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Returns to Work Experience in Chile

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Returns to Work Experience in Chile[*]

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Abstract

This paper studies returns to work experience in Chile, providing evidence in support of their relevance for human capital dynamics. Using the methodology proposed by Lagakos et al. (2018), several waves of the Socioeconomic Characterization Survey are exploited in order to provide a rich cross-section characterization. The findings suggest that, on average, workers maximize returns to experience throughout the initial years after entering the work force. Additional results deliver further evidence in favor of greater returns for workers with higher-educational level and for those who are employed in cognitive occupations. Furthermore, this article also provides evidence that under this criterion returns to experience exhibit a relevant gender gap in favor of male workers. In addition, it assesses how macroeconomic conditions affect the accumulation of these returns. After conducting an econometric analysis to avoid possible collinearity between age, time, and birth cohort effects, estimated returns are lower along the first years, while higher at the end of the workers' productive period. The life-cycle wage-growth profile documented by the literature for Chile is consistent with estimates for other countries with similar levels of development. Nevertheless, throughout the median of the individual's working life, returns are marginally lower than expected given the country's income level.

Resumen

Este articulo estudia los retornos a la experiencia laboral en Chile, aportando evidencia empírica a favor de su relevancia para el análisis del capital humano. Se utilizan distintas versiones de la Encuesta de Caracterización Socioeconómica (CASEN) y la metodología propuesta por Lagakos et al. (2018),

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para realizar un análisis de corte transversal. Los resultados muestran que el trabajador promedio concentra los retornos a la experiencia en los primeros años de la vida laboral. No obstante, los perfiles de crecimiento del ingreso son mayores para los trabajadores de mayor nivel educacional y para quienes realizan ocupaciones cognitivas. Además, existe una brecha de género importante en los retornos a la experiencia, a favor de los hombres. Por otro lado, las condiciones macroeconómicas afectan la capacidad de tener retornos positivos a la experiencia laboral. Adicionalmente, un análisis econométrico realizado para aislar una posible colinealidad entre los efectos experiencia, cohorte y tiempo entrega menores retornos a la experiencia al inicio de la vida laboral y mayores al final. Los perfiles de crecimiento del ingreso obtenidos para Chile son coherentes con los documentados para países con un nivel de desarrollo similar. Sin embargo, el retorno a la experiencia en la mitad de la vida laboral es algo menor de lo que se espera dado el nivel de ingresos del país.

I Introduction

Workers can acquire human capital from two sources: formal education and skills developed while they are working (on-the-job skills). This last type of human capital is usually known as "informal training" (De Grip, 2015; Lynch, 1992; Rosen, 1972). Unfortunately, as it does not have formal supports such as a diploma or an academic degree, it is difficult to accurately measure it. For this reason, the literature has in general computed informal training using as a proxy the number of years of work experience. The intuition behind this idea is that the longer a worker has been in the labor market; the greater chance he had to accumulate informal training. Therefore, if employers value this type of human capital, experience-wage growth profiles should be increasing over the life-cycle.

Work experience has important consequences in labor productivity and, thereby, in economic development (Arrow, 1962). Actually, using experience-wage growth profiles, we can describe how workers increase their productivity over time, differentiating between the development of job-specific skills and movements toward jobs where they can better exploit their potential and talents.

Over the past years, the literature has developed a growing interest in this topic, focusing, in general, in advanced economies (Hendricks, 2015; Kolasa, 2012; Rupert & Zanella, 2015). The evidence for developing countries remains scarce, due to the difficulty to have panel data that covers a very long period, which is crucial to describe individuals' complete working life. Nevertheless, Lagakos et al. (2018) –henceforth LMPQS– make a very important contribution to the study across countries: they propose an approach to use household surveys with individual-level data to measure returns to work experience. Recently, other authors have followed this approach to study life-cycle wage growth in other countries (Aktug et al., 2018).

Accordingly, this paper studies returns to work experience in Chile, documenting experience-wage growth profiles over the life-cycle, to provide evidence in support of their relevance for human capital dynamics. To achieve this goal, this article follows the methodology proposed by LMPQS and uses data from the Socioeconomic Characterization Survey (*Casen* by its Spanish acronym) from 1990 to 2017.

The findings suggest that, on average, Chilean workers maximize returns to experience throughout the initial years after entering the work force. There is further evidence in favor of greater returns for workers with higher-educational level and for those who are employed in cognitive occupations. In consequence, the experience-wage variance profile is rising over the life-cycle. Furthermore, this work also provides evidence that

under this approach returns to experience exhibit a relevant gender gap in favor of male workers, regardless of their level of educational attainment. In addition, this article assesses that macroeconomic conditions affect the accumulation of these returns for certain cohorts, because the chances of developing job-specific skills or having good movements toward jobs are reduced during economic crises.

These previous results are computed using the simple cross-sectional approach developed by LMPQS. Nevertheless, an additional econometric analysis is conducted to avoid possible collinearity between age, time, and birth cohort effects. In particular, this paper follows the two approaches they propose: Deaton-Hall and Heckman-Lochner-Taber. Using the latter approach, returns to experience are lower along the first years, while higher at the end of the workers' productive period, than the ones calculated with the cross-sectional approach.

Finally, this paper shows that the life-cycle wage growth profile documented by the literature for Chile is consistent with the ones estimated for other countries with similar levels of economic development. In addition, there is a positive correlation between relative wage growth at 20-24 years of experience and real GDP per capita, so we can conclude that returns to experience are higher in richer countries. Nevertheless, we see that for Chile, throughout the median of the individual's working life, returns are marginally lower than expected given the country's income level.

This article is organized as follows. Section II measures returns to work experience in Chile using the cross-sectional approach developed by LMPQS and identifies differences in experience-wage growth profiles according to educational attainment, type of occupation, gender, and for different cohorts. Section III compares these results with the profiles estimated using the Deaton-Hall and the Heckman-Lochner-Taber approaches. Section IV uses empirical evidence provided by previous literature to compare returns to experience in Chile and in other countries. Finally, section V concludes.

II   Returns to Experience in Chile: Cross-Sectional Approach

Since it is difficult to quantify informal human capital, the literature has established how much employers value it by studying returns to work experience. This article follows the methodology developed by Lagakos et al. (2018), which allows me to use cross-sectional household surveys with individual-level data. They start their work with a simple cross-sectional approach that lies in two steps. Firstly, for each available year,

they compute the average wage of each 5-year experience bin and, then, they express it as a percent difference from the average wage of workers with 0-4 years of experience. Next, they average these results across calendar years[1]. To deal with the difficulty of properly measuring work experience in cross-sectional surveys, they define "potential experience" as the minimum between the number of years since the individual reached the age of majority (18 years old) or since he completed his education[2].

Unlike LMPQS, this paper calculates experience-wage growth profiles for Chile using all available waves of the Socioeconomic Characterization Survey (Casen by its Spanish acronym) from 1990 to 2017, and not only from 1990 to 2011. This should improve the estimation because it includes more information to compute time fixed effects and, then, to better identify returns to experience.

One major advantage of the Casen Survey is that we can calculate hourly wages, because the survey provides information on the monthly income the individual received from his primary job[3] and on the number of hours he worked in this job in a month. Using hourly wages permits to abstract from potential divergences in the number of working hours between different types of individuals that could bias the results. Also, the baseline sample only considers male wage earners employed in the private sector in full-time jobs, to match the sample restrictions made by LMPQS[4].

