Labor Market Search, Informality and Schooling Investments.

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Web Appendix – Not for Publication

Contents

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A Data and Institutions

A.1 Data Appendix

This Section provides a more detailed description on how we build the *balanced panel* of workers we use to extract transitions probabilities and hazard rates. Information contained in the ENOE survey on the consecutive number of the interview (from 1 to 5) allow us to link at the individual level the quarterly waves under the sample selection criteria outlined in Section 2.2. This dataset generates yearly transition probabilities across the four labor market states of formal and informal employment, self-employment and unemployment for individuals entering the survey in each quarter of the year 2005. For instance, an individual who enters in the first quarter of 2005 is observed for five quarters up to the first quarter of 2006, while an individual who first enters in the last quarter of 2005 is observed until the last quarter of 2006.

Since the transition probabilities are potentially affected by attrition in the ENOE survey, we focus on a *balanced panel* of workers with five consecutive quarterly survey rounds. The relevant time horizon for each observation is a quarter, and hence we cannot detect changes in intertwining spells of employment or job search that are shorter than three months. For instance, the observed transition rates between formal and informal employment may possibly "hide" a short period of unemployment in between. This feature of the data applies to both the ENOE sample and the simulated samples generated by the model from which we construct the moments used in estimation.

We observe a small but significant amount of yearly transitions out of self-employment (see Table 2) but at the same time very long on-going durations in self-employment (not reported in Table 2, median=80 months). We also observe very short on-going durations in unemployment (not reported in Table 2, median=1 month), which are difficult to reconcile with the corresponding transition rates out of unemployment. We claim that the transitions information is more reliable because it is obtained by the labor market state reported in the ENOE survey at the moment of the interview. Retrospective information on the termination date of the last employment spell may be instead prone to recall bias. Indeed, duration spells are on average much longer than those implied by changes in the searching state across contiguous quarters, with severe mismatches for more than half of the individuals in the panel sample.

We thus exclusively use information about changes in labor market states across quarters when constructing the hazard rates out of unemployment. Notably, we focus on the sub-set of workers who become unemployed during the five quarters of observation of the panel (6% of the sample) and generate hazard rates at three and six months by schooling group. Notice that we don't use hazard rates out of the other searching state (self-employment) since the presence of heterogeneous self-employment income (y) may generate differences between these exit rates at different time horizons that are unrelated to duration dependence.

A.2 Institutional Parameters

The parameters $\{B_0, \tau, t\}$ are set to the values determined by the institutional setting of the Mexican labor market. In particular:

$\boldsymbol{\tau} = \mathbf{0.55}$ In order to derive the share of the bundle of additional benefits for Formal employees (τ), we follow calculations reported in Levy (2008), which are based on the current legislation in Mexico. Accordingly, for a worker who earns twice the minimum wage in 2007 (2,931 Pesos), social security contributions amount to 864.30 Pesos (almost 30% of the wage), of which 55% are attributable to spending categories that are proportional to the wage - notably, work-risk insurance (76.2 Pesos), disability and life insurance (69.6 Pesos), retirement pensions (184 Pesos) and housing fund (146.6 Pesos).

$\boldsymbol{t} = \mathbf{0.33}$ We rely on calculations reported in Anton et al. (2012), which are based on official statistics reported by the Mexican Social Security Institute (IMSS). The authors decompose the average tax rate on formal labor (38%) into government subsidies (5%) and firms and workers contributions (33%).

$\boldsymbol{B_{0,1}} = \mathbf{2.42}$ **and** $\boldsymbol{B_{0,0}} = \mathbf{1.92}$ Total spending in non-contributory social security programs for the year 2005 amounted to 133,090,002,747 Pesos, of which 11,916,448,117 Pesos were devoted to the *Seguro Popular* program. For the same year, we compute the total number of informal workers (25,035,508) and unemployed (1,353,561) by applying sampling weights to the nationally-representative labor market survey used in our empirical analysis (ENOE). Assuming full time working hours over a period of one year (2,080 hours), we can compute the per-capita hourly monetary benefits extended to the part of the labor force that is non-Formally employed, separately for those who reside in municipalities with ($B_{0,1}$) and without ($B_{0,0}$) the *Seguro Popular* program.

B Model

B.1 Lemmas

Lemma 1 ***The sign of the dependence of*** $S(y,h)$ ***on*** y ***is ambiguous.***

Proof. Consider two values of y such that $y' < y''$. We want to sign the difference:

$$S(y'',h) - S(y',h) \tag{B.1}$$

By using equation (18), we can show that:

$$\begin{aligned}
[S(y'',h) - S(y',h)] \;\; \propto \;\; & (y'' - y') \\
+ \;\; \gamma_h & \left\{ \begin{array}{l} \int_{\neg\mathcal{A}(y'',h)} \max\{E_0[w_0(x), y'', h], S(y'', h)\} dG(x|h) \\ + \int_{\mathcal{A}(y'',h)} \max\{E_1[w_1(x), y'', h], S(y'', h)\} dG(x|h) \end{array} \right\} \\
- \;\; \gamma_h & \left\{ \begin{array}{l} \int_{\neg\mathcal{A}(y',h)} \max\{E_0[w_0(x), y', h], S(y', h)\} dG(x|h) \\ + \int_{\mathcal{A}(y',h)} \max\{E_1[w_1(x), y', h], S(y', h)\} dG(x|h) \end{array} \right\}
\end{aligned} \tag{B.2}$$

While the first term $(y'' - y')$ is positive, the difference between the terms in curly brackets is ambiguous. The ambiguity arises from the dependency of the set $\mathcal{A}$ on y. As shown in equation (13), the set defines the support of the match productivity x over which firms offer formal contracts. Since firms choose this optimally, they may pick ranges that decrease the portion of the surplus going to the worker. In so doing, they may offset some of the advantage that a worker with higher

y may have in bargaining, an advantage arising by his higher flow value while searching.

