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Abstract

This article develops a double selection model in order to test whether part-time workers are excluded from full time jobs (underemployed) or choose to put themselves into distinct labour market segments. Results show statistical support for both exclusion and self-selection in the labour market. Additionally, they suggest that underemployment is mostly driven by the structural heterogeneity of the Chilean economy with human capital variables playing a secondary role. Wage equations are estimated as to further characterize each group; they show that the same economic segments that hire more full time workers pay wage premiums, a result consistent with the hypothesis of structural heterogeneity.

Keywords

labour market segmentation, queues, structural heterogeneity, underemployment

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1. Introduction

Since 1982, the definition and measurement of labour force participation — employment and unemployment — used by the International Labour Organization have seen substantial modifications. Recent labour statistics have been expanded to include a broader definition of unemployment in order to provide a more rigorous measurement of capacity utilization. One of the innovations is the inclusion of the underemployed in the unemployment rate. According to the ILO, the underemployed are those workers holding part time positions who want to work more hours, but are unable to do so due to economic reasons.[1]

Unfortunately, theoretical modelling and empirical investigation have not run at the same pace as statistical definitions, and as such, there is not theoretical framework or empirical work in order to understand underemployment. This is despite the fact part-time work has been the subject of considerable public attention and academic research.

Theoretically, it is fruitful to understand underemployment as a specific manifestation of non-standard work arrangements (Kalleberg, Reskin and Hudson, 2000), and to understand differences in work arrangements as shaped not only by workers' self-selection, but also by differences in firms' productivity. This contrasts with the view that non-standard work arrangements are caused by stringent formalization requirements and state regulation in developing economies (Maloney, 2004).

Empirically, a double-selection model is estimated in order to show that there is statistical support for the contention that part-time jobs are the result of both self-selection and an exclusion process. . In the first stage of the model, individuals choose whether to queue for a job in a full time job, which is label as being in the queue (IQ). The individuals that prefer a part time job self select to it. In a second stage, some individuals in the queue are chosen from the queue (CFQ) by employers. Those not chosen are the underemployed or excluded from full time occupations. The model shows that full time exclusion is correlated with size and industry variables that allow the researcher to infer productivity segments. Then earning equations are estimated for each group, and it is shown that underemployed workers receive a higher premium

[1] Common reasons are the inability to find a full time job or the employer's refusal to grant a full time shift. Examples of non-economic reasons include being a student or taking care of the elderly or children. Details vary across surveys and methodologies.

on primary education, while full time workers receive a higher premium on tertiary education. The covariance between the unobserved components of being chosen from the queue and the wage earned is positive, suggesting that the same unobserved characteristics that increase the probability of being excluded lower the wages of the excluded workers. This is consistent with the theory that firms in lower productivity segments offer both more precarious employment arrangements and lower wages, or that unobserved attributes match lower-productivity workers with low productivity segments. Overall, these results suggest that the traditional structuralist founded labour-market segmentation consistently explains the empirical patterns.

The rest of the paper proceeds as follows: Section 2 presents a theoretical framework in order to understand underemployment. We build on the traditional structuralist literature, labour segmentation models, and the literature on non-standard work arrangements. Section 3 describes the database utilized as well as summary statistics for the relevant sample; Section 4 reviews the double selection procedure, describes how it attempts to identify the existence for queues in the full-time job market, and presents the estimation methodology for the wage equations. Section 5 presents the main econometric results, which support the existence of queues for full-time jobs, that is, labour market segmentation, and earning equations that present correlations broadly consistent with the presented theoretical framework. Section 6 concludes and presents some ways of tackling future research on underemployment and non-standard work arrangements.

2. Structural heterogeneity, labour market segmentation and non-standard work arrangements

Starting with the seminal article of Pinto (1970), the school of economic and sociological thought known as *structuralism* (or the *structuralist school),* has emphasized that one of the main problems faced by developing countries is that of *structural heterogeneity*, that is the *persistent,* historical differences between distinct economic segments across developing economies. As Pinto himself recognized, he was merely extending the "dual economy" models of authors such as Lewis (1954), in which the economy is split between a capitalist sector, with high productivity, savings, and wages and a "traditional" or pre-capitalist sector, in which workers live at subsistence levels, with negligible or zero productivity and savings.

Pinto argued that during the historical phase known as "import substitution industrialization,"[2] which roughly encompasses the period 1945-1970, an incipient manufacturing sector, mostly composed of textiles, apparel, food and beverages, formed an intermediate sector between the pre-capitalist and the modern export sector that characterized Latin America. Today, Pinto's model regarding the productive structure of developing economies can be thought as constituting distinct segments, where those segments are classified as a discontinuous function of the productivity gap between that segment's productivity and the productivity of the same segment in the developed world.

Structuralism not only identified that the main challenge faced by developing countries is reducing structural heterogeneity, it also asserted that social stratification and class formation should be understood in terms of the dynamics of structural heterogeneity. Authors such as Cardoso and Faletto (1996) famously championed that the formation of middle classes in Latin America should be understood as a by-product of state modernization, and, with a very Marxist touch, that the prevalence of small peasantry and pre-capitalist work relations resulted from the inability of the modern and intermediate segment to absorb the low productivity, pre-capitalist segments.

Likewise, contemporary authors influenced by the structuralist position (Ruiz and Boccardo, 2015) have argued that the pro-market reforms faced by Latin America during the 1980s and 90s had deep consequences for structural heterogeneity and class formation. They argued that pro-market reforms benefited the "modern" sectors based on primary product exportation and a set of service sectors composed of big financial, real estate and retail firms. Thus what used to be the intermediate (manufacturing) sector was substantially affected the by the market reforms, especially by the elimination of directed credit and subsidies, the abolition of import taxes, and the privatization of most state owned firms. The structure of Chilean production illustrates this point for the region. While manufacturing growth rates averaged 3.3% during the 1990-2010 period, financial services, real estate and retail all showed growth rates superior to 6% (Ruiz and Boccardo, 2015).

[2] Some authors contend that such characterization is inappropriate, since import substitution industrialization was only one of the public policies used to foster industrialization and in many national cases not the most important. See Bertola and Ocampo (2013).

According to these authors, pro-market reforms not only altered the degree of structural heterogeneity, they also altered the class structure of Latin America countries to a substantial degree. On one side, they recognized that the middle class is linked to state expansion, and is substantially diminished with state enterprises entrenched and privatized. On the other side, they recognize that the working class itself became more heterogeneous, but they fail to link working class segmentation with changes in the productive structure. Then, according to Ruiz and Boccardo (2015) the channels through which the working class is segmented in different countries are legal and political, but not economic.