Firstly, Figure 1 documents that the experience-wage profile is concave, i.e., it is increasing at a decreasing rate, and that, on average, workers maximize returns to experience throughout the initial years after entering the work force[5]. In fact, relative wage growth reaches the maximum between 15 and 19 years of experience: nearly 40% wage growth relative to the least experience group. Then, there is a flatter profile until 29 years of experience. After 30 or more years of experience, returns are decreasing, probably because older workers suffer from depreciation of their skills and/or from a lower match quality at the end of their productive period.

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[1] It is worth mentioning that with this methodology, I am not trying to analyze wage level differences between workers, but to study how accumulating more work experience increases wage growth relative to workers with no experience.
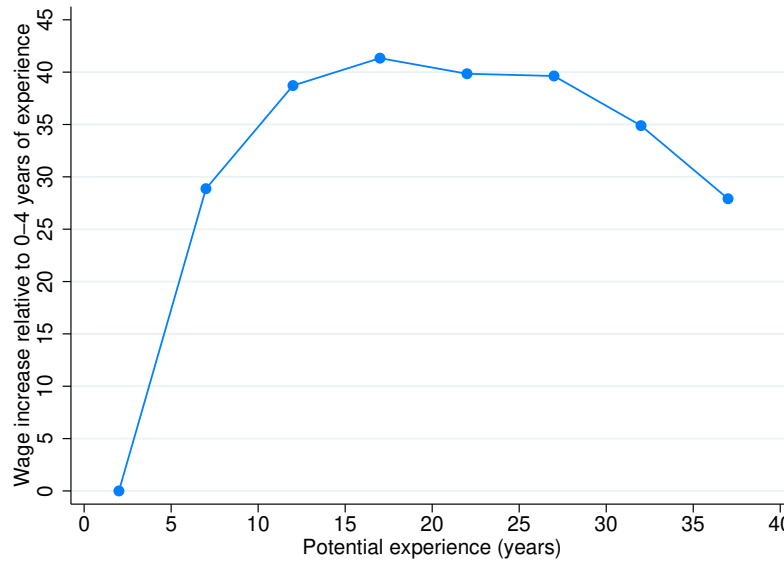
[2] The assumption behind potential experience is that it is defined as $age - 18$ for workers who have at most 12 years of schooling and as the number of years since they ended their education for workers who have at least 13 years of schooling. This implies that each experience group considers workers of different ages.

[3] All wages are converted to 2017 Chilean Pesos using the Consumer Price Index (CPI), whereas LMPQS use the price deflators calculated by the IMF.

[4] I perform several robustness exercises to see if alternatives sample selection criterion are driven the results. In fact, the findings depend on only considering full-time workers or wage earners, but they remain quite similar if the public sector is included.

[5] Given data limitations, these results may be due to changes in the composition of wage employment over the life-cycle or to cohort-neutral changes. Section III tries to deal with these issues.

Figure 1: Life-cycle wage growth by years of potential experience (*)
(percentage change, average 1990-2017)

This previous experience-wage growth profile is calculated for the average worker; therefore it may hide important differences according to the relative position of the worker in the income distribution. Using data from the U.S. Social Security Administration (SSA) records, Guvenen et al. (2015) conclude that wage growth over the life-cycle is strongly influenced by the level of lifetime earnings. In fact, they document that between the age of 25 and 55, earnings of the median individual are multiplied by 1.38 times, they are multiplied by 3.3 times for those in the 95 percentile and by almost 16 times for individuals in the top 1%.

Accordingly, this article analyzes if experience-wage growth profiles vary by level of educational attainment. Workers are categorized into three education groups[6]: (i) workers with less than 9 years of schooling, (ii) workers with 9-12 years of schooling, and (iii) workers with at least 13 years of schooling.

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[6] Instead of using the variable *years of schooling* direct from the survey, I impute the number of years according to the level of educational attainment, as defined in Table A. 1 of Lagakos et al. (2018)'s appendix to ensure a proper comparison of the results.

Figure 2: Life-cycle wage growth by years of potential experience and educational level (*)

(percentage change, average 1990-2017)
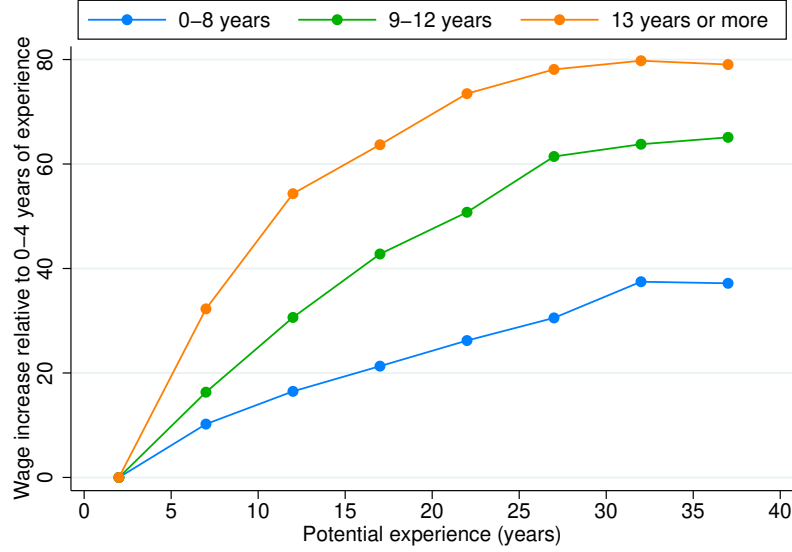
(*) This figures follows the approach proposed by Lagakos et al. (2018). Instead of using the variable *years of schooling* direct from the survey, I impute the number of years according to the worker's level of educational attainment, as defined in Table A. 1 of Lagakos et al. (2018)'s appendix. For further details, see Figure 1.

Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).

Figure 2 shows that returns to experience are increasing in years of schooling. Therefore, we can infer that formal education conditions the ability to develop valued on-the-job skills (Heckman & Carneiro, 2003)[7]. Near the end of the working life, on average, less educated workers have a wage growth of 37% relative to workers with 0-4 years of experience, whereas for workers with 9-12 years of schooling, this figure is 65%; for more educated workers, this figure is almost 80% [8]. Furthermore, while the profile is always increasing for workers with 9-12 years of schooling, they are increasing until 30 years of potential experience and then flatten for the more and the least educated workers.

This result indicates that education gaps in the employed population are not only causing earnings differences when workers enter the labor force, but they affect through-

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[7] As previously stated, these results abstract from wage level differences between different education groups. In fact, for each group, they compare average wage for each experience bin relative to the least experience bin.

[8] The fact that less educated workers have lower profiles than more educated workers is in some way captured by returns to education. See Klapp & Candia (2016) for more details about this topic in Chile.

out working life. Actually, more educated workers, in addition to have more human capital when they enter the labor force, seem to have better chances to develop on-the-job skills and/or to move towards jobs that better match their abilities over the life-cycle. Evidence for the United States supports this last view: returns to work experience are increasing in educational attainment, which is partly related to the fact that more educated workers manage to have better matches with firms (Connolly & Gottschalk, 2006; Rubinstein & Weiss, 2006). Unfortunately, cross-sectional data, such as that available for Chile, cannot be used to study these hypotheses.

The next step is to estimate experience-wage growth profiles according to the type of occupation the worker performs[9]. I follow LMPQS to group occupations in two broadly categories according to the International Standard Classification of Occupations (ISCO): manual and cognitive occupations. Manual occupations are performed by agricultural, forestry, and fishery workers; plant and machine operators and assemblers; and it includes elementary occupations. Managers, professionals, technicians and associate professionals, clerical support workers, service and sales workers, and craft and related trades workers, perform cognitive occupations.