Figure B.1 clarifies the discussion. The figure (a generalization of Figure 2) represents the value functions of a vacancy filled with an informal or a formal job, as defined in equations (10) and (11). These value functions determine the optimal decision rules that affect the continuation value of the worker's searching state. Consider for example the worker with $y = y'$. For $x \in [0, x_0^*(y', h))$, he will continue searching; for $x \in [x_0^*(y', h), \tilde{x}(y', h))$, he will accept to work informally; and for $x \in [\tilde{x}(y', h), \infty)$, he will accept to work formally. The range that creates the ambiguity in the sign is $x \in [\tilde{x}(y', h), \tilde{x}(y'', h))$. Over this range, the y'–worker works formally while the y''-worker works informally. Since it is the firm that chooses the formality status, we do not know which one of the two types of worker is better off over this range. In other words, for a given x in this range we do not know the sign of:

$$E_0[w_0(x), y'', h] - E_1[w_1(x), y', h] \tag{B.3}$$

This ambiguity does not allow to univocally sign the difference in continuation values between the two types of workers, i.e. the terms in curly brackets in equation (B.2) presented above. As a result, it does not allow to univocally sign expression (B.1). ■

B.2 Proof of Proposition 2

Proof.

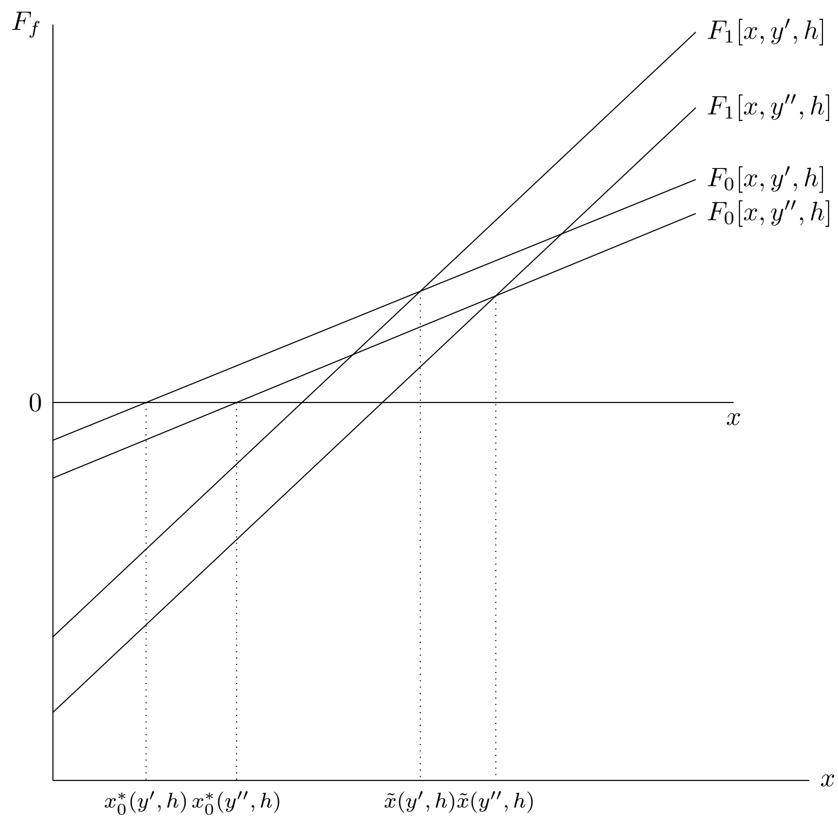
The result is proved by first observing that, given the wage schedules (24) and (23), the value functions for a filled informal and formal job are linearly increasing in x:

$$F_0[x, y, h] = \frac{(1 - \alpha_h)[x - (1 + \chi_h c_h)[\rho Q(y, h) - \beta_{0,h} B_0]]}{\rho + \eta_h + \chi_h} \tag{B.4}$$

$$F_1[x, y, h] = \frac{(1 - \alpha_h)[x - \phi_h[\rho Q(y, h) - \beta_{1,h} b_1]]}{\rho + \eta_h} \tag{B.5}$$

Since, by equation (22), the cost of posting a vacancy is constant in x, $F_0[x, y, h]$ and $F_1[x, y, h]$ will cross that horizontal line and they will cross it only once. This guarantees existence and

Figure B.1: Optimal Decision Rules



NOTE: The Figure shows the equilibrium when $\tilde{x}(y, h) > x_1^*(y, h)$ for given $\{y, h\}$. We assume $y'' > y'$. For the definitions of F_0, F_1, x_0^*, x_1^*, and $\tilde{x}$, see equations (10), (11), (26), (27), and (25).

uniqueness of $x_0^*(y,h)$ and $x_1^*(y,h)$.

Second, the slope of the value function for a filled formal vacancy is steeper than the one for the informal value function since:

$$\frac{\partial F_1[x,y,h]}{\partial x} = \frac{1-\alpha_h}{\rho+\eta_h} \geq \frac{1-\alpha_h}{\rho+\eta_h+\chi_h} = \frac{\partial F_0[x,y,h]}{\partial x} > 0$$

As a result $F_0[x,y,h]$ will cross $F_1[x,y,h]$ and will cross it only once, guaranteeing existence and uniqueness of $\tilde{x}(y,h)$.

Finally, the conditions above generate a range of rankings between the three reservations values that depends on parameters. Based on those rankings, one of the four equilibrium cases listed in Proposition 2 is realized. No other equilibrium cases are possible. In addition, given a set of parameters and a choice of $\{y,h\}$, only one of the equilibrium cases is realized.

■

B.3 Equilibrium Definition

To provide a formal definition of the equilibrium, we start by reporting the expressions for the equilibrium value functions at given meeting rates. We report only the expressions for Case 2 of Proposition 2. The other cases are straightforward specializations of these expressions. We report all the expressions conditioning on h even if the case $h=0$ requires a further specialization. We discuss it at the end of the section.

The equilibrium value functions of the filled job states are obtained by inserting the wage schedules (23)–(24) in the value functions expressions (10)–(11) under free-entry:

$$F_0[x,y,h] = \frac{(1-\alpha_h)[x-x_0^*(y,h)]}{(\rho+\eta_h+\chi_h)} \tag{B.6}$$

$$F_1[x,y,h] = \frac{(1-\alpha_h)[x-x_1^*(y,h)]}{(\rho+\eta_h)} \tag{B.7}$$

Equating these two expressions and solving for x lead to the reservation value $\tilde{x}(y,h)$ defined in (25). Notice that in these and all the following expressions we use the reservation values $x_0^*(y,h)$ and $x_1^*(y,h)$ defined in equations (26) and (27).