A restatement of the structuralist position might help build a progressive research programme that allows understanding the expansion and proliferation of what has been termed "non-standard employment arrangements" (Kalleberg, Reskin and Hudson, 2000) as a form of working class segmentation among the developing countries of Latin America, particularly Chile.

Kalleberg, Reskin and Hudson suggest we think of non-standard employment relationships as all of those workers who do not work full time, are not assumed to continue their employment in a long-term horizon, and their *De-Jure* employer is different than their *De-Facto* employer. They show that, at least for the United States, non-standard employment relationships are correlated with "good job" characteristics such as access to health insurance and pension benefits.[3] Other research, concerned specifically with female part-time workers as a subset of non-standard employment arrangements in the UK and Europe (but not with the fraction of part-time workers who are underemployed), show that these workers receive a negative wage premium (Bardasi and Gornick, 2008), but have increased overall satisfaction and wellbeing (Assadullah and Fernandez, 2008).

As far as Chile is concerned, Ruiz and Boccardo (2015) recognize the proliferation of multiple forms of non-standard work arrangements such as outsourced workers prevalent in copper mines and forestry firms, or decentralized contracting in retail firms,[4] but they do not show if these

[3] The database used does not have data for other non-standard work arrangements, and thus the focus of the article is only on understanding part-time male workers. This is also due to the fact there is cumulative amount of research done in this area, whereas the same is not true for other work arrangements.

[4] Even though they are hard to classify in Kellengberg's schema, big retail and commerce firms in Chile follow a practice which could be easily classified as a non-standard work arrangement; they classify each store as a distinct legal entity, which makes it impossible for workers in single firm but working in different stores to bargain together their labour condition. This practice is known locally as *multi-ruts*.

employment arrangements are correlated with bad job characteristics. Rau & Montero (2015) show that part time work has a negative effect on men's well-being but has a null effect on women. Using an Oaxaca decomposition, Rau (2010) documents that there is positive correlation between hourly wages and part-time work, which is explained by unobserved factors. The mentioned papers also find that part time workers generally do not have a written contract that entails a long term relationship (i.e., with a standard employment relationship), have higher turn-over rates, less access to social security, and tend to be concentrated in smaller firms. Thus, while the preceding literature has failed to recognize underemployment as a separate segment of workers distinct from those workers who chose to work in a part time job, it would appear that part-time work, as a subset of non-standard employment arrangements, correlates partly with bad job characteristics.

Figure I attempts to integrate the concepts of structural heterogeneity, labour market segmentation, and non-standard work arrangements. Synthetically, we can conceptualize the firms of any economy in a continuum ordered by their productivity. In developed economies, this continuum is smooth, and the differences in productivity across firms are not big in magnitude. This translates into lower wage dispersion, homogenous employment arrangements, and working class formation. In developing countries, the continuum is not smooth and presents significant discontinuities across segments, which in turn increases wage dispersion, produces heterogeneous work arrangements, and more complex patterns of working class formation. Thus firms with lower productivity only survive on the basis of lower wages and poor work arrangements. This contradicts informality theories which suggest that self-employment, part time work, and other forms of non-standard work arrangements are shaped by differences in regulation across firm sizes and by the stringent costs of formalization (Maloney, 2004).

[FIGURE I HERE]

In relation to the previous literature, the model presented here is most closely related to the searching models of Mortensen (2005) and Pisarrides (1990), where persistent differences across inter-industry wages and queuing are explained by variations in firms' productivity. This is part of a longer tradition that attributes queuing and inter-industry wage differential to differences in

rent sharing across industries (Heywood, 1990).[5] These models can also be accommodated to show that differences in other job characteristics, such as tenure, are related to these inter-sectorial productivity differentials.

An important caveat to keep in mind is that "segments" vary both *across* and *within* economic sectors. To give a concrete example, Chile's mining industry, the leading exporting sector, is composed by different types of firms with considerable differences in terms of productivity, revenue, and production structures. For instance, large-scale copper mining firms are responsible for the majority of total output (95%), investment and are intense in both capital and skilled labour These firms offer considerably better working conditions than their counterparts, paying up to three times more than medium-scaled firms. In contrast, artisan and small-scale mining firms are described by Chaparro (2000) as unskilled-labour intensive; and having very little investment, technological development, and innovation. They are associated with lower wages and precariousness, with accident rates more than triple the modern sector's benchmark.

1. Data description and variable definition

The database upon which this research is constructed is the National Survey of Socioeconomic Characterization (CASEN in Spanish), for 2009, 2011, and 2013. This survey is extensively used because it is nationally representative, collecting information on different modules regarding employment, income, health, and education.[6]

Since 2009, CASEN incorporated methodological innovations that permitted the construction of a restricted measure of underemployment. Following standard ILO conventions, CASEN asks for the numbers of hours worked during a standard workweek. Immediately after, respondents are asked if they would like to work more hours, and their answer is categorized under one of the following options: (1) Yes, immediately, (2) Yes, in another time of the year, and (3) No. We

[5] The other popular explanation for queuing and labour market segmentation relies on effort elicitation models (Stiglitz and Shapiro, 1984; Bowles, 1985). These models predict that inter-industry differences across monitoring costs should explain queuing and wage differentials across industries. An empirical example of this position is found in Green and Weisskopf (1990).

[6] All three versions contain a weighting factor that we use throughout the summary statistics, which makes the sample representative at the national and regional level.

define part time workers as those working between 10 and 30 hours,[7] and the underemployed as the subset of part-time workers who report wanting to work more hours at that very moment. Due to data availability, it is not possible to differ between the causes that determine the inability to work more hours in 2011 and 2013, although the prevalence of non-economic underemployment is small in magnitude for 2009.[8]

From all the available observations, this article works only with subsamples of men, aged from 25 to 55 years old, which are wage workers. This is in order to obtain the most homogeneous sample possible. In particular, women were excluded as to avoid modelling a three-step selection procedure as female labour force participation is exceptionally low in Chile, bordering 45% in the period under consideration, and women only represent 37% of the labour force. Still, part time work is more widespread for women (11% for the equivalent sample), with underemployment representing more than 50% of total part time work. The lower and upper age boundaries were imposed in order to avoid contamination due to educational and retirement choices. Lastly, we exclude all self-employed in the sample, since we are only concerned with queuing within the capitalist segment .[9] Table 1 shows the descriptive statistics for the restricted sample; columns 6 and 7 present the corresponding mean tests between groups.