Figure 3 documents that cognitive occupations have steeper profiles than manual occupations. Actually, there is an occupation-gap from the early years of potential experience. For example, between 5 and 9 years of experience, workers employed in cognitive occupations have a relative wage growth that is three times higher than the one workers employed in manual occupations have.

Therefore, the goal is to analyze if, because of these previously documented gaps, the dispersion of wages is increasing in years of work experience. The methodology proposed by LMPQS to compute the variance over the life-cycle is as follows. For each education group and for each 5-year experience bin, they compute the variance of $log(wages)$ and, then, they obtain a weighted average across available years, where the weighs are the share of each education group among the employed population in a given year. Figure 4 suggests that, except for a fall between 25 and 29 years of experience, the variance of the logarithm of wages increases as workers accumulate more potential experience.

This experience-wage variance profile is consistent with the search model proposed by Bagger et al. (2014). This model generates sorting, i.e., high-type workers receive more often job offers and, thus, will be employed by better firms than low-type workers will. As a consequence, there is an experience-wage variance profile that is increasing

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[9] It is important to have in mind that the type of occupation a worker can perform is closely linked to his level of educational attainment.
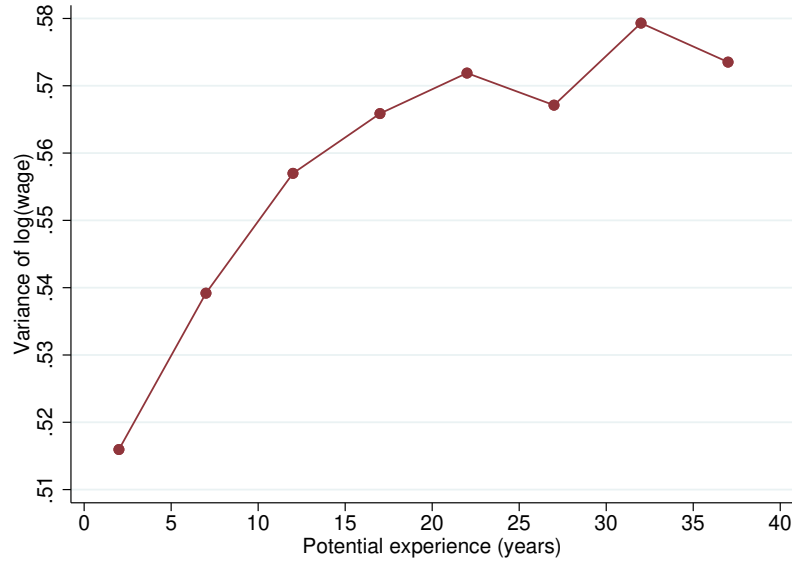
Figure 3: Life-cycle wage growth by years of experience and type of occupation (*)
(percentage change, average 1990-2017)
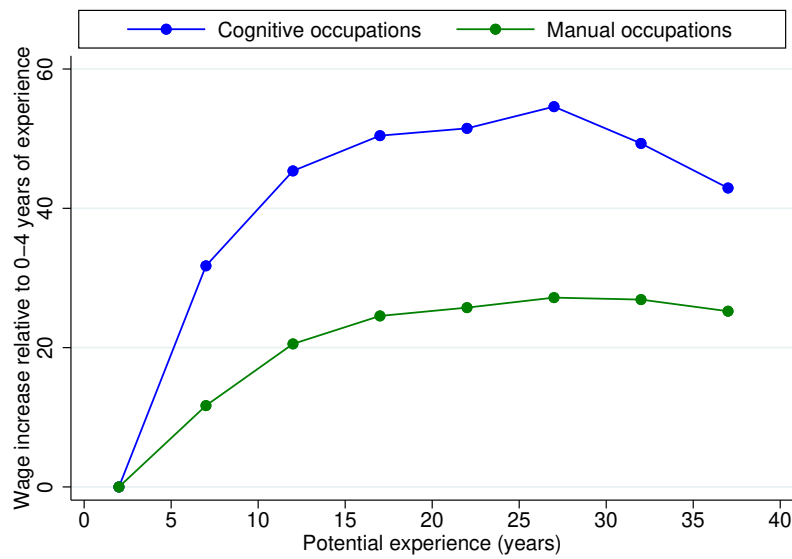
(*) This exercise follows the approach proposed by Lagakos et al. (2018). Using the International Standard Classification of Occupations, they define two broadly categories: cognitive (codes 1 to 5 and 7) and manual occupations (codes 6, 8, and 9). Individuals employed in the armed forces or with a missing occupation are not included. For further details, see Figure 1.

Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).
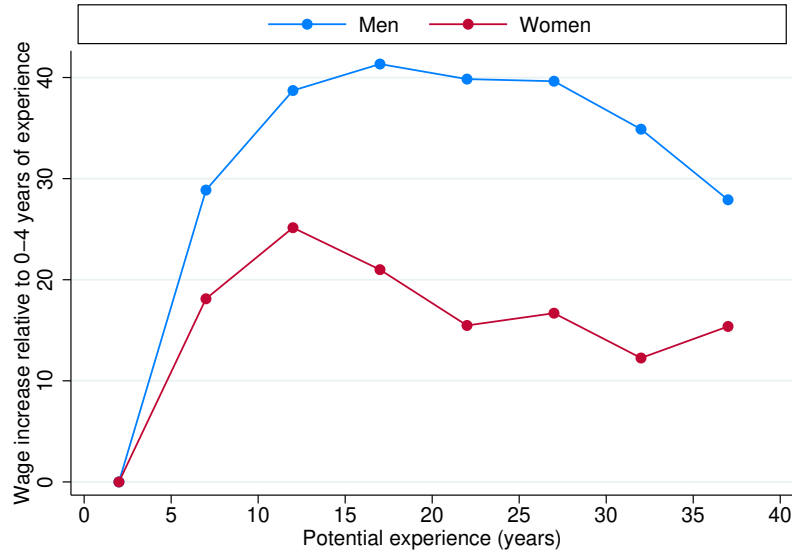
Figure 4: Variance of $log(wage)$ by years of potential experience (*)
(variance of $log(wage)$, average 1990-2017)

(*) This exercise follows the approach proposed by Lagakos et al. (2018). First, for each year and educational group, they compute the variance of the logarithm of wages. Then, they obtain a weighted average, where weights are the share of each educational group in the working population in each year. Finally, they average these weighted averages across years.

Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).

Figure 5: Life-cycle wage growth by years of potential experience and gender (*)
(percentage change, average 1990-2017)

over the life-cycle, but at a decreasing rate, which is mostly explained by an increasing dispersion in firms' productivity.

In addition to the exercises proposed by LMPQS, this article compares experience-wage growth profiles by gender. To be consistent with the previous results, the sample only includes wage earners employed in full-time jobs in the private sector. Figure 5 documents that, from the early years, returns to experience exhibit a relevant gender gap in favor of male workers. For example, while men with 5-9 years of experience earn nearly 30% more relative to men without experience, female workers only earn nearly 20% more relative to women with 0-4 years of potential experience. Also, while for male workers experience-wage growth profile is increasing until 19 years of experience, for female workers, it is decreasing between 15 and 24 years of experience and, then, it remains relatively constant[10].

Nevertheless, since women enter and exit the labor force because of maternity or

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[10] As previously stated, this work abstracts from wage level differences and only compute, for each gender, wage growth relative to their least experience bin.

