidence on the rise and fall of the skill premium in Chile documented above.

We have shown, in Tables 6 and 7, the rise in the educational attainment of the labor force and the college enrollment rates experienced by the economy over the past two decades. Both variables are used in the literature as a proxy for the evolution of the supply of skilled workers (e.g., Murphy and Welch 2001). This positive supply shift of more educated workers is, in part, consistent with the higher return to education observed in the earlier decades of the period of analysis. In turn, the fall in the return to higher education observed during the post-2000 period reflects the gradual entry of new cohorts of college educated agents into the labor market, the exit of the older and less educated cohorts, and a slower relative growth of the demand for skilled workers. The human capital accumulation process described by Tables 6 and 7 was also fueled by important reforms to the higher education market initiated at the beginning of the 1980s. Those reforms expanded and diversified the supply of higher education institutions, which probably impacted more significantly the educational choice of the poorer quintiles. We will briefly describe those reforms.

The Military Government, based on an official diagnosis of the Chilean higher education market, carried out at the beginning of the 1980s an important education reform that included a series of legislative changes that led to a major reduction in barriers to entry to the higher education market for private providers. The new regime was instituted after the enactment of Decree Law 3541 of 1980, which granted special powers to the Head of State to restructure the country's universities. Under that decree, the Military Government issued a set of norms throughout 1981, which, in combination, make up the new legislative regime of the Chilean higher education market. Among the guiding principles of the reform are (1) the opening of higher education to the market on the basis of academic freedom, understood as the freedom to create and support educational institutions, (2) a reduction in the barriers to entry for providers, and (3) a further fostering of competition as a source of quality improvements in the supply of education.

The liberalization of tertiary education in 1980 is arguably the largest supply shock in education policy during the last three decades in Chile (see Brunner

1993, 2008). As a result of the 1980 reform, both the institutional composition and the financing of Chilean higher education underwent dramatic changes. New establishments mushroomed. More than 300 institutions, practically all private in nature, were created from 1980 to 1990, thus dramatically changing the shape of the higher education system.

Following the expansion and diversification of higher education, the question of quality assurance began to be raised. The first steps towards a quality assurance system were taken in the mid-1990s with the creation of the Education Council, which started implementing a compulsory licensing system for some educational institutions. In the late 1990s and early 2000s, institutions were created to develop voluntary program accreditation at the undergraduate and graduate levels, including the Commission for the Evaluation of Undergraduate Programs (CEUP) in 1999 and the Commission for the Evaluation of Postgraduate Programs in 2000. In 2004, CEUP also started implementing accreditation at the institutional level. After this learning period, in 2006, Law 20.129 set up the National Higher Education Quality Assurance System, creating new quality assurance institutions and functions.

Therefore, on the supply side, the endogenous response of agents to the higher returns to education was fueled by a reform of the education system initiated at the beginning of the 1980s, which expanded and diversified the supply of higher education institutions. In addition, in the middle of the 1990s, a new infrastructure of higher education quality assurance was built. This new infrastructure, comprising initially the Education Council and, later, the commissions for the evaluation of undergraduate and postgraduate programs and the National Higher Education Quality Assurance System, has strengthened the focus on the quality of Chilean higher education institutions since the mid-to-late 1990s. Therefore, the supply of skilled workers rose during the period 1990–2011, but especially since the mid-to-late 1990s, in terms of both enrollment in higher education and its quality.

Regarding the demand forces, the growth of the Chilean economy has been driven by and has triggered several forces that have directly affected the demand for different skills in the labor market. First, a change inherent to the process of a country's economic development is that the service sector grows and the manufacturing sector shrinks. This structural economic transformation moves output from manufacturing to services. Given that the service economy is more knowledge intensive and less physically intensive, the demand for skilled labor increases. This process through which the service economy rises as the economy develops and in turn pushes up the education premium has been well documented by Buera and Kaboski (2012) for the U.S. economy. The Latin American economies, in general, and Chile, in particular, have not been exempt from this process, as is well documented by De la Torre et al. (2013).

De la Torre et al. (2013) show that economic activity in Latin American countries (Chile included) in the past decades has been shifting from manufacturing to services, a process that they call "tertiarisation". The authors argue that the rise of services that the region has experienced seems to be more a general consequence of the region's development than a by-product of the commodity boom, in line with the evidence that Buera and Kaboski (2012) document for the US economy. Moreover, the authors present conclusive evidence that the contribution to value-

added growth in Latin America in the past decades has not been circumscribed to low-skilled activities or construction; on the contrary, the contribution to growth has been more significant in high-skilled services.

De la Torre et al. (2013) also present data on the skill composition by sector which indicates that services are the sector in Latin American countries that uses the highest share of educated workers. Moreover, they document that the service sector has become more skill-intensive than the manufacturing sector and that no decline is observed in the share of the labor force in skill-intensive sectors relative to the rest. Sectors with higher education intensity grew comparatively more, which contradicts the hypothesis of a shift towards low-skill sectors. Therefore, the rise of the service economy seems to be a force pushing up the relative demand for more educated workers during the past decades in Chile and the region, in line with the process described by Buera and Kaboski (2012).

In addition, in a developing economy, such as Chile, international trade is one of the main forces through which foreign technologies are absorbed (Parente and Precott 1994). In parallel, there is vast empirical evidence that technological change is skill-biased (see Katz and Murphy 1992; Berman et al. 1998; Borjas et al. 1997; Acemoglu 2002, among others). That is, technological improvements increase the relative productivity of more skilled workers, which also increases the relative demand for those types of workers. For Chile, Gallego (2012) also documents that the technological change has been biased toward more skilled workers. Therefore, the rapid trade liberalization experienced by the Chilean economy and the skill bias of the new technologies absorbed by the country should have pushed up the relative demand for skilled workers in the past decades.