[TABLE I HERE]

Although total part time work in general is not very widespread for the defined sample — 5% — it is relevant to note that the underemployed represent around 60% of total part time workers. The preponderance of underemployment over optimal part time workers hints of the relevance of exclusion in the composition of the total part time labour force.

Additionally, wages differ significantly across groups. In per hour terms, part time workers receive the highest remuneration, followed by the underemployed, and full time workers. In

[7] The lower bound is implemented as to avoid any data anomalies such as people who reported working 2 hours last week. The intention is to obtain a "well behaved" sample in order to minimize distortions.

[8] Underemployment is defined as the inability to work more hours due to economic reasons such as employers not offering full time jobs, or failure to find a second occupation. In contrast, non-economic underemployment relates with personal reasons, such as taking care of the elderly or children. For 2009 non-economic underemployment represented only 20% of total underemployment.

[9] Previous empirical work, has shown that queues do exist from the pre-capitalist segment to the capitalist segment, that is, from self-employment to wage work (Contreras, Gillmore and Puentes, 2015) and that long-run trends of self-employment have remained stable over time (Contreras, Puentes and Sanhueza. 2007), which could be an indication of the persistence of structural heterogeneity.

terms of monthly income, full time workers compensate with more hours worked, making the most money, but it is relevant to highlight that the underemployed do not make up for the difference in the per hour wage. Thus they are the worst positioned group in terms of monthly income.

[FIGURE II HERE]

Figure II shows that not only mean hourly and monthly wages differ, but the whole distribution of wages for each group of workers differs. Wage dispersion is highest for the underemployed, followed by part time and then full time workers. Thus, changes across the economy in the composition of worker segments contribute both via inter-wage dispersion and intra-wage dispersion.

It should be noted that standard human capital variables such as age, illiteracy, and schooling do not differ significantly across the three types of workers. However, the data allows to distinguish different types of families associated with each type of worker. Part time and underemployed workers have fewer children, more elderly people living with them, and are less likely to be the head of household than their full-time counterparts. This is puzzling since mainstream economics suggests that fewer children and having more potential child care via elderly people in the household, should diminish the constraints that workers face to stay at home and increase both participation rates and hours worked. However, the underemployed and part time workers are less likely to be the head of household, which is consistent with the view that they could be secondary labour force, preferring part-time jobs.

The job-related characteristics of the three groups do show statistically significant and important in magnitude differences: while 12% of underemployed workers and 11% part time workers have multiple jobs, only 5% of full time workers do so. This gap in multiple jobs is significantly larger than in other countries: In the UK, the figures are 6.3%, 5.6% and 2.3%, respectively, but in Ecuador, they are 1.8%, 3.2% and 4%, respectively.[10] Furthermore, access to a written or verbal contract, which is an important indicator of job formality in developing countries (Huneeus, Landerretche, Puentes and Selman, 2015) and grants access to legal protection and

[10] The percentages for both countries are for 2011. The percentages were calculated using the labor force survey (LFS) for the UK, and the national survey of employment, unemployment and underemployment (EUU) for Ecuador.

rights, is widespread for full time workers (91%) and is less common among part time workers (70%), and scarce for the underemployed (50%).

Overall, the presented statistics portrait three different groups, which do not differ significantly in human-capital related variables, but which can be clearly distinguished by job characteristics, employment arrangements, and their wage distribution. All in all, underemployment as a form of non-standard work arrangement is clearly correlated with bad job characteristics, although this correlation is less pronounced for part-time workers. This suggests that the correlation across bad jobs and non-standard work arrangements is not only a phenomena in the United States (Kalleberg, Reskin and Hudson, 2000) but it's also present in developing countries like Chile.

This could be interpreted in two different ways. Bad-job characteristics are the price to pay for an hourly wage-premium and reduced working hours, or workers find themselves excluded from jobs that guarantee minimum legal safety and have higher monthly incomes, and are in the high productivity segments of the economy. Our proposed empirical strategy allows as testing both hypothesis, self-selection and exclusion, accordingly.

2. Identification Strategy

Queuing models are useful because they depict processes that involve sequential decisions by different actors, and therefore capture several perspectives of complex situations. In labour research, they are commonly used to separate the effects of worker and employer/firm characteristics in a given process and are amply used to test for the existence of queues for union jobs (Abwood and Farber, 1982). They are also used to test the existence of queues from self-employment to wage work (Contreras, Puentes and Gillmore, 2015).

Following Dickens and Lang (1999), proving the existence of labour market segmentation relies on three empirical strategies. First, proving that there are queues, (i.e., workers who would like to work in a given sector but cannot get a job in that sector). Second, proving the existence of different wage-determination mechanisms (i.e., the fact that human capital and other related variables behave differently across segments). Third, showing that some theoretically constructed typology of work relations (in this case standard and nonstandard salaried employment arrangements) are non-randomly distributed across some firm characteristics, such as size or economic sector. These strategies are detailed in this section.

The model is built under the assumption that any individual who seeks work will effectively find a job; the question is whether she will find a full time or a part time position. It supposes that part time jobs are available for everyone, where full time jobs are subject to a queue and a later selection process by the employer. This implies an excess of workers in the full-time sector, which may be due to efficiency wages, rent sharing, or searching models in the full time labour market. As mentioned earlier, the structuralist interpretation suggests that queues are a result of low-productivity segment workers trying to enter high-productivity sectors. As the researcher is not able to observe the queuing process, but only confirm the final outcomes, it is relevant to note that this model is theoretical. In consequence, a framework involving latent variables that motivate observable outcomes is necessary.

In the present formulation, agents must decide whether they will be working full time or part time based on an implicit utility function considering income, leisure, and individual characteristics. This is the selection, or "in the queue" (IQ), equation; individuals who desire a full time occupation are automatically assumed as participants in a queue for full time jobs. In contrast, those who want to work part time will always be able to find a part time job.

$$L_{1i} = X_{1i}\,\beta\ + \epsilon_{1i}\ \#(1)$$

$$D_{1i}\ = \begin{cases} 1\ if\ \ L_{1i} > 0 \\ 0\ if\ L_{1i}\ \leq 0 \end{cases} \#(2)$$

L_1 in equation (1) stands for the latent variable "propensity to work full time," and determines whether individual *"i"* decides to join (or not to join) the queue for full time jobs. X_I represents observable characteristics, β the vector of parameters, and ϵ_{1i} accounts for the effects of unobserved variables and possible heterogeneity. We observe $D_{1i} = 1$ if i decided to join the queue, and $D_{1i} = 0$ if not.