Figure 6: Returns to work experience by gender and education group (*)
(percentage change, average 1990-2017)

a) 0-8 years of schooling

b) 9-12 years of schooling

c) 13 or more years of schooling
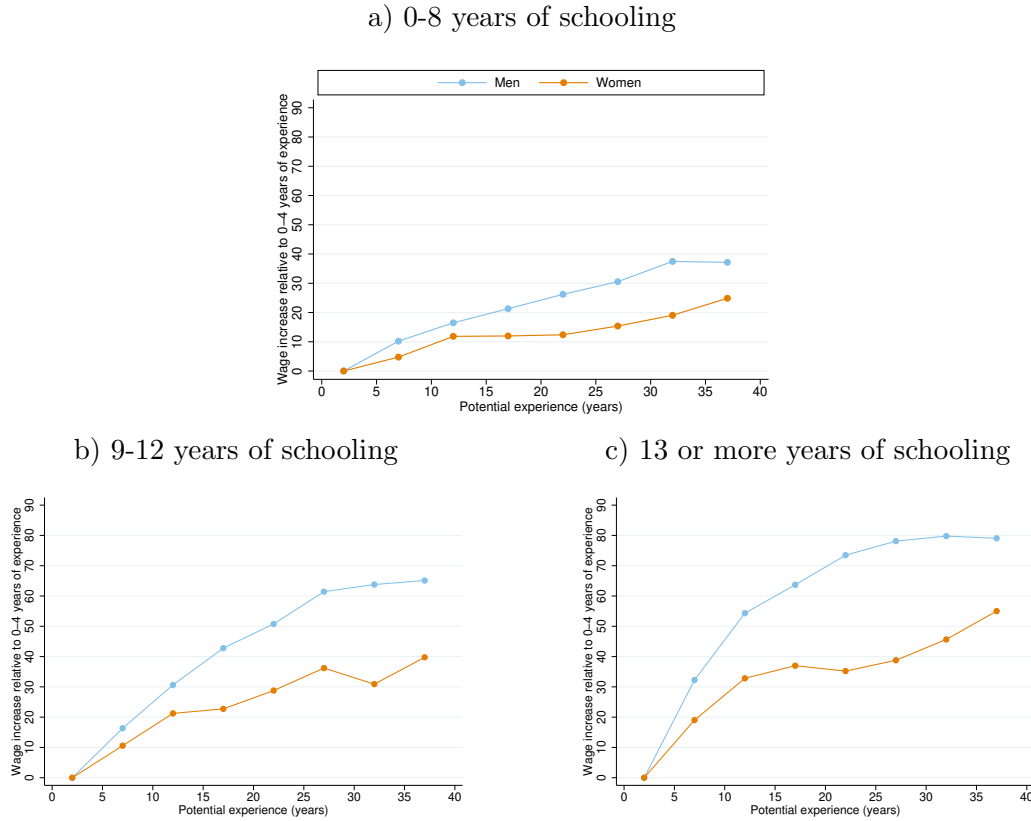
(*) This figure follows the approach proposed by Lagakos et al. (2018). For further details, see Figures 2 and 5.
Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).

child raising, the literature has documented that using potential experience may bias the results. Light & Ureta (1995) try to address this issue using panel data from the United States. The main advantage of their data is that they can observe how many months the individual was actually employed in a given year. Their findings suggest that the disparity in the timing of work experience explains almost a third of the proportion of the gender wage gap that is usually attributed to differences in returns to experience. Therefore, maternity and child raising are important factors to explain the raw wage gap and differences in returns to experience.

Moreover, Aktug et al. (2018) document a similar pattern for Turkey: women have a lower return to experience than men do. They show that this gap is mostly explained by differences among less educated workers, whereas they do not find significant differences among more educated workers. In Chile, however, this gender gap cuts across levels of educational attainment. Indeed, regardless of the education group analyzed, female

workers have a lower experience-wage growth profile than male workers (Figure 6).

Even, in Chile, less educated workers have a lower gender gap at the end of the working life than more educated workers do. For example, while the gender gap is near 25 points for workers with at least 9 years of schooling, this figure is 13 points for workers with at most 8 years of schooling. In addition, this gap is increasing in years of potential experience, even if there are no significant differences when they enter the labor force. Then, we can conclude that returns to experience are in some way reflecting different careers-path between men and women.

I estimate these previous results without taking to account that there may be different macroeconomic and financial conditions. Since the methodology proposed by LMPQS implies normalizing the average wage of each experience-bin by the average wage of 0-4 years of experience, the profiles should be equivalent over time. However, it is well documented that there are long-term negatives consequences of entering the labor force in a bad economy (Kahn, 2010; Oreopoulos et al., 2012; Van den Berge, 2018). Therefore, this paper studies if there is a relationship between the moment when the worker enters the labor force and his ability to accumulate valued experience.

Intuitively, there can be two possible effects. On the one hand, if a certain cohort enters the labor market in a good economy, they would have better matches at the beginning of their careers than other cohorts would and, thus, they would have a bigger average wage growth when they are starting. As the methodology used in this document normalize the average wage of each experience group to the average wage of the least experience group, everything else held constant, this implies a future lower relative wage growth for this cohort and, therefore, a lower return to experience than a cohort that enters the labor force in a bad time.

On the other hand, a bad economy should hurt less individuals who are recently entering the labor force than experienced workers. In a tight market, more experienced workers should have more troubles finding a job where their previous experience is rewarded or it should be more difficult for them to have bargaining power to negotiate with their employers a salary increase as they develop job-specific skills and become more productive.

Figure 7 computes experience-wage growth profiles for each one of the fourth cohorts for those we can observe the moment when they enter the labor force with this dataset: those who began their career between 1990 and 1994, between 1995 and 1999, between

Figure 7: Life-cycle wage growth by years of potential experience for selected cohorts (*)

(percentage change, average 1990-2017)
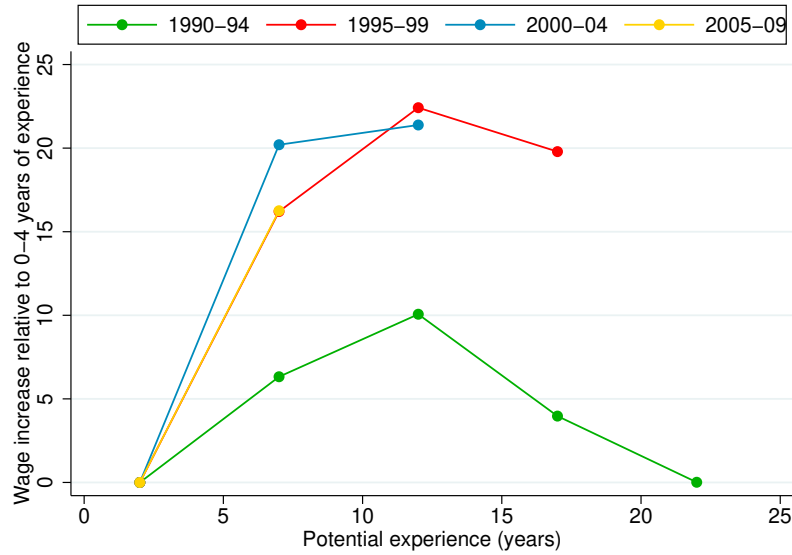
2000 and 2004, and between 2005 and 2009[11]. The findings suggest that, even if the cohort 1990-1994 entered the labor force while the country was undergoing an economic boom, they suffered two important crises: The Asian Crisis and The Great Recession. The Asian Crisis hits this cohort when they had between 5 and 9 years of experience and they suffered the Great Recession ten years later. If we consider that, on average, this is the moment when workers reach their maximum relative wage growth; it is straightforward to conclude that this cohort had been hardly affected by these episodes. In fact, after 20 years of potential experience, their return to experience was almost zero. By comparison, cohorts who started in a tight market, like the cohorts 1995-1999 or 2005-2009, had an important relative wage growth the following years, probably because their average wage at the beginning of their careers was quite low.