Trade liberalization also affects the relative demand for different types of workers through other channels. A traditional trade theorem, the Stolper–Samuelson effect, predicts that as countries open their economies to international trade, developed countries will specialize in goods whose production is more intensive in skilled workers, while less developed countries will specialize in goods that require less skilled workers. The main prediction of these models is that the demand for skilled workers should rise in developed countries and decrease in less developed countries. However, in developing countries, there is a second force that counterbalances the Stolper–Samuelson effect: capital-skill complementarity, which means that capital is more complementary to more educated workers. When economies increase their imports of capital goods, the relative productivity of more educated workers rises and, consequently, the relative demand for these workers increases. Internationally, the hypothesis of capital-skill complementarity is empirically supported by the seminal work of Krusell et al. (2000). In a recent paper, Correa et al. (2016) empirically confirm the existence of capital-skill complementarity in the Chilean economy.

Therefore, on the demand side, all of the forces described above are both engines of economic growth and sources of increases in the relative productivity of more educated workers and, thus, the relative demand for those workers. The supply and demand elements discussed above, together with the empirical evidence throughout this paper, suggest that it is a race between the demand for and the supply of educated workers in the labor market that is, in the end, behind the rise and fall of

wage inequality. Long-term forces inherent to economic development constantly push up the relative demand for skilled workers. At the beginning of the process, the response of the supply is slower than the increase in the demand. Therefore, the returns to education rise, and this higher premium on education increases income inequality.

However, the gradual entry of new cohorts of college graduates into the labor market together with the retirement of older less educated cohorts increase the supply of more educated workers. When the supply begins to grow faster than the demand, inequality starts falling. In the case of Chile, the human capital accumulation process was also fueled by the education reforms initiated in the 1980s that expanded and diversified the supply of higher education and by the flourishing of higher education quality assurance since the mid-to-late 1990s.[12]

Therefore, the only way of making the decline of inequality observed during the period 2000–2011 sustainable is by facilitating access to education for more vulnerable groups. In this way, those groups would be able to reap the higher returns to education, and the incipient decreasing trend in income inequality documented in this paper would become a long-term trend.

6 Conclusions

This paper presents evidence on the evolution of income inequality in Chile during the past two decades. We document a rise and fall in income inequality during the period 1990–2011. Specifically, income inequality rises before 2000 and then decreases after 2000. The only exception is the period 2006–2009, when income inequality increases. We performed several decompositions to isolate the quantitative contribution of the different components of inequality. Our results can be summarized as follows:

1. Labor income inequality is the main contributor to the observed movements in overall inequality. Non-labor income plays only a minor role.
2. Employment gaps between the richest and poorest quintiles are particularly relevant for understanding the deviations from the increasing trend of inequality during the 1990–2000 period and from the decreasing trend during the 2000–2011 period. For instance, employment gaps account for most of the increase in labor income inequality from 2003 to 2009.
3. When the employment gaps are kept constant over time, the rise and fall in labor income inequality are especially clear. We observe a continuous increase in labor income inequality during the 1990–2000 period among individuals who report positive hours worked, and a pronounced fall after 2000.

[12] Institutional labor market factors seem not to have played an important role during the period of analysis. Data from the unemployment insurance system reveal that for only a small fraction of the labor force has the minimum wage been binding during the past decades. In addition, data collected by the OECD show that the level of unionization of the labor force has remained relatively stable during the past decades.

4. Hourly wage inequality accounts for most of the rise and fall in labor income inequality. The gap in hours worked, conditional on being employed, stays relatively constant over the whole period.
5. Performing a decomposition of inequality in hourly wages into its three main components (observable characteristics, prices of skills, and unobservables), we find that observable characteristics of workers and relative prices of different skills account for most of the changes in overall wage inequality.
6. Specifically, inverted U-shaped trends in educational attainment gaps and in the Mincerian returns to education are the main factors behind the inverted U-shaped trend in the inequality in hourly wages.

The evidence presented in this paper is consistent with a story in which several forces inherent to economic growth increase the demand for more educated workers and, therefore, the returns to education and inequality in earnings. As the supply of educated workers begins to respond (encouraged by the higher returns to education), the rise in income inequality is moderated or even reversed.

In this way, the phenomenon reported for Chile shares several characteristics with the one observed in other countries of the region, as discussed in Sect. 2. Those common elements are the following: (1) the rise and fall in income inequality during two well-marked sub periods, 1990–2000 and 2000–2011, respectively; (2) the relatively greater contribution of labor markets to changes in overall inequality; (3) the existence of a skill premium that first widens and then shrinks during the periods when labor income inequality rises and falls, respectively; (4) an upgrading of the labor force; and (5) the existence of demand forces linked with economic growth that fuel the relative demand for more educated workers. Of course, some differences exist across countries; for instance, the fact that institutional labor market factors seem to be more relevant in some countries than in others. However, the evidence presented for Chile in this article reinforces the view for the region that income inequality seems to be, in general, the result of a race between the demand for skilled workers that goes hand in hand with the economic development of countries and the capacity of the education system to provide the skills that the labor market demands more intensively. The evidence discussed in Sect. 2 and the results presented in this article for Chile point to education policies as the most effective way of reducing income inequality levels in the long term.

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