In a second stage, employers choose which individuals from the queue will effectively work full time – "chosen from the queue" (CFQ) – based on their observable characteristics and the firm's needs:

$$L_{2i} = X_{2i}\,\beta\ + \epsilon_{2i}\ \#(3)$$

$$D_{2i} = \begin{cases} 1 \; if \;\; L_{2i} > 0 \\ 0 \; if \; L_{2i} \;\; \leq 0 \end{cases} \#(4)$$

Latent variable L_2 in equation (3) represents the hypothetical employers propensity to hire the individual i full time. That is, the employer observes queuing individual i's set of relevant characteristics and her particular necessities (vector X_i), weights them according to the parameters β_i, and afterwards makes his hiring decision. Therefore, we observe the dichotomous outcome $D_{2i} = 1$ f i was "chosen from the queue: and $D_{2i} = 0$ if she was not.

Three outcomes are possible after this joint optimization process: (1) agents who optimally decided to work part time; (2) individuals working full time, implying they joined and were chosen from the queue; and (3) those who joined the queue but were not selected, therefore are working sub optimally in part time jobs. All individuals grouped in outcome (3) are categorized as underemployed. Figure III illustrates the complete decision process.

[FIGURE III HERE]

Note that employers only observe and consequently hire those individuals who choose to join the queue for full time positions, although their propensity to hire full time is theoretically defined for the entire population. This is a relevant consideration because the possibility exists that a group of individuals is permanently not joining the queue although our hypothetical employer would gladly hire them. Therefore, we are facing a potential problem of self-selection in the queuing process. In contrast, a group of workers may be permanently selecting themselves into the queue but not being chosen at all, which implies they work in part time occupations as a consequence of exclusion.

Wage equations are estimated in order to contrast the three different groups (full time workers, optimal part time workers and the underemployed) and their income outcomes. These wage equations are corrected by the previous double selection process following Tunali (1985). We denote wage equations as:

$$W_e \; = \; Z_e \; \delta_e \; + \; v_e \#(5) \#(5)$$

Where W_e stands for log hourly earnings, Z_e for the vector of characteristics, δ_e the earning parameters, and v_e are unobserved factors influencing wages. The subscript e stands for each

relevant group. Particularly, $e \in \{FT, PT, UE\}$ for full time, optimal part time and underemployed workers respectively.

Estimation

The existence of selectivity bias renders the traditional OLS estimates biased and inconsistent. Assuming that ϵ_{1i} and ϵ_{2i} are bivariate standard normally distributed with correlation ρ, Heckman (1979) shows that this issue may be treated as a relevant variable omission. In consequence, we follow Van de Vaar and Van Praag (1981) by applying Heckman's two-step procedure to a bivariate probit in order to correct for sample selection. ML estimates are obtained from the following likelihood function:

$$\prod_{i=1}^{G_1} \Phi_2(X_i\,\beta, Z_i\,\gamma, \rho) \prod_{i=G_1+1}^{G_2} \Phi_2(X_i\beta, -Z_i\gamma, \rho) \prod_{i=G_2+1}^{G_3} \Phi\,(-X_i\beta)\ \#(6)$$

Which is built over equations (1), (2), and (4). The first G_1 observations are the ones that meet $D_1 = D_2 = 1$, G_2 observations meet $D_1 = 1 \wedge D_2 = 0$ whereas G_3 individuals show $D_1 = 0$. Based on Heckman's work, it is necessary to include at least one exclusion variable in the first stage in order to assure the method is correcting sample selection bias instead of nonlinearities. Φ and Φ_2 stand for the univariate and bivariate normal distributions respectively.[11]

The statistical significance of the correlation ρ from the model is crucial as it supports the relevance of the relationship between both stages, justifying the use of a bivariate distribution, giving proof of the queue's existence, and of both the selection and exclusion present in PT occupations. As a matter of fact, the sign of the correlation matters; a negative ρ implies that the unobserved characteristics that make individuals who are more likely to be IQ are less likely to be CFQ. A positive ρ would hint in the opposite direction.

In order to obtain unbiased estimates of the wage equation parameters, it is necessary to account for the expectations of the error terms conditional of being in a particular sector. Following

[11] Including women in the sample would have implied the necessity of including a third stage, previous to the other two, to deal with the women's participation decision. This implies the use of trivariate distributions, and the challenge of finding different exclusion variables for both the participation and the selection equations (literature usually uses family variables for both separately).

Tunali (1985), the corresponding correction for individuals employed full time is: $E(v_{FT}|Z_{FT}, D_1 > 0, D_2 > 0) = \sigma_1\lambda_{1FTi} + \sigma_2\lambda_{2FTi}$where:

$$\lambda_{1FTi} = \frac{\Phi(X_i\beta)\Phi\left[Z_i\gamma - \rho X_i\beta/\sqrt{1-\rho^2}\right]}{\Phi_2(X_i\beta, Z_i\gamma; \rho)} \#(7)$$

$$\lambda_{2FTi} = \frac{\Phi(Z_i\gamma)\Phi\left[X_i\beta - \rho Z_i\gamma/\sqrt{1-\rho^2}\right]}{\Phi_2(X_i\beta, Z_i\gamma; \rho)} \#(8)$$

While σ_1 and σ_2 are the corresponding covariances of the error terms between being IQ and CFQ for FT workers and the error term in the wage equation. In a similar manner, the correction terms for underemployed workers are $E(v_{UE}|Z_{UE}, D_1 > 0, D_2 \leq 0) = \sigma_3\lambda_{3UEi} + \sigma_4\lambda_{4UEi}$ with:

$$\lambda_{3FTi} = \frac{\Phi(X_i\beta)\Phi\left[-(Z_i\gamma - \rho X_i\beta)/\sqrt{1-\rho^2}\right]}{\Phi_2(X_i\beta, -Z_i\gamma; -\rho)} \#(9)$$

$$\lambda_{4FTi} = \frac{-\Phi(Z_i\gamma)\Phi\left[X_i\beta - \rho Z_i\gamma/\sqrt{1-\rho^2}\right]}{\Phi_2(X_i\beta, -Z_i\gamma; -\rho)} \#(10)$$

Where again σ_3 and σ_4 are the covariances between the error terms of being IQ and CFQ with the error term in wage equations. Lastly, for optimal part time workers, the expectation is $(v_{PT}|D_1 \leq 0) = \sigma_5\lambda_{5PTi}$, with:

$$\lambda_{5PTi} = \frac{-\phi(X_i\beta)}{(1-\Phi(X\beta))} \#(11)$$

Where σ_5 stands for the covariance between the error term in the wage equation and the queueing decision.