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[11] The assumption behind this exercise is that the moment when an individual has zero years of potential experience is the moment when he enters the labor market.

III Returns to Experience in Chile: Controlling for Time, Education, and Cohort

Section II followed the cross-sectional approach developed by LMPQS. For each available year, the methodology proposes to express the average wage of each 5-year experience bin as a percent difference from the average wage of workers with 0-4 years of experience, and, then, to average these results across available years.

However, as these authors analyzed, even if this approach is simple and easy to understand, it has some theory and econometric issues that require more attention. In particular, this approach cannot properly estimate returns to experience and isolate them from returns to education or can't control for a possible cohort effect. This is crucially if we think there is a relationship between schooling and the ability to find better matches or to develop job-specific skills and/or if we think different cohorts might face different labor regulations. Therefore, we might not be able to estimate properly return to experience, net of schooling, birth cohort, and time effects.

LMPQS present two theoretical approaches to address these issues: the Deaton-Hall and the Heckman-Lochner-Taber approaches to estimate the following flexible version of Mincer (1974):

$$\log(w_{ict}) = \alpha + g(s_{ict}) + f(x_{ict}) + \gamma_t + \chi_c + \varepsilon_{ict} \tag{1}$$

where w_{ict} is the hourly wage the worker i who belongs to the birth cohort c received in year t, s_{ict} are his years of schooling, x_{ict} are his years of potential experience, γ_t and χ_c are time and cohort effects respectively, and ε_{ict} is the residual.

The Deaton-Hall Approach

The cross-sectional approach ignores the role of schooling or heterogeneity among birth cohorts. LMPQS address these issues following the methodology developed by Hall (1968) and Deaton (1997)[12]. This approach searches to estimate the function $f(.)$ and assumes a functional form of function $g(.)$ in equation (1):

$$\log(w_{ict}) = \alpha + \theta(s_{ict}) + \sum_{x \in X} \phi_x D_{ict}^x + \gamma_t + \chi_c + \varepsilon_{ict} \tag{2}$$

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[12] It is worth mentioning that this approach seeks to illustrate the difficulty of estimating simultaneously cohort and time effects, and not to quantify the relative importance of each one of them.

where D_{ict}^x is dummy variable that takes the value of one if an individual i, member of the birth cohort c, has $x \in X = \{5-9, 10-14, ...\}$ years of experience in year t and 0 otherwise. The least experience group, i.e., individuals with 0-4 years of experience, is the omitted category. Thus, the coefficient ϕ_x estimates the average wage of the experience group x relative to the average wage of the group with no experience.

Since the effects of experience, birth cohorts, and time can't be properly identified because of collinearity, the Deaton-Hall approach imposes additional restrictions on cohort and/or time effects in equation (2)[13]. In particular, LMPQS consider three alternative versions of this approach. The first version is the original from Deaton (1997): cohort effects explain all labor productivity growth; thus, years dummies only capture cyclical fluctuations (Deaton-Hall (a)). The second version considers the contrary: time effects explain all labor productivity growth (Deaton-Hall (b)). The third version is halfway between the first version and the second one: cohort and time effects equally explain labor productivity growth (Deaton-Hall (c)).

The estimation using the first version of the Deaton-Hall approach, i. e., all labor productivity growth is attributed to cohort effects, shows a steep and always increasing experience-wage growth profile for men. Using the second version, i. e., all labor productivity growth is attributed to time effects, the experience-wage growth profile is very similar to the one estimated using the cross-sectional approach (Figure 8).

According to LMPQS, the estimation when we assume all labor productivity growth is due to cohort effect gets larger returns to experience than the cross-sectional approach because the later imposes time dummies to be orthogonal to time trend. Thus, the wage growth obtained by a given cohort over time is fully attributed to the effect of experience. On the other hand, estimated returns to experience are similar if we estimate them using the second version of the Deaton-Hall approach or if we use the cross-sectional approach. In fact, in both cases the assumption is that wage growth depends on macroeconomic conditions and not on cohort-neutral changes.

As for the women, despite of the version, the experience-wage growth profiles estimated with the Deaton-Hall approach are always increasing and we do not see the fall in the middle of the working life that was documented with the cross-sectional approach. However, the differential between the three versions are less pronounced than the one documented for men.

In summary, the estimation using the Deaton-Hall approach gets distinct experience-wage growth profiles if the assumption is that cohort or time effects explain all labor

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[13] See Appendix for further details on the Deaton-Hall approach.

Figure 8: Life-cycle wage growth by years of potential experience and gender, following the Deaton-Hall approach (1) (2)
(percentage change, average 1990-2017)
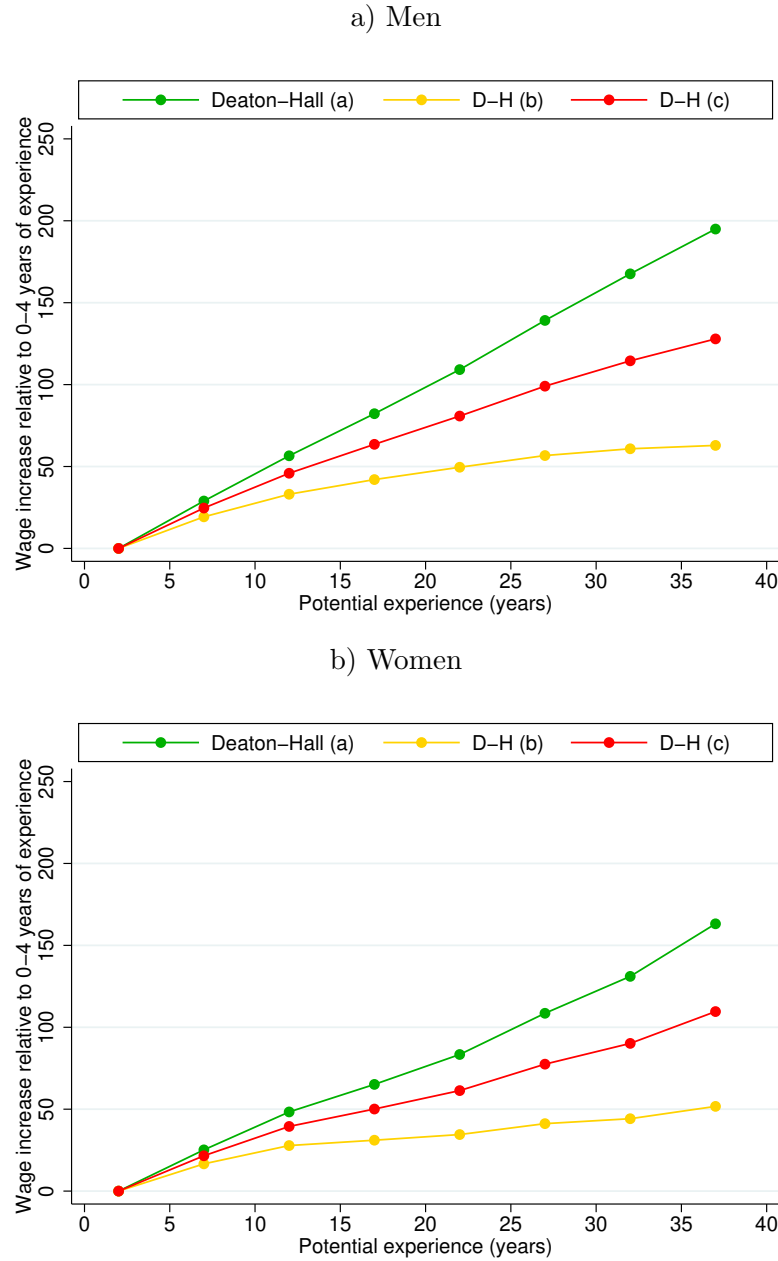
a) Men

b) Women

(1) Potential experience is defined as the minimum between the number of years since the individual reached the age of majority (18 years old) or since he completed his education. The wage is calculated as the ratio between the monthly income of the primary job in 2017 Chilean pesos and the number of hours worked in this job in a month. The sample only considers wage earners employed in the private sector in full-time jobs. For further methodological details, see Lagakos et al. (2018).