The equilibrium value functions of the employee states are obtained by inserting the wage schedules (23)–(24) in the value functions expressions (15)–(16):

$$E_0[w_0(x), y, h] = \frac{\alpha_h[x - x_0^*(y,h)]}{(\rho + \eta_h + \chi_h)(1 + \chi_h c_h)} + Q(y,h) \tag{B.8}$$

$$E_1[w_1(x), y, h] = \frac{\alpha_h[x - x_1^*(y,h)]}{(\rho + \eta_h)\phi_h} + Q(y,h) \tag{B.9}$$

The equilibrium value functions of the posted vacancy are obtained by inserting the wage schedules (23)–(24), the equilibrium value functions (B.6)–(B.7) and the optimal decision rules described in Proposition 2 in the value functions expressions (10)–(11):

$$\begin{aligned} 0 &= \nu_h \\ &+ \zeta_h \frac{(1-\alpha_h)}{\psi(h)b(h)} \int_0^{y^*(h)} b(y|h, y < y^*(h)) \left\{ \begin{array}{c} \frac{1}{(\rho+\eta_h+\chi_h)} \int_{x_0^*(0,h)}^{\tilde{x}(0,h)} [x - x_0^*(0,h)] dG(x|h) \\ + \frac{1}{(\rho+\eta_h)} \int_{\tilde{x}(0,h)}^{\infty} [x - x_1^*(0,h)] dG(x|h) \end{array} \right\} dy \\ &+ \zeta_h \frac{(1-\alpha_h)}{\psi(h)b(h)} \int_{y^*(h)}^{\infty} \psi_h b(y|h, y \geq y^*(h)) \left\{ \begin{array}{c} \frac{1}{(\rho+\eta_h+\chi_h)} \int_{x_0^*(y,h)}^{\tilde{x}(y,h)} [x - x_0^*(y,h)] dG(x|h) \\ + \frac{1}{(\rho+\eta_h)} \int_{\tilde{x}(y,h)}^{\infty} [x - x_1^*(y,h)] dG(x|h) \end{array} \right\} dy \end{aligned} \tag{B.10}$$

The equilibrium value functions of the employee states are obtained by inserting the wage schedules (23)–(24), the equilibrium value functions (B.8)–(B.9) and the optimal decision rules described in Proposition 2 in the value functions expressions (17)–(18):

$$\begin{aligned} \rho U(h) &= \xi_h + \beta_{0,h} B_0 \\ &+ \frac{\lambda_h \alpha_h}{(\rho + \eta_h + \chi_h)(1 + \chi_h c_h)} \int_{x_0^*(0,h)}^{\tilde{x}(0,h)} [x - x_0^*(0,h)] dG(x|h) \\ &+ \frac{\lambda_h \alpha_h}{(\rho + \eta_h)\phi_h} \int_{\tilde{x}(0,h)}^{\infty} [x - x_1^*(0,h)] dG(x|h) \end{aligned} \tag{B.11}$$

$$\begin{aligned} \rho S(y,h) &= y + \beta_{0,h} B_0 \\ &+ \frac{\gamma_h \alpha_h}{(\rho + \eta_h + \chi_h)(1 + \chi_h c_h)} \int_{x_0^*(y,h)}^{\tilde{x}(y,h)} [x - x_0^*(y,h)] dG(x|h) \\ &+ \frac{\gamma_h \alpha_h}{(\rho + \eta_h)\phi_h} \int_{\tilde{x}(y,h)}^{\infty} [x - x_1^*(y,h)] dG(x|h) \end{aligned} \tag{B.12}$$

The equilibrium measures over labor market states conditioning on schooling level h are obtained by imposing the usual steady state conditions equating flows in and out of each state. Flows are governed by the optimal decision rules described in Proposition 2 together with the shocks defined in Section 3. We denote with $b(y|h)$, $e(y|h)$ and $l(y|h)$ the steady state measures for, respectively, searchers, informal employees and formal employees. We start by recalling that they are mutually exclusive states and that the following equalities hold:

$$b(y|h) + e(y|h) + l(y|h) = r(y|h) \tag{B.13}$$

$$\int_y \{b(y|h) + e(y|h) + l(y|h)\}\, dy = \int_y r(y|h) dy = 1 \tag{B.14}$$

$$b(h) + e(h) + l(h) = 1 \tag{B.15}$$

For each $y|h$, we exploit optimal decision (7), which generates a different behavior if searching as a self-employed ($y \geq y^*(h)$) or as an unemployed ($y < y^*(h)$). To give an example of the flows that this optimal behavior generates, let's focus on the second case:

$$\begin{aligned}
\dot{b}(y|h, y < y^*(h)) &= (\eta_h + \chi_h)e(y|h, y < y^*(h)) + \eta_h l(y|h, y < y^*(h)) - \lambda_h[1 - G(x_0^*(y,h))]b(y|h, y < y^*(h)) \\
\dot{e}(y|h, y < y^*(h)) &= \lambda_h[G(\tilde{x}(0,h)) - G(x_0^*(0,h))]b(y|h, y < y^*(h)) - (\eta_h + \chi_h)e(y|h, y < y^*(h)) \\
\dot{l}(y|h, y < y^*(h)) &= \lambda_h[1 - G(\tilde{x}(0,h))]b(y|h, y < y^*(h)) - \eta_h l(y|h, y < y^*(h))
\end{aligned}$$

The other flows have a similar structure. Imposing steady state and exploiting (B.13) leads to:

$$\begin{aligned}
b(y|h, y \geq y^*(h)) &= \frac{\eta_h(\eta_h + \chi_h)r(y|h)}{\eta_h\gamma_h[G(\tilde{x}(y,h)) - G(x_0^*(y,h))] + (\eta_h + \chi_h)\gamma_h[1 - G(\tilde{x}(y,h))] + \eta_h(\eta_h + \chi_h)} \\
e(y|h, y \geq y^*(h)) &= \frac{\eta_h\gamma_h[G(\tilde{x}(y,h)) - G(x_0^*(y,h))]r(y|h)}{\eta_h\gamma_h[G(\tilde{x}(y,h)) - G(x_0^*(y,h))] + (\eta_h + \chi_h)\gamma_h[1 - G(\tilde{x}(y,h))] + \eta_h(\eta_h + \chi_h)} \\
l(y|h, y \geq y^*(h)) &= \frac{(\eta_h + \chi_h)\gamma_h[1 - G(\tilde{x}(y,h))]r(y|h)}{\eta_h\gamma_h[G(\tilde{x}(y,h)) - G(x_0^*(y,h))] + (\eta_h + \chi_h)\gamma_h[1 - G(\tilde{x}(y,h))] + \eta_h(\eta_h + \chi_h)} \\
&\text{and} \\
b(y|h, y < y^*(h)) &= \frac{\eta_h(\eta_h + \chi_h)r(y|h)}{\eta_h\lambda_h[G(\tilde{x}(0,h)) - G(x_0^*(0,h))] + (\eta_h + \chi_h)\lambda_h[1 - G(\tilde{x}(0,h))] + \eta_h(\eta_h + \chi_h)} \\
e(y|h, y < y^*(h)) &= \frac{\eta_h\lambda_h[G(\tilde{x}(0,h)) - G(x_0^*(0,h))]r(y|h)}{\eta_h\lambda_h[G(\tilde{x}(0,h)) - G(x_0^*(0,h))] + (\eta_h + \chi_h)\lambda_h[1 - G(\tilde{x}(0,h))] + \eta_h(\eta_h + \chi_h)} \\
l(y|h, y < y^*(h)) &= \frac{(\eta_h + \chi_h)\lambda_h[1 - G(\tilde{x}(0,h))]r(y|h)}{\eta_h\lambda_h[G(\tilde{x}(0,h)) - G(x_0^*(0,h))] + (\eta_h + \chi_h)\lambda_h[1 - G(\tilde{x}(0,h))] + \eta_h(\eta_h + \chi_h)}
\end{aligned}$$

Since each worker is assigned by nature a value of self-employment income $y|h$, we have to integrate the above equations over $r(y|h)$ to find the equilibrium expressions for $b(h), e(h), l(h)$. In other words, we have to insert the above equations in expression (B.14) in order to obtain the three equilibrium components of the left-hand-side of expression (B.15).

The next step is determining the endogenous measure of vacancies by schooling, which is denoted by $v(h)$. It can be found by incorporating in equation (B.10) the workers' side equilibrium measures just defined and by recalling that ζ_h is a function of $b(h)$ and $v(h)$ through the matching function defined in equation (19).

Finally, the steady measure of individuals with high schooling level is determined by the optimal decision rule described in Section 3.2: we denote this value with p.

Since all the optimal decision rules and steady state measures depends only on parameters and on the values $\{U(h), S(y, h)\}$, we can now propose the following:

Definition 2 ***Equilibrium Definition.***

Given the vector of parameters $\{\rho, \xi_h, \lambda_h, \gamma_h, \eta_h, \chi_h, \psi_h, \iota_h, \beta_{0,h}, \beta_{1,h}, \alpha_h, c_h, \nu_h\}$ *and the probability distribution functions* $\{R(y|h), G(x|h), T(\kappa)\}$ *a* ***search model equilibrium*** *in an economy with institutional parameters* $\{B_0, \tau, t\}$ *is a set of values* $\{S(y, h), U(h)\}$ *that:*

1. *solves the equilibrium equations (B.10)–(B.12);*

2. *satisfies the firms' free-entry condition (22);*

3. *satisfies the steady state conditions over the measures* $\{p, b(h), e(h), l(h), v(h)\}$*.*

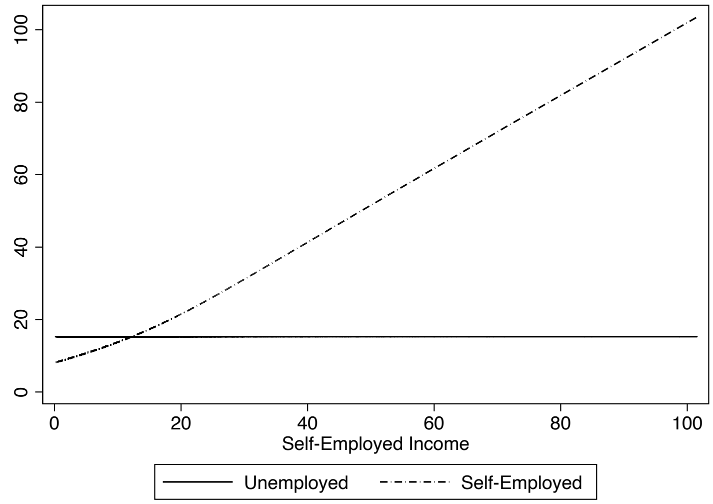
Two important remarks about Definition 2 are in order. The first remark was mentioned at the beginning of the section: the case for $h = 0$ requires a further specialization that we have not described so far in order to simplify notation. Given the schooling decision stated in Section 3.2, individuals with $h = 0$ are selected over y. Therefore, we cannot use the primitive distributions $r(y|0)$ in the equilibrium expressions above. In its place, we use the equilibrium distribution of y for those agents that decide to remain at schooling level $h = 0$. We denote this distribution with $\tilde{r}(y|0)$. The definition is obtained by applying the optimal decision rule derived by problem (4). Recall that each agent extracts a self-employment income y from $R(y|0)$ and a direct cost of schooling κ from $T(\kappa)$. Given a direct cost of schooling κ, the opportunity cost of schooling is increasing in self-employment income y. For given κ, only individuals with self-employment income low enough will decide to acquire additional schooling. We denote this indifference point with $y^{**}(\kappa)$. $\tilde{r}(y|0)$ will then be the $r(y|0)$ distribution truncated at $y^{**}(\kappa)$ and integrated over the $T(\kappa)$ distribution. Formally:

$$\tilde{r}(y|0) = \int \frac{r(y|0)}{1 - R(y^{**}(\kappa)|0)} dT(\kappa) \tag{B.16}$$