Thus, the wage equations allow the estimation of the covariance (σ's), which show the relationship among the unobserved factors that influence the decisions of queuing, hiring, and the unobservable wage terms of each group. For example, a positive σ_1 would hint that the

unobserved variables that make FT workers favour being IQ have also a positive effect on their salaries (for example being more productive in FT occupations).

Heteroscedasticity is corrected using White's sandwich variance estimation process. A cluster formulation was discarded as the potential intra-sectorial heterogeneity predicted by the structuralist framework eliminated the idea of economic sectors as the optimal clustering unit. Finally, no attempts were made to correct for potential endogeneity issues arising with some independent variables included in both stages of the modelling process such as education, firm size, or sector. Consequently, inconsistency of the presented estimates is not discarded and therefore estimates are not informative about causal relations but about strong correlations.

In brief, our overall formulation allows part time employment to be the product of two different dynamics: selection, by those individuals who decided not to queue and directly applied for part time occupations; and exclusion, concerning the individuals who queued but were not selected. The statistical significance of the correlation ρ determines the existence of queues, whereas the correction terms included in the wage equations correct for selection and hint at the mechanisms that play a role in the wage determination of the three different groups.

3. Econometric Results

Queuing Model

The estimated double selection model includes the following variables: age and age squared; primary, secondary and tertiary schooling to capture differential returns to distinct educational levels; and binary variables if the worker belongs to an ethnic group or lives in an urban area. The exclusion variables in the IQ equation are the family-related ones commonly employed in labour research: number of children, number of elderly people in the household, and being the head of the household. It's plausible to think that these can be exclusion variables since they are not observed by the employer, and we test their statistical relevance below. We include firm size and one-digit industry dummies in the CFQ equation in order to infer, ex-post, which workers belong to which productivity segment. Since the industrial classification used by CASEN changed in 2011, the industries were re-grouped in order to form the three aggregate industries traditionally used in Latin American economies: a "primary" sector composed of fishing,

agriculture and mining; a "secondary" sector composed of manufacturing, utilities and construction; and a "tertiary" sector including trade, tourism, financial services, education and other services.

[TABLE II HERE]

Table II shows the resulting mean centred marginal effects of the baseline queuing model.[12] The model was estimated pooling three years: 2009, 2011, and 2013. The results for the IQ equation are presented on the first column. Education and age are statistically significant: younger and more educated workers prefer part-time jobs. The magnitude of the coefficients, however, is not economically significant: a 10-year increase in age only increases the probability of joining the queue by roughly 2%. Likewise, 5 years of college (which is the average length of university education in Chile) decreases the probability of queuing by roughly 0.9%. The exclusion variables show that only being head of household is statistically significant and make those workers more probable to join the queue.

The results for the CFQ equation are showed on the second column. Older workers are more likely to be selected from the queue. Schooling acts in a surprising way: while increments in primary and secondary schooling increase the probability of being chosen from the queue, increases in tertiary educational generate the opposite response. An interactive variable between going to the university — a dummy which takes value 1 if the individual attended college and zero if he received vocational training — and years of tertiary education is included to check if the result is driven by professionals who have vocational tertiary education. The interactive variable, however, is not statistically significant. This discards the possibility of further segmentation due to educational differences; for instance, workers with vocational education could have been additionally penalized by a modern sector demanding better educated professionals.

Industry and size dummies are mostly significant and show larger coefficients than the human capital variables. Bigger firms choose more workers from the queue, as do manufacturing firms compared to mining, fishing, and agricultural firms. It is interesting to note that service sector

[12] In order to check the sensitivity of the results, the underemployed were re-defined as those who work less than 35 and 25 hours, without significant changes in the results.

firms show a perverse interactive effect: the bigger a service firm gets, the smaller the probability that it selects workers from the queue. [13]

If the probability of being chosen from the queue is interpreted as an indicator of the segment's productivity, it is possible to infer that bigger, secondary-sector firms belong to the modern sector, while small and big tertiary sector firms belong to the intermediate sector. However, data on sectorial productivity is not available in the survey, and thus this is only a conjecture. [14]

The queuing model estimated a correlation coefficient ρ of -0.91. The first row of Table III shows the equation independence test those tests whether the first stage and the second stage are correlated or not. It is equivalent to testing the statistical significance of ρ and is rejected at any conventional significance value. A statistically significant correlation of -0.91 confirms the existence of selection in the queuing process. As previously mentioned, a negative correlation implies that the non-observables that make workers more likely to be IQ also make them less likely to be CFQ. The relevance of this finding will be commented in detail later.

[TABLE III HERE]

A battery of statistical tests was applied in order to confirm the consistency of the model; these results are presented in Table 3. The second row discards a universal queue (that is a probability of queuing equal to 1), while the third test discards the non-existence of the queue (a probability of being chosen equal to one), both at the 0.1% confidence level. The non-existence of the queue test consists of testing the joint significance of the independent variables in the CFQ equation. If the variables are not jointly significant it is equivalent to verifying that employers select every worker from the queue. Lastly, the fourth test tests the joint relevance of the exclusion variables utilized in the first stage, also rejecting the irrelevance hypothesis at 0.1% confidence. This last result is particularly relevant as only one of the exclusion variables is individually significant in the first stage.

[13] The same regression was run with 2-digit industry disaggregation for 2011 and 2013. This suggests that manufacturing industries, which have an average marginal effect of 30%, drives the obtained coefficients for the secondary sector. Utilities and construction are not statistically significant. The tertiary sector's results are more homogeneous with big and small trading, education and tourism showing the same average marginal effects as reported here.

[14] Note that these results are hard to square with the "stringent formalization" theories of Maloney and other authors. While it is certainly true that smaller firms are not formally registered and this could explain that they hire less workers from the queue, it's hard to explain why formalization costs would vary *across sectors,* and even more why there is an interactive effect between sectors and size.

Wage equations

After estimating the queuing model, predicted mill's ratios are obtained for each group. As described in the previous section, incorporating these ratios as repressors in the earning equations corrects for self-selection in the estimation, which in turn eliminates a source of inconsistency and bias, which is common in labour-segmentation models (Heckman and Sedlaceck, 1985; Heckman and Hots, 1986). Table IV presents wage estimations for each group: full time workers, part time workers, and underemployed workers. The first column for each group shows the estimation without incorporating the correction terms while the second column shows the estimation with the correction terms.

[TABLE IV HERE]

The results show that human capital related variables have different coefficients for each group. Underemployed workers have positive and significant returns to primary and secondary education, while full time workers have the same for secondary and tertiary education. After correcting for selection bias, only the underemployed show returns from experience, proxied by age.