(2) Deaton-Hall (a) corresponds to the profile calculated using the Deaton-Hall approach and assuming that labor productivity growth is driven by cohort effects. D-H (b) is the profile calculated using the Deaton-Hall approach and assuming that labor productivity growth is driven by time effects. D-H (c) is the profile calculated using the Deaton-Hall approach and assuming that labor productivity growth is equally driven by cohort and time effects.

Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).

productivity growth. Nevertheless, it is important to have in mind that the purpose of this approach is to illustrate the difficulty of properly identifying the effects of experience, birth cohort, and time, and not to discipline time and cohort effects.

The Heckman-Lochner-Tabber Approach

LMPQS propose an alternative approach to define what fraction of labor productivity growth is due to time effects and what fraction is due to cohort effects, using economic theory. They name this approach Heckman-Lochner-Tabber (HLT) because their insights in 1998 is the starting point of this methodology. The idea is to estimate time effects assuming there is almost no experience effect at the end of the working life and, then, any wage growth in this period is due to time effects.

The methodology proposed by LMPQS to apply the HLT approach is as follows. First, they have to choose two parameters: the numbers of years y at the end of the worker's career without experience effects and the depreciation rate d, which measures how skills and/or match quality depreciate at the end of the working life. This paper uses 10 years with no experience effects and an annual depreciation rate of 0%[14]. Then, they have to make an assumption about time trend and use this guess to obtain individual wages net of time effects. They use these calculated wages to estimate equation (1). If their result is that returns to experience have dropped, on average, $d\%$ in the last y years, the guess was correct. If not, they have to make a new assumption and start the process again. Once it converges, they obtain returns to experience, net of cohort and time effects.

Using the HLT approach, the estimated experience-wage growth profile is concave for men and reaches the maximum relative wage growth between 30 and 34 years of experience, which is almost 15 years later than was previously estimated (Figure 9). These results show that the cross-sectional approach over-estimates returns to experience by nearly 10 points over the first years of experience.

As for the women, the profile estimated using the HLT approach is quite similar to the one calculated with the cross-sectional approach. Actually, in both cases, they reach the maximum relative wage growth between 10 and 14 years of experience. Nevertheless, the HLT approach gets a lower fall after 15 years of experience than the cross-sectional one did, and, just as for men, the cross-sectional approach over-estimates the returns

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[14] LMPQS, following Huggett et al. (2011), consider 5 or 10 years without experience effects and two possible depreciation rates: 0 or 1% per year. They plot their Figure 5 using 10 years without no experience effects an an annual depreciation rate of 0%.

Figure 9: Life-cycle wage growth by years of potential experience and gender, following the Heckman-Lochner-Tabber approach (1) (2)
(percentage change, average 1990-2017)
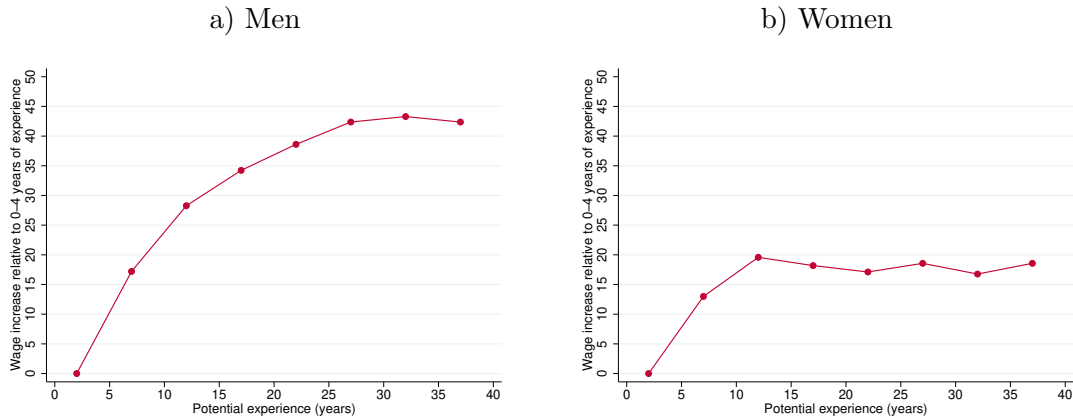
a) Men   b) Women

(1) Potential experience is defined as the minimum between the number of years since the individual reached the age of majority (18 years old) or since he completed his education. The wage is calculated as the ratio between the monthly income of the primary job in 2017 Chilean pesos and the number of hours worked in this job in a month. The sample only considers wage earners employed in the private sector in full-time jobs. For further methodological details, see Lagakos et al. (2018).
(2) These profiles consider 10 years at the end of the working life with no experience effects and a depreciation rate of 0%.
Source: Author's calculations based on the data from the Ministry of Social Development (Casen Survey).

along the first years of experience.

In summary, these findings suggest that when we are estimating returns to experience it is important to control for schooling, time, or cohort effect. In fact, the cross-sectional approach abstracts from a possible relationship between schooling and the ability to find better matches or to develop job-specific skills and/or from the fact that each cohort might face different labor regulations.

IV   Chile in the International Context

This section compares the results obtained for Chile with the evidence provided by LMPQS for other countries: advanced economies and less developed countries (Figure 10)[15]. As these authors highlight, rich countries have cross-sectional experience-wage growth profiles that are steeper than poor countries. In particular, Germany has the

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[15] Since this paper has some slight methodological differences with LMPQS, to ensure a proper comparison across countries, it presents the cross-sectional experience-wage growth profile they estimate for Chile.