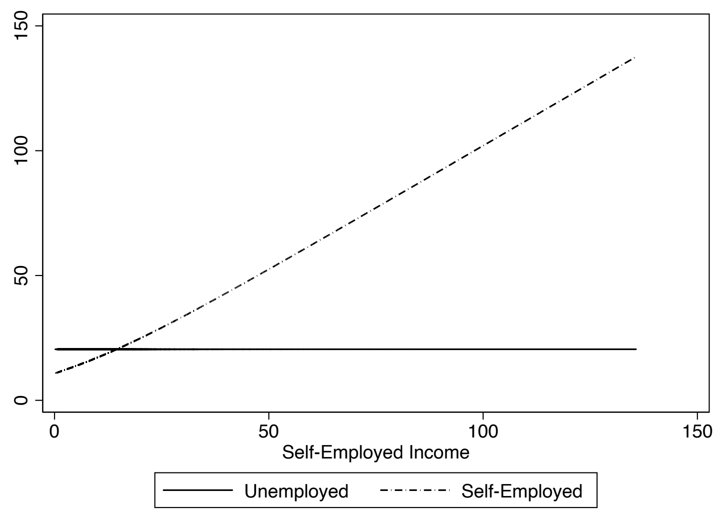
The second remark is about uniqueness. It is possible that for some parameters combinations the equilibrium defined in (22) is not unique. The sources of multiplicity are the composition effects over education and over self-employment income. Consider the process of firms entering the labor market for schooling level $h = 1$. The direct effect is a tighter market for firms but a better market for workers. Since the labor market for $h = 1$ is now more attractive, more workers acquire schooling level $h = 1$, counter-balancing the direct effect. The extent to which these two opposing forces are enough to create multiple equilibria depends on parameters. Formally, they may lead to more than one value of vacancy rates $v(h)$ such that the free entry condition $V(h) = 0$ is satisfied.

As we discussed in Section 3.5, multiplicity greatly complicates the identification and estimation of the model with the data at our disposal. We have therefore chosen to estimate the model conditioning on two conjectures that deliver uniqueness. We now show that our conjectures hold at our parameter estimates. In section 3.3, we proposed Conjecture 1 stating that the workers' value of search as self-employed ($S(y, h)$) is monotonically increasing in y. The conjecture assures the uniqueness of $y^*(h)$. Figure B.2 reports $S(y, h)$ as a function of the self-employed income y for both schooling levels (the dashed lines). Both value functions are monotonically increasing and cross the value of searching as unemployed (the solid lines representing $U(h)$) only once. The intersection points determine the unique $y^*(h)$. The second source of possible equilibrium multiplicity is the value of posting a vacancy: posting externalities together with the endogenous schooling decision rules may lead to non-uniqueness in the vacancy rate that sends the value of posting to zero. We then proposed Conjecture 3 stating that the firms' value of posting a vacancy is monotonically decreasing in the vacancy rate v_h. Figure B.3 shows that the conjecture holds for both schooling levels at our parameter estimates.

Figure B.2: Workers' Values of Searching: $S(y, h)$ and $U(h)$



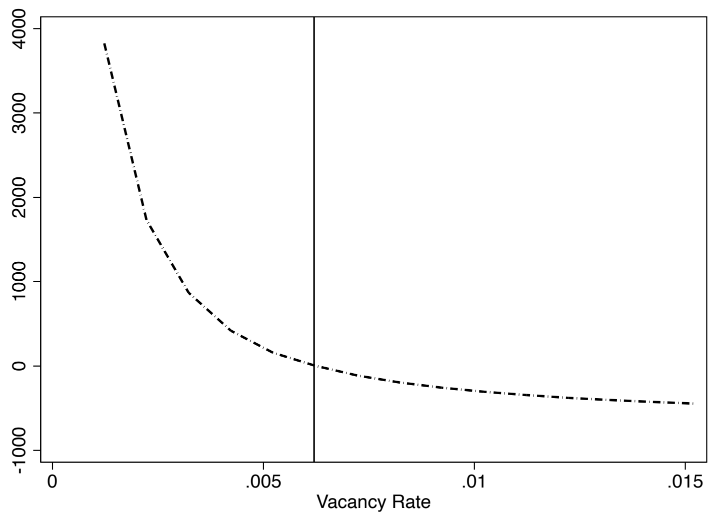
(a) Low Schooling



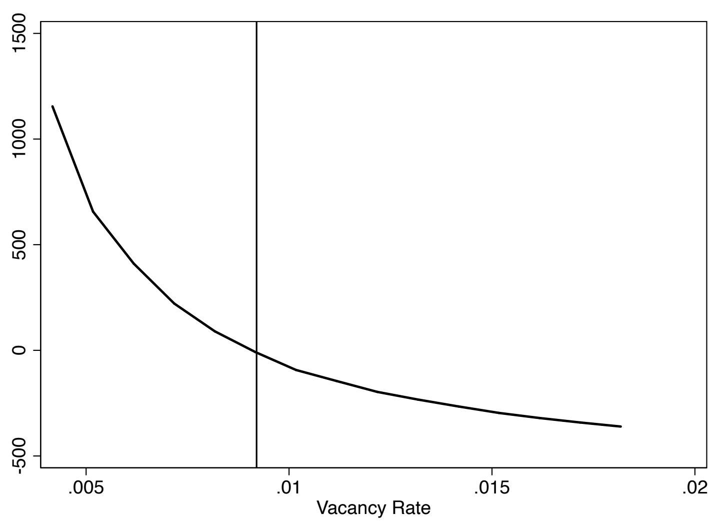
(b) High Schooling

NOTE: The figures report the present discounted values of searching as an unemployed ($U(h)$, solid lines) and as a self-employed ($S(y, h)$, dashed lines) as a function of the flow self-employment income y. Values approximated using simulated samples of 10,000 worker-level observations for each schooling group. All results based on the parameter estimates reported in Table 3.

Figure B.3: Firms' Values of Posting: $V[h]$



(a) Low Schooling



(b) High Schooling

NOTE: The figures report the present discounted values of posting a vacancy $V[h]$ as a function of the vacancy rate $v(h)$. Values approximated using simulated samples of 10,000 worker-level observations for each schooling group. All results based on the parameter estimates reported in Table 3. The vertical lines represent the vacancy rate at baseline.

B.4 Per-Capita Social Security Benefits: b_1

As described in Section 3.1, the common benefit b_1 received by formal employees is fully financed by a portion $(1-\tau)$ of the payroll contribution $tw_1(x;y,h)$. As a result, b_1 is an equilibrium object that depends on the distribution of formal employees in steady state. In this section, we derive the equilibrium expression for b_1.

Each formal employee contributes $(1-\tau)tw_1(x;y,h)$. The average contribution for a given education level h is obtained by integrating over the equilibrium distribution of accepted productivity x and the distribution over y, weighted by the equilibrium measure of formal employee $l(y|h)$:

$$\text{AvContr}(h) = \int_{\mathbb{S}(y)} \int_{\mathbb{S}(x)} (1-\tau)tw_1(x;y,h)l(y|h)\frac{g(x|h)}{[1-G(\tilde{x}(y,h))]}r(y|h)dxdy \tag{B.17}$$

where $\mathbb{S}(y)$ and $\mathbb{S}(x)$ denote the equilibrium supports of y and x. Due to the schooling decision, the value of $r(y|h)$ is the primitive distribution $r(y|1)$ when the schooling level is high but is the conditional distribution $\tilde{r}(y|0)$ defined in (B.16) when the schooling level is low. Since the benefit is financed by both schooling levels and equally shared between them, the final b_1 is the average contribution over the two schooling levels:

$$b_1 = \text{AvContr}(1)p + \text{AvContr}(0)(1-p) \tag{B.18}$$

where p denotes the equilibrium proportion of agents in the high schooling level $h = 1$.