Firm-related variables perform in the expected way; bigger firms consistently pay higher wages, but the premium across firm size is substantially bigger for the underemployed. Manufacturing industries pay a substantially higher wage premium than the service sector for each group, in the range of 5% to 10%. As in the queuing model, the interactive service-size coefficient has a statistically significant and perverse negative wage premium for the three groups. The interaction counter-acts the benefits of a firm's bigger size by roughly 50% for each group.

These results broadly suggest that firm characteristics that are associated with a higher probability to being CFQ are also correlated with higher wages. The only exceptions are the biggest firms in the manufacturing sector, which exhibits a wage penalty for the full time and part time groups. A positive correlation among wage premiums and desirable employment

relationships is consistent with the structuralist model and with rent-sharing and searching theories of the labour market.[15]

Furthermore, as mentioned in the identification strategy section, estimating wage equations while correcting for selectivity bias allows the researcher to estimate the covariance between the residuals in the wage equations and the residuals from the IQ and CFQ equations from double selection model using the mill's ratio as an input. For the underemployed, the covariance between the probability of being IQ and the wage is negative, while the covariance between the probability of being CFQ and the wage is positive. The same results hold for full time workers. For part time workers, the covariance between wages and joining the queue is negative. Thus the same unobserved factors that make individuals more likely to queue negatively affect their probability of being selected for a full time occupation and have perverse effects on their future wages. Overall, if there is a relationship between wages and unobserved productivity, then these results suggest that low-productivity workers join the queue, and employers in high productivity segments choose the more productive worker from the pool of workers from the queue.[16]

4. Conclusion

Despite increasing interest in understanding part time work and non-standard work arrangements in recent academic literature, underemployment has received little theoretical or empirical attention. This article contends that as a specific subset of part time and non-standard work arrangements in developing countries, underemployment can be understood as an exclusion phenomenon driven by labour market segmentation and structural heterogeneity. A general model where different productivity segments in the economy are associated with specific labour market segments is proposed, which can help guide future investigations.

[15] They are also inconsistent with compensating wage differentials, that is, the theory that posits that "good job characteristics" should be negatively correlated with lower wages, since these characteristics are costly for the employer and act as substitutes for the worker.

[16] It should be noted that our mill correction terms are unusually large in size. This could be attributed to the fact that the underemployed, that is, workers not chosen from the queue, are a very small fraction of the total labour force in the second step of estimation. In order to see if this is true, random sub-samples of 2.000 full time and 2.000 part time workers (not distinguishing whether they were underemployed or optimal part time workers) were drawn for the sample, and the same model was estimated. This was done 100 times, the resultants coefficients averaged out. The mill correction terms do not change their sign; the magnitude of the coefficients drops substantially, showing reasonable values, while the rest of the parameters remained essentially the same. Results are available upon request.

Empirically, a double selection model that tests the existence of queues for full time jobs is estimated. The model shows support for both self-selection and exclusion of total part time labour force, showing that standard human capital variables decrease the probability of being underemployed with the exception of tertiary education, an unexpected finding that we leave for future research. Industry and size dummies show that bigger, manufacturing firms select more workers from the queue, while small and large service firms select fewer workers from the queue. The correlation between both stages of the selection process is negative, showing that unobserved factors that make it more likely that a worker will join the queue also make him less likely to be selected from the queue. The results are robust to a series of statistical tests and underemployment definitions.

Wage equations are estimated for each group incorporating corrections from self-selection bias; results show that the unobserved factors that make individuals queue also reduce their salaries. Underemployed workers receive returns for lower educational levels, while the opposite is true for full time and optimal part time workers. Industry and firm size wage premiums are positively correlated with the probability of being chosen from the queue.

Overall, these results suggest a situation where workers with low unobserved productivity queue for contract-driven, better paid, full time jobs in the high productivity or modern sector. Only a subset of total part time worker queue and is excluded from these occupations, while another subset self-selects to work fewer hours. While it is clear from the statistical analysis that the results of the underemployed and full time labour groups are consistent with the structuralist framework, more research is needed in order to characterize optimal part time work.

The presented results suggest questions for working class structuring in developing counties. How closely linked are productivity gaps with other forms of labour market segmentation and non-standard work arrangements, such as working for contract companies and self-employment? These questions present a promising framework for future research, at least from the point of view of forging a more intimate connection between social structure and the productive structure of developing economies.

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Annex

Figure I – Structural Heterogeneity and Working Class – Formation.

	Capitalist Segment		Pre – Capitalist Segment
Productivity Gaps	**Modern Sector** (No productivity gaps)	**Intermediate Sector** (Moderate productivity gaps)	**Informal Sector** (Huge productivity gaps)
Working – Class formation	**Standard employment arrangements**	**Non-Standard employment arrangements** (underemployment, on-call labour, etc.)	**Self-Employed workers**

Source: Elaborated by authors.