Figure 10: Life-cycle wage growth by years of potential experience for selected countries
(*)
(percentage change, average across all available years for each country)
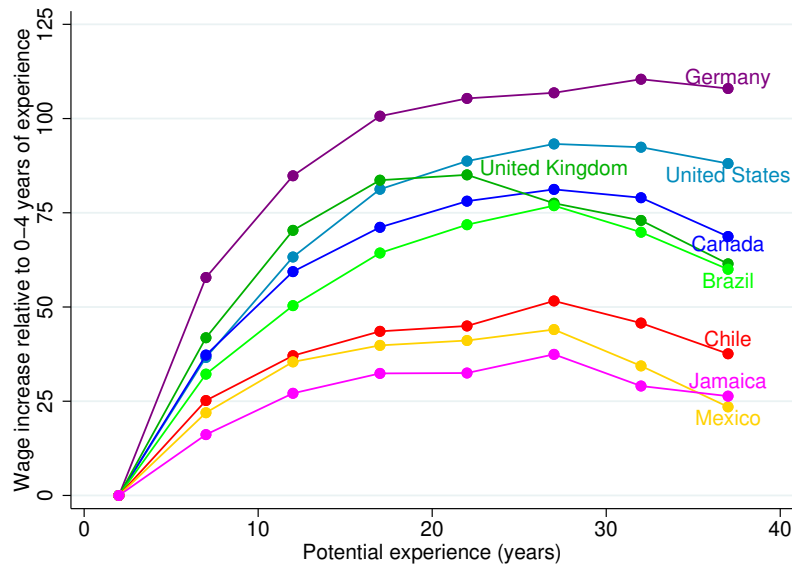
(*) To ensure a proper comparison between these countries, this figure presents the cross-sectional experience-wage growth profiles estimated by Lagakos et al. (2018). These authors define these eight countries as core countries because, for all of them, they have all the information they need to perform their exercises.
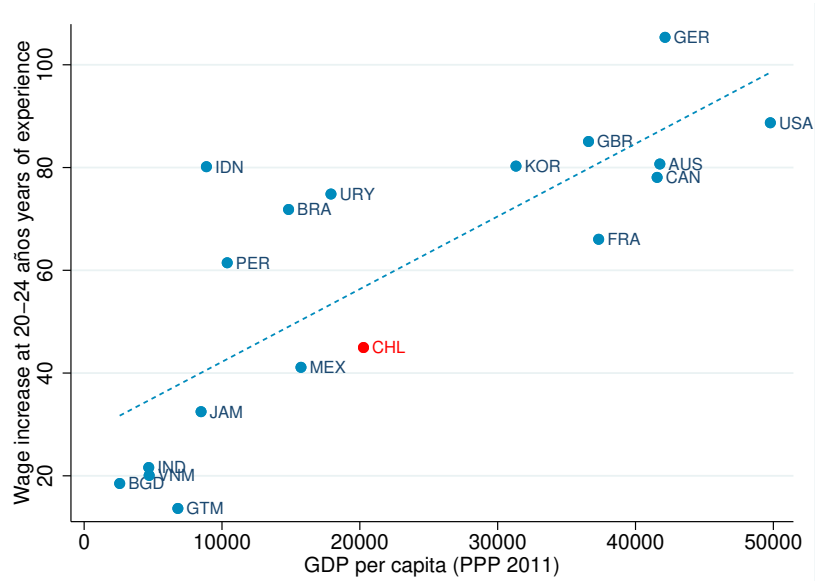Source: Lagakos et al. (2018).

steepest profile whereas Jamaica has the lowest one. Chile has a profile that resemble the one estimated for Mexico, a country with a similar level of development.

This result is consistent with both human capital and search and matching models. On the side of human capital theories, this result is in line with the model proposed by Manuelli & Seshadri (2014). They conclude that an individual in a rich country will choose to accumulate more human capital over the life-cycle (both years of schooling and post-schooling training) than an individual in a poor country.

On the side of search and matching models, advances economies have steeper profiles than less developed countries because rich countries have more fluid labor markets, thus workers can easily move towards jobs that better match their skills. Engbom (2017) documents a positive correlation between labor market fluidity and life-cycle wage growth, using panel data for 12 OECD countries. Actually, his model predicts that if we increase the fluidity of a country's labor market by two standard deviations, life-cycle wage growth will increase by 20 log points, where the heterogeneity in the cost of hiring workers explains the fluidity of the labor market.

Figure 11: Relative wage growth at 20-24 years of potential experience by real GDP per capita (*)
(percentage change)

(*) To ensure a proper comparison between these countries, this figure presents the estimates calculated by Lagakos et al. (2018).
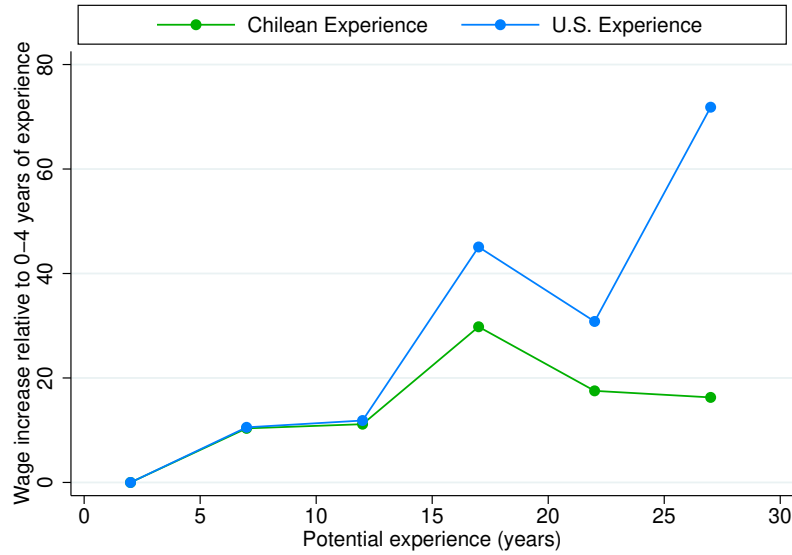
Source: Lagakos et al. (2018).

Another way to illustrate the contrast in life-cycle wage growth across countries is to analyze the correlation between the average wage increase at 20-24 years of potential experience and real GDP per capita. Figure 11 shows a positive and strong relationship between returns to experience and the country's income level. Nevertheless, the returns to experience estimated for Chile are marginally lower than expected given the country's development level.

According to the literature, disparities in the quality of work experience explain the positive relationship between returns to experience and country's income level. This can be the consequence of differences in culture or managerial practices that favor or obstruct innovation (Bloom & Van Reenen, 2007, 2011) or differences in learning-by-doing (Arrow, 1962; Romer, 1986). In particular, Coulombe et al. (2014) estimate that if a country like Kenya, which has a GDP per capita that is one-twentieth that of Canada, had the same human capital quality than Canada, the country would be almost 41% richer.

Lagakos et al. (2018b) perform an alternative exercise to clarify if their main conclusions can be explained by miss-measurement issues or by the fact that each country

Figure 12: Returns to native and foreign experience for Chilean immigrants in the US
(*)
(percentage change)

(*) Lagakos et al. (2018b) use the year when the immigrant arrived in the U.S. to split his work experience into Chilean (native) and US (foreign) experience. They drop individuals who immigrated before entering the labor market.
Source: Lagakos et al. (2018b).

has its own particular labor regulation. They apply a similar approach to data for US immigrants. This exercise has two main advantages: the data comes from the same source for all individuals and all workers are in the same labor market, thus, they face the same institutions and regulations[16]. Their main result is that immigrants from richer countries have higher returns to experience than immigrants from less developed countries have, regardless if they are using experience acquired before migrating (native) or experience acquired after migrating (foreign). Coulombe et al. (2014) find similar results for Canadian immigrants.

For Chilean immigrants, Figure 12 documents that, until 14 years of potential experience, there is no major difference if the experience was acquired in Chile or in the US. However, from 15 years of experience, there are higher returns to experience if it was acquired in the US rather than before migrating[17]. As stated by Lagakos et al.

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[16] It is worth mentioning that, even if all workers are in the same country, there is an important heterogeneity in labor legislation across states. If immigrants from different countries are not randomly settled across the U.S., this exercise can't properly address these issues.

[17] This figure only shows experience-wage growth profiles until 29 years of potential experience. The main reasons are that Chilean immigrants are usually economic-migrants, so they might be self-selected to the US, and that there is a low number of observations to ensure statistical inference.

(2018b), immigrants from less developed countries, at 20-24 years of experience, have a lower relative wage growth if their experience was acquired in their birth-country rather than in the US.