C Estimates and Model Fit

Table C.1: Demand-side Parameters for Different Values of ι

	Low Schooling: $h = 0$	High Schooling: $h = 1$
	$\iota_h = \{0.632, 0.628\}$	
ζ_h	6.004	4.594
ν_h	-373.551	-607.001
	$\iota_h = \{0.732, 0.728\}$ (benchmark)	
ζ_h	7.972	5.857
ν_h	-496.011	-773.799
	$\iota_h = \{0.832, 0.828\}$	
ζ_h	10.585	7.466
ν_h	-658.615	-986.432

NOTE: This table reports alternative values for the arrival rate of workers to firms (ζ_h) and the firms' flow cost of keeping a vacancy open (ν_h) as implied by setting the matching function parameter (ι_h) at standard values found in the literature. The benchmark case corresponds to the value of the estimated parameters reported in Table 3.

Table C.2: Predicted Values

	Low Schooling $h = 0$		High Schooling: $h = 1$	
	Value	Std. Error	Value	Std. Error
Primitive Distributions				
$E(x\|h)$	19.231	0.694	19.935	0.750
$SD(x\|h)$	13.275	0.610	18.779	0.697
$E(y\|h)$	7.188	0.138	9.698	0.887
$SD(y\|h)$	6.527	0.139	9.224	1.197
$E(k)$	63.316	4.086		
Reservation Values				
Treatment Group				
Low Ability: $k = 1$				
$x_0^*(0, h)$	14.191	0.665	21.482	7.916
$\tilde{x}(0, h)$	15.596	1.062	22.711	6.709
$E_y[x_0^*(y, h)]$	23.170	7.810	33.411	11.725
$E_y[\tilde{x}(y, h)]$	27.407	10.874	34.942	10.437
$y^*(h)$	10.448	4.558	12.159	2.826
High Ability: $k = 2$				
$x_0^*(0, h)$	15.693	0.653	22.780	6.658
$\tilde{x}(0, h)$	25.649	1.386	33.977	7.751
$E_y[x_0^*(y, h)]$	23.555	7.344	33.232	10.349
$E_y[\tilde{x}(y, h)]$	40.333	14.746	49.193	12.833
$y^*(h)$	12.955	5.375	15.676	3.964
Control Group				
Low Ability: $k = 1$				
$x_0^*(0, h)$	14.728	0.676	22.023	7.906
$\tilde{x}(0, h)$	13.048	1.163	21.476	6.967
$E_y[x_0^*(y, h)]$	23.845	7.661	32.801	12.593
$E_y[\tilde{x}(y, h)]$	25.041	10.615	32.527	11.528
$y^*(h)$	10.468	4.432	12.168	2.757
High Ability: $k = 2$				
$x_0^*(0, h)$	16.247	0.632	23.229	6.636
$\tilde{x}(0, h)$	22.806	1.402	32.499	8.028
$E_y[x_0^*(y, h)]$	24.936	7.259	32.703	11.228
$E_y[\tilde{x}(y, h)]$	39.033	14.595	46.291	14.317
$y^*(h)$	13.796	5.937	15.697	3.905

NOTE: Bootstrap standard errors based on 100 replications reported. The Values are obtained from the equilibrium of the model defined in Section 3.5 using the parameter estimates reported in Table 3.

Table C.3: Cross-Sectional Moments and Model Fit – Treated Sample

Schooling:	$h=0$			$h=1$		
	Model	Data	Weight	Model	Data	Weight
Share Formally Employed	0.512	0.546	79.232	0.572	0.581	66.017
Share Informally Employed	0.227	0.253	43.236	0.179	0.216	29.415
Share Self-employed	0.170	0.162	31.946	0.159	0.155	23.843
Share Unemployed	0.091	0.040	14.940	0.089	0.048	12.217
Mean Formal Wages	10.126	12.162	64.066	17.241	15.699	47.190
SD Formal Wages	11.333	13.873	79.919	17.343	18.436	48.446
Mean Informal Wages	4.370	4.191	36.651	4.547	4.245	22.601
SD Informal Wages	8.272	8.436	49.167	9.816	10.392	24.452
Mean Self-empl Income	3.500	3.566	25.990	3.987	3.796	19.152
SD Self-empl Income	8.696	9.891	34.883	10.767	11.072	23.855
Share Informal Employee - Q1	0.014	0.109	19.915	0.013	0.095	15.246
Share Informal Employee - Q2	0.015	0.063	12.819	0.104	0.046	8.820
Share Informal Employee - Q3	0.119	0.034	8.797	0.058	0.034	7.872
Share Informal Employee - Q4	0.070	0.027	8.497	0.003	0.020	5.690
Share Informal Employee - Q5	0.008	0.020	9.673	0.001	0.021	7.621
Mean Formal Wages - Q1	1.256	1.096	50.510	2.088	1.246	41.113
Mean Formal Wages - Q2	1.491	1.714	51.541	2.624	2.032	40.557
Mean Formal Wages - Q3	1.888	2.209	41.645	3.201	2.464	35.638
Mean Formal Wages - Q4	2.256	2.781	33.476	3.765	3.690	34.090
Mean Formal Wages - Q5	3.236	4.362	47.001	5.562	6.267	31.451
Mean Informal Wages - Q1	0.183	1.086	15.512	0.245	0.967	13.886
Mean Informal Wages - Q2	0.208	0.984	12.590	2.550	0.780	7.948
Mean Informal Wages - Q3	2.210	0.679	7.785	1.611	0.775	8.912
Mean Informal Wages - Q4	1.520	0.684	9.490	0.087	0.598	5.695
Mean Informal Wages - Q5	0.249	0.758	10.789	0.054	1.125	6.062
Share Schooling	0.614	0.623	114.437	0.386	0.377	183.702

Note: Cross-sectional sample extracted from the Labor Market Survey (ENOE) in 2005:Q1. The treated sample composed by individuals from municipalities receiving the *Seguro Popular* program. The moments are computed unconditionally on the labor market state to guarantee a smoother and well-defined quadratic form during the optimization procedure. The weights in the quadratic form (36) are equal to the inverses of the variance of each sample moment. Additional details on samples and variables definitions are in Section 2.2 and Appendix A.1.