Figure II – Normal Density Functions for Hourly Earnings

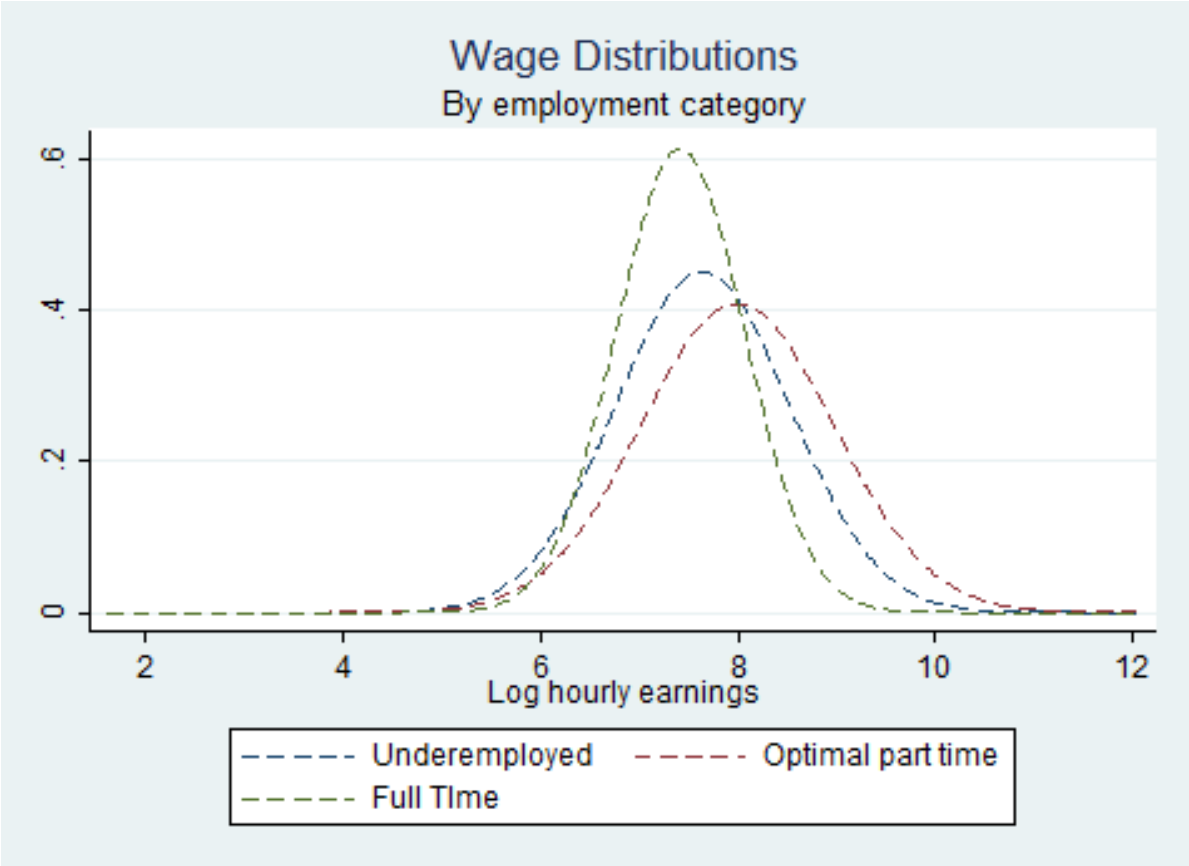
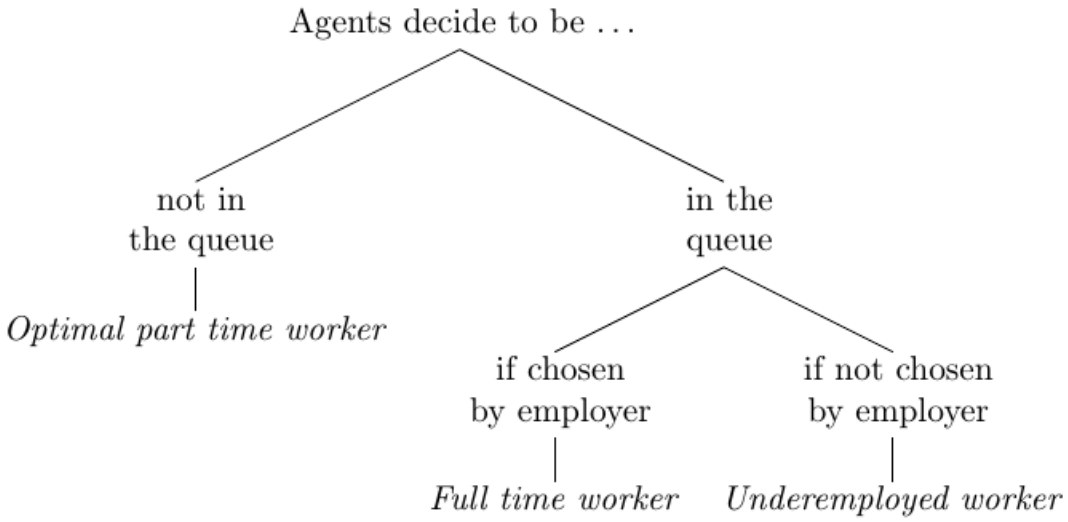


Figure III – Queuing Process



The two-staged queuing process

Table I – Descriptive statistics of the sample

	Underemployed (UE)	Part Time (PT)	Full Time (FT)	Test UE - PT	Test UE – FT	Test PT - FT
Share	3%	2%	96%			
N	2,062	1,430	74,476			
Age	38.3	38.9	40.0	0.27	0.01***	0.01***
Schooling	11.5	12.0	11.7	0.10*	0.36	0.17
Hourly Wage	3,740.94	5,655.25	2,578.51	0.01***	0.01***	0.01***
Monthly Income	135,931	150,151	196,382	0.01***	0.01***	0.01***
Hours Worked	22.2	21.0	48.0	0.01***	0.01***	0.01***
Contract	50%	70%	91%	0.01***	0.01***	0.01***
Multiple Jobs	11%	12%	5%	0.92	0.01***	0.01***
Urbanism	87%	86%	88%	0.74	0.45	0.37
Illiterate	3%	3%	2%	0.88	0.01***	0.04**
Ethnicity	8%	7%	7%	0.33	0.27	0.91
Head of Household	49%	52%	63%	0.38	0.01***	0.01***
Family Size	3.9	3.9	4.1	0.88	0.01***	0.01***
Children	59%	64%	76%	0.38	0.01***	0.01***
Elderly	37%	36%	31%	0.73	0.02***	0.06*
Non Labour Income	149,460	144,145	114,851	0.94	0.07*	0.23
Father's Schooling	7.4	7.9	7.5	0.89	0.66	0.79
Mother's Schooling	6.7	7.5	7.0	0.42	0.22	0.99

Note: All data are from a pooled sample of men aged 25-55. Children are considered as people between ages 0-15 living in the household. “Elderly” refers to one or more people above 60 living with the wage earner in his household.

Table II – Baseline Results of the Queuing Model

Equation	Principal	Selection
Age	0.00335***	0.00222***
	(0.000692)	(0.000585)
Age squared	-3.55e-05***	-2.68e-05***
	(8.71e-06)	(7.37e-06)
Primary Schooling	0.00182***	0.00138***
	(0.000461)	(0.000393)
Secondary Schooling	0.00208***	-0.000103
	(0.000480)	(0.000404)
Tertiary Schooling	-0.00297***	-0.00166***
	(0.000598)	(0.000543)
University * Tertiary Schooling	-0.000730	-0.00101*
	(0.000616)	(0.000540)
2011	-0.00625***	0.00320**
	(0.00158)	(0.00133)
2013	-4.51e-05	0.00296**
	(0.00156)	(0.00133)
Manufacturing	0.00941***	
	(0.00346)	
Services	0.00330	
	(0.00298)	
6 to 9 workers	0.0167***	
	(0.00366)	
10 to 49 workers	0.0333***	
	(0.00319)	
50 to 199 workers	0.0381***	
	(0.00379)	
More than 200 workers	0.0514***	
	(0.00395)	
Manufacturing * 6 to 9 workers	-0.00129	
	(0.00594)	
Manufacturing * 10 to 49 workers	0.00182	
	(0.00505)	
Manufacturing * 50 to 199 workers	-0.00499	
	(0.00558)	
Manufacturing * More than 200 workers	-0.00679	
	(0.00559)	
Services * 6 to 9 workers	-0.00147	
	(0.00495)	
Services * 10 to 49 workers	-0.0137***	
	(0.00403)	