V Conclusion

This paper studies returns to work experience in Chile, providing evidence in support of their relevance for human capital dynamics. The findings suggest that, on average, workers maximize returns to experience throughout the initial years after entering the work force. The results deliver further evidence in favor of greater returns for workers with higher-educational level and for those who are employed in cognitive occupations. Consequently, this article documents an experience-wage variance profile that is increasing over the life-cycle. Furthermore, it also provides evidence that under this criterion, returns to experience exhibit a relevant gender gap in favor of male workers, despite of the level of educational attainment. Additionally, this paper documents that the moment when the worker enters the labor force affects his ability to accumulate valued experience, because, in a bad economy, there are worse chances to find good matches with firms and/or to develop valued on-the-job skills.

Then, an econometric analysis is conducted to avoid possible collinearity between age, time, and birth cohort effects. Both methodologies, the Deaton-Hall and the Heckman-Lochner-Taber approaches, get different experience-wage growth profiles. In particular, with the HLT approach, estimated returns are lower along the first years, while higher at the end of the workers' productive period.

Additionally, the life-cycle wage-growth profile documented by the literature for Chile is consistent with estimates for other countries with similar levels of development, like Mexico. Nevertheless, throughout the median of the individual's working life (20-24 years of experience), returns in Chile are marginally lower than expected given the country's income level.

These results have considerable macroeconomic implications. In a neoclassic model of economic growth, labor is only adjusted by formal education and it is not adjusted by the accumulation of human capital as workers acquire valued experience in the labor market. Then, any improvement in informal training will be computed as an increase in Total Factor Productivity, since it is measured as a residual, whereas labor will remain constant. Therefore, having a better understanding of how workers develop on-the-job skills seems key to have a better economic growth accounting.

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Appendix: Deaton-Hall Approximation

According to Lagakos et al. (2018), equation (1) in the main text is a flexible version of the regression proposed by Mincer (1974) of the logarithm of wages on schooling and potential experience:

$$\log(w_{ict}) = \alpha + \theta(s_{ict}) + f(x_{ict}) + \gamma_t + \chi_c + \varepsilon_{ict}$$

where w_{ict} is the hourly wage the worker i who belongs to the birth cohort c received in year t, s_{ict} are his years of schooling, x_{ict} are his years of potential experience, γ_t and χ_c are time and cohort effects respectively, and ε_{ict} is the residual. Then, individual wage can be written as:

$$w_{ict} = \exp(\alpha + \theta(s_{ict}) + f(x_{ict}) + \gamma_t + \chi_c + \varepsilon_{ict})$$

If N_{ct} is the number of individuals from the birth cohort c working in year t, total wage received by the cohort c in year t is:

$$
\begin{aligned}
\sum_{i=1}^{N_{ct}} w_{ict} &= \sum_{i=1}^{N_{ct}} \exp(\alpha + \theta(s_{ict}) + f(x_{ict}) + \gamma_t + \chi_c + \varepsilon_{ict}) \\
&= \exp(\alpha + \gamma_t + \chi_c) \underbrace{\sum_{i=1}^{N_{ct}} \exp(\theta(s_{ict}) + f(x_{ict}) + \varepsilon_{ict})}_{F_{ct}} \\
&= \exp(\alpha + \gamma_t + \chi_c) F_{ct}
\end{aligned}
$$

Let C_t be set of the cohorts working at year t and $\bar{F}_t = \sum_{c \in C_t} F_{ct}$, then, total wage W in year t is:

$$
\begin{aligned}
W_t &= \sum_{c \in C_t} \sum_{i=1}^{N_{ct}} w_{ict} \\
&= \sum_{c \in C_t} \exp(\alpha + \gamma_t + \chi_c) F_{ct} \\
&= \exp(\alpha) \exp(\gamma_t) \sum_{c \in C_t} \exp(\chi_c) F_{ct} \\
&= \exp(\alpha) \exp(\gamma_t) \bar{F}_t \sum_{c \in C_t} \exp(\chi_c) \frac{F_{ct}}{\bar{F}_t}
\end{aligned}
$$

As explained by LMPQS in their Online Appendix, if all individual wages satisfy equation (1), W_t can be expressed as:

$$W_t = \underbrace{\exp(\gamma_t)\, \bar{F}_t}_{\Gamma_t} \underbrace{\sum_{c \in C_t} \exp(\chi_c) \frac{F_{ct}}{\bar{F}_t}}_{\bar{X}_t}$$

$$W_t = \Gamma_t \bar{F}_t \bar{X}_t$$

This mathematical relationship implies that, in this economy, total wage growths because of time effects (Γ_t), cohort effects ($\bar{X}_t$), or changes in the composition of schooling and experience of the working population ($\bar{F}_t$).

The Deaton-Hall approach imposes one additional linear restriction on $\Omega_t = \Gamma_t \bar{X}_t$, which is similar to a measure of labor productivity in year t, to estimate equation (1). Over time, this term can change because of changes in cohorts (captured by Γ_t) or in the composition of cohorts in the working population (captured by $\bar{X}_t$). Then, if they impose restrictions on Ω_t, they can identify time and cohort effects. In order to do so, they have to decompose this year-specific aggregate labor productivity term into two components, a trend and a cyclical component, and they have to assume that productivity growth is explained by time or by cohort effects.

They define $\omega_t = \log(\Omega_t)$ and $\bar{x}_t = \log(\bar{X}_t)$ to work in logarithms. Also, they define time periods in deviations from the sample mean: $\frac{1}{T} \sum_{t=0}^{T} t = 0$. Then, they renormalize $\bar{x}_t$ and γ_t, such that $\frac{1}{T} \sum_{t=0}^{T} \gamma_t = \frac{1}{T} \sum_{t=0}^{T} \bar{x}_t = 0$. In order to do so, they express ω_t as:

$$\omega_t = \bar{w}_t + \gamma_t + \bar{x}_t \tag{3}$$

where $\bar{w}_t$ is a choose constant to ensure this equality.

Additionally, γ_t and $\bar{x}_t$ can be decomposed into a trend g and a cyclical component u, such that $\gamma_t = g_\gamma t + u_{\gamma,t}$ and that $\bar{x}_t = g_{\bar{x}} t + u_{\bar{x},t}$. If they replace this two equations in equation (3):

$$\omega_t = \bar{w}_t + g_\gamma t + u_{\gamma,t} + g_{\bar{x}} t + u_{\bar{x},t}$$

$$\omega_t = \bar{w}_t + g_\omega t + u_{\omega,t}$$

Since $g_\omega = g_\gamma + g_{\bar{x}}$, the three versions of the Deaton-Hall approach that they consider are different ways of dividing the trend component of ω between g_γ and $g_{\bar{x}}$:

1. **Deaton-Hall (a): Growth is fully explained by cohort effects.** In this

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version, they assume $g_\omega = g_{\bar{x}}$ and $g_\gamma = 0$. This implies that $\sum_{t=0}^{T} \gamma_t t = 0$: year dummies only capture cyclical fluctuations.

2. **Deaton-Hall (b): Growth is fully explained by time effects.** In this case, they assume $g_\omega = g_\gamma$ and $g_{\bar{x}} = 0$, which means that $\sum_{t=0}^{T} \bar{x}_t t = 0$.

3. **Deaton-Hall (c): Growth is equally explained by cohort and time effects.** In this version, they assume $g_\gamma = \frac{1}{2} g_\omega$ and $g_{\bar{x}} = \frac{1}{2} g_\omega$. This implies that $\frac{1}{2} \sum_{t=0}^{T} \bar{x}_t t = \frac{1}{2} \sum_{t=0}^{T} \gamma_t t$.

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