Table C.4: Cross-Sectional Moments and Model Fit – Control Sample

Schooling:		$h=0$			$h=1$	
	Model	Data	Weight	Model	Data	Weight
Share Formally Employed	0.595	0.585	71.481	0.598	0.601	54.399
Share Informally Employed	0.138	0.207	30.460	0.140	0.170	20.134
Share Self-employed	0.170	0.159	26.772	0.159	0.175	20.422
Share Unemployed	0.097	0.049	13.760	0.103	0.054	10.874
Mean Formal Wages	11.588	13.055	56.434	17.981	16.454	40.448
SD Formal Wages	11.201	13.696	70.433	18.431	18.074	42.787
Mean Informal Wages	2.756	3.512	25.613	3.653	3.526	15.446
SD Informal Wages	6.959	8.130	34.817	9.154	10.058	15.573
Mean Self-empl Income	3.607	3.177	20.646	3.817	3.820	16.609
SD Self-empl Income	9.034	8.929	24.136	10.017	10.489	22.598
Share Informal Employee - Q1	0.000	0.097	17.214	0.000	0.077	11.504
Share Informal Employee - Q2	0.000	0.043	9.782	0.076	0.034	6.495
Share Informal Employee - Q3	0.077	0.025	6.420	0.059	0.029	6.431
Share Informal Employee - Q4	0.055	0.020	7.443	0.002	0.014	4.294
Share Informal Employee - Q5	0.006	0.022	8.506	0.002	0.015	5.196
Mean Formal Wages - Q1	1.413	1.287	26.576	2.147	1.424	33.632
Mean Formal Wages - Q2	1.722	1.919	29.433	2.747	2.143	33.154
Mean Formal Wages - Q3	2.180	2.231	13.881	3.290	2.906	26.222
Mean Formal Wages - Q4	2.572	2.988	19.474	3.862	3.688	21.520
Mean Formal Wages - Q5	3.701	4.630	40.220	5.934	6.293	27.282
Mean Informal Wages - Q1	0.000	0.979	15.061	0.000	0.873	9.843
Mean Informal Wages - Q2	0.000	0.695	11.703	1.873	0.614	7.102
Mean Informal Wages - Q3	1.441	0.495	6.586	1.611	0.707	6.523
Mean Informal Wages - Q4	1.142	0.497	6.430	0.074	0.437	4.105
Mean Informal Wages - Q5	0.173	0.846	8.353	0.095	0.895	4.890
Share Schooling	0.622	0.639	100.134	0.378	0.361	56.542

NOTE: Cross-sectional sample extracted from the Labor Market Survey (ENOE) in 2005:Q1. The control sample composed by individuals in municipalities *not* receiving the *Seguro Popular* program. The moments are computed unconditionally on the labor market state to guarantee a smoother and well-defined quadratic form during the optimization procedure. The weights in the quadratic form (36) are equal to the inverses of the variance of each sample moment. Additional details on samples and variables definitions are in Section 2.2 and Appendix A.1.

Table C.5: Longitudinal Moments and Model Fit

Schooling:	$h = 0$			$h = 1$		
	Model	Data	Weight	Model	Data	Weight
One-year Transitions:						
Formally E. – Formally E.	0.427	0.575	56.925	0.490	0.666	52.361
Informally E. – Informally E.	0.161	0.138	19.655	0.135	0.118	13.186
Self-employed – Self-employed	0.154	0.072	12.855	0.154	0.066	9.682
Informally E.-Formally E.	0.024	0.061	12.149	0.018	0.037	6.943
Formally E.-Informally E.	0.024	0.057	11.496	0.017	0.040	7.638
Unemployed-Formally E.	0.052	0.018	6.546	0.044	0.008	3.107
Self-employed-Informally E.	0.006	0.016	6.249	0.004	0.011	3.891
Informally E.-Self-employed	0.006	0.015	6.168	0.003	0.011	3.837
Formally E.-Unemployed	0.054	0.014	5.781	0.051	0.013	4.085
Self-employed-Formally E.	0.010	0.010	4.873	0.008	0.008	3.382
Formally E.-Self-employed	0.015	0.009	4.696	0.008	0.010	3.712
Unemployed-Informally E.	0.026	0.008	4.274	0.019	0.002	1.717
Informally E.-Unemployed	0.025	0.004	3.143	0.022	0.006	2.894
Unemployed – Unemployed	0.015	0.003	2.501	0.027	0.005	2.440
Hazard rates out of Unemployment:						
At 3 months	0.744	0.783	15.441	0.627	0.793	10.743
At 6 months	0.541	0.667	5.541	0.422	0.667	3.004

NOTE: Longitudinal sample extracted from a balanced panel of four ENOE cohorts entering in 2005:Q1 through 2005:Q4 and observed over 5 consecutive quarters. The moments are aggregated over municipalities receiving and *not* receiving the *Seguro Popular* program and they are computed unconditionally on the labor market state in order to guarantee a smoother and well-defined quadratic form during the optimization procedure. The weights in the quadratic form (36) are equal to the inverses of the variance of each sample moment. Additional details on the samples and variables definitions are in Section 2.2 and Appendix A.1.

Table C.6: Aggregate Moments and Model Fit

Labor Share:				
	Model	Data	Weight	
	0.533	0.419	2.000	
Vacancy rate:				
Schooling:	$h = 0$		$h = 1$	
	Model	Data	Model	Data
	0.0062	0.0062	0.0092	0.0092

NOTE: Labor share from from AMECO. Vacancy rates from Ministry of Labor's *Bolsa de Trabajo*. Additional details on samples and variables definitions are in Section 2.2 and Appendix A.1.