Services * 50 to 199 workers	-0.0147***	
	(0.00467)	
Services * More than 200 workers	-0.0217***	
	(0.00456)	
Urban	-0.00412**	-0.00180
	(0.00172)	(0.00137)
Indigenous	-0.00132	-0.00587***
	(0.00218)	(0.00174)
Head of Household		0.00456***
		(0.00145)
Number of Children		0.000664
		(0.000678)
Elderly		-0.00117
		(0.000955)
House owner		-0.000119
		(0.00113)
Mother's Schooling		9.76e-05
		(0.000224)
Father's Schooling		0.000171
		(0.000226)
Non Labour Income		-0.000482
		(0.000454)
Regional Controls	Yes	Yes
Observations	62,085	62,085

Robust standard errors in parentheses

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

Table III – Robustness check

Test	Null Hypothesis	P - Value
Independence of equations	$H_0: \rho = 0$	0.000
Universal Queue	$H_0: Pr(IQ) = 1$	0.000
Non-existence of the queue	$H_0: Pr(CFQ) = 1$	0.000
Irrelevance of the exclusion variables	$H_0: X_{ex}\beta = 0$	0.000

Table IV – Earning equations for each group.

Worker Type	Full Time		Part Time		Underemployed	
	Baseline	Heckman	Baseline	Heckman	Baseline	Heckman
Age	0.0395***	0.000592	0.130***	0.0248	0.0554***	0.116***
	(0.00220)	(0.00265)	(0.0287)	(0.0311)	(0.0202)	(0.0425)
Age Squared	0.000391***	6.97e-05**	0.00141***	-0.000172	0.000582**	-0.00119**
	(2.76e-05)	(3.20e-05)	(0.000362)	(0.000387)	(0.000256)	(0.000474)
Primary	0.0231***	-0.00216	0.0606***	-0.00585	0.0166	0.0450*
	(0.00145)	(0.00175)	(0.0207)	(0.0222)	(0.0129)	(0.0236)
Secondary	0.0552***	0.0559***	0.0706***	0.0707***	0.0595***	0.116***
	(0.00130)	(0.00145)	(0.0206)	(0.0201)	(0.0136)	(0.0264)
Tertiary	0.166***	0.177***	0.111***	0.144***	0.161***	0.0837**
	(0.00276)	(0.00296)	(0.0236)	(0.0231)	(0.0172)	(0.0378)
University *	0.0206***	0.0436***	-0.00409	0.0401*	-0.00839	-0.00354
	(0.00305)	(0.00304)	(0.0250)	(0.0242)	(0.0179)	(0.0207)
2011	0.0602***	0.0198***	0.0301	-0.0583	0.137***	-0.0906
	(0.00497)	(0.00558)	(0.0675)	(0.0664)	(0.0450)	(0.0908)
2013	0.123***	0.0908***	0.0554	-0.0375	0.210***	0.171***
	(0.00483)	(0.00485)	(0.0628)	(0.0625)	(0.0450)	(0.0449)
Manufacturing	0.0694***	0.0872***	0.243	0.267*	0.126	0.356***
	(0.0137)	(0.0149)	(0.156)	(0.153)	(0.0902)	(0.124)
Services	0.0171	0.0343**	0.165	0.177	0.156**	0.212***
	(0.0132)	(0.0133)	(0.135)	(0.131)	(0.0721)	(0.0737)
6 to 9 workers	0.0770***	0.0906***	0.189	0.173	0.0999	0.572***
	(0.0135)	(0.0175)	(0.152)	(0.145)	(0.102)	(0.209)
10 to 49	0.131***	0.157***	0.347**	0.342**	0.0829	1.027***
	(0.0111)	(0.0215)	(0.156)	(0.152)	(0.0893)	(0.388)
50 to 199	0.206***	0.236***	0.673***	0.620***	0.384***	1.431***
	(0.0121)	(0.0231)	(0.182)	(0.180)	(0.140)	(0.439)
More than 200	0.371***	0.397***	1.084***	1.019***	0.534***	1.990***
	(0.0119)	(0.0256)	(0.144)	(0.144)	(0.128)	(0.592)
Manufacturing	-0.00613	-0.00976	0.0365	-0.00267	-0.0115	-0.0424
	(0.0199)	(0.0201)	(0.274)	(0.264)	(0.168)	(0.164)
Manufacturing	0.0318*	0.0184	0.0250	-0.0339	0.442***	0.502***
	(0.0163)	(0.0165)	(0.236)	(0.231)	(0.159)	(0.159)
Manufacturing	-0.000392	-0.0176	0.262	0.240	0.150	0.0511
	(0.0173)	(0.0179)	(0.257)	(0.256)	(0.188)	(0.190)
Manufacturing	-0.102***	-0.116***	-0.458**	-0.443**	-0.0722	-0.242
	(0.0167)	(0.0175)	(0.213)	(0.209)	(0.181)	(0.192)
Services * 6 to	0.0189	0.0133	-0.0997	-0.122	-0.0579	-0.0876
	(0.0193)	(0.0192)	(0.203)	(0.199)	(0.134)	(0.133)
Services * 10 to	0.0344**	0.0135	-0.102	-0.113	0.0450	-0.358*
	(0.0156)	(0.0171)	(0.190)	(0.184)	(0.112)	(0.194)

Services * 50 to	-0.0136	-0.0379**	-0.345	-0.326	-0.238	-0.640***
	(0.0168)	(0.0180)	(0.214)	(0.210)	(0.163)	(0.220)
Services * More	-0.0973***	-0.118***	-0.697***	-0.679***	-0.390***	-0.989***
	(0.0160)	(0.0175)	(0.177)	(0.174)	(0.145)	(0.279)
σ_1		-4.885***				
		(0.121)				
σ_2		0.354*				
		(0.195)				
σ_5				-1.581***		
				(0.214)		
σ_3						-14.85***
						(3.193)
σ_4						1.790**
						(0.712)
Regional	Yes	Yes	Yes	Yes	Yes	Yes
Constant	5.902***	7.159***	4.221***	3.209***	5.943***	8.173***
	(0.0455)	(0.0777)	(0.604)	(0.607)	(0.418)	(0.708)
Observations	58,397	58,362	1,031	1,031	1,515	1,515
R-squared	0.476	0.492	0.329	0.364	0.395	0.405

Robust standard errors in parentheses

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