Table C.7: Out-of-Sample Model Validation

	Hourly Labor Income (log)			Labor Market Proportions			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Formal	Informal	Self	Formal	Informal	Self	Unemployed
One-Sided T-Tests (P-values)							
$H_0 : \beta_{\text{Data}} < 0$	0.031	0.524	0.441	0.925	0.026	0.451	0.667
$H_0 : \beta_{\text{Model}} < 0$	0.000	1.000	0.822	1.000	0.000	0.520	0.871
$H_0 : \beta_{\text{Data}} > 0$	0.969	0.476	0.559	0.075	0.974	0.549	0.333
$H_0 : \beta_{\text{Model}} > 0$	1.000	0.000	0.178	0.000	1.000	0.480	0.129
Two-Sided T-Tests (P-values)							
$H_0 : \beta_{\text{Data}} = \beta_{\text{Model}}$	0.424	0.539	0.809	0.002	0.000	0.895	0.941

NOTE: The Table reports p-values of one-sided and two-sided T-Tests for the estimated θ coefficients displayed in equation (37), which capture the effect of receiving the *Seguro Popular* program in 2006 on labor market outcomes both in the data sample and in the simulated sample. The data sample is drawn from the Mexican labor market survey (ENOE 2006) and matched at the municipality-level with the roll-out of the *Seguro Popular* program in the year 2006. the simulated sample is based on simulated data generated by the estimated model parameters reported in Table 3. The full set of OLS coefficients with robust standard errors are reported in Figure 5.

D Experiments

In our model, the distortions introduced by the institutional parameters and by the presence of multiple labor market contracts interact with the three sources of inefficiency and externality discussed in Section 6. This interaction introduces an additional layer of complexity that prevents the model from delivering such clean theoretical result as the ones provided in Acemoglu and Shimer (1999) for the hold-up problem, in Hosios (1990) for the posting externality or Charlot and Decreuse (2010) for the selection over ability. However, in this Appendix we can still study the joint importance of these channels by focusing on the two crucial parameters governing the extent of their impact: α and ι. Similarly to what we performed in Section 6.2, we study a range of outcomes resulting from counterfactual experiments obtained by changing the parameters of interest. In this case, the parameter of interest is the workers' bargaining weight in the Nash product α: the higher α, the higher the share of the surplus going to the worker (see equation (21)). We vary α over a broad range of values, including the "Hosios condition" value corresponding to the estimated ι_h.[1]

Figure D.1 reports welfare and schooling obtained by varying the workers' bargaining weight α. In the first row, we perform the exercise at the average estimated value of ι (0.73). Panel (a) shows that overall welfare is quite sensitive to α. If α were set to 0.1 (giving most of the surplus to firms), welfare would decrease by about 7% with respect to benchmark. If α were set to 0.9 (giving most of the surplus to workers), welfare would decrease by about 31% with respect to benchmark. Two implications are of interest. First, the asymmetry of the impact signals that the importance of externalities and inefficiencies are different between the two sides of the market: transferring bargaining power to the workers is relatively more costly than transferring it to the firms. Second, the concavity implies that it must exists an optimal value of α that maximizes welfare. This value is equal to about 0.325 and it is lower than the one estimated in the model (equal to 0.563 and denoted by the vertical solid line in the figure), suggesting that workers receive a too high share of the surplus and firms do not post enough vacancies. Panel (b) shows that the education decision

[1] In estimation, we allow matching elasticities to differ by education. Since the estimated values are very similar for both schooling group (see Table 3), we just report one value equal to 0.73 (the mean of the estimated 0.732 and 0.728) to avoid cluttering the figures.

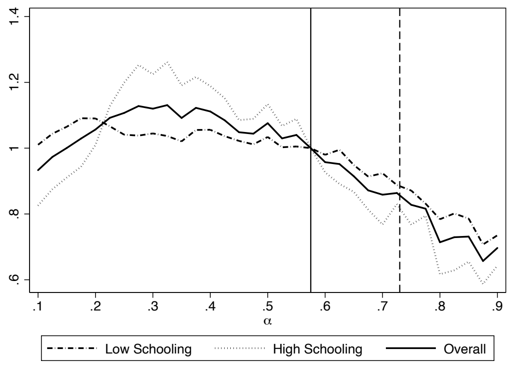
– and the related externalities and inefficiencies – are not very sensitive to the way the surplus is split. Over a large range of α, a range that includes both the optimal and the baseline value, the overall optimal proportion of High Schooling agents is very similar. Only for extreme values of α (higher than 0.8 and smaller than 0.2), education starts to significantly decrease, mimicking the loss of welfare. Finally, it is interesting to note that the optimal α is much lower than the optimal value suggested by the Hosios condition. The optimal α is equal to 0.325, a value much lower than the average estimated ι_h which is equal to 0.73 and denoted by the vertical dashed line in the figure. Under the conjecture that the Hosios condition is a good approximation of efficiency in our setting, this result would suggest that the institutional framework adds inefficiencies above and beyond the standard inefficiencies affecting this class of models.

We further investigate this point by focusing on the matching elasticity ι and asking if the observed result is sensitive to its estimated value.[2] The third and second rows of Figure D.1 reports the same exercise for values of ι higher and lower than benchmark. The main result is confirmed: the optimal α is much lower than the optimal value suggested by the Hosios condition. The departure from Hosios is larger for the lower value of ι (0.63) than for the higher one (0.83). The relative low elasticity of schooling with respect to α is also qualitatively robust to changes in ι. The range of low elasticity is large in all cases but its support and location change for different values of ι: the lower ι, the higher the range of α for which schooling is increasing.

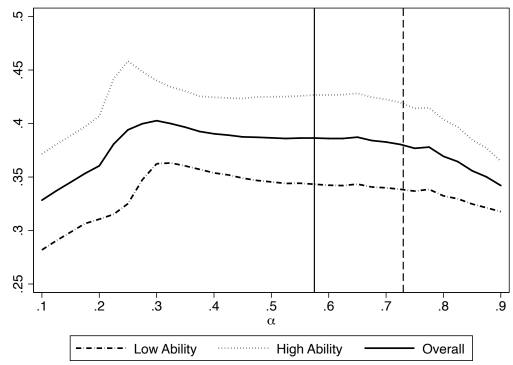
We draw two main conclusions from this partial efficiency analysis. First, the distortions introduced by the institutional features that generate informality also seem to magnify the inefficiencies already present in our non-competitive model of the labor market. Second, given the institutional setting, workers' bargaining power may be too high to induce firms to post an efficient amount of vacancies in the two schooling markets.

[2]Our estimated value is similar to what found by Arroyo Miranda et al. (2014) using macro data on Mexico and it is within the range of standard measures reported in the Petrongolo and Pissarides (2001)'s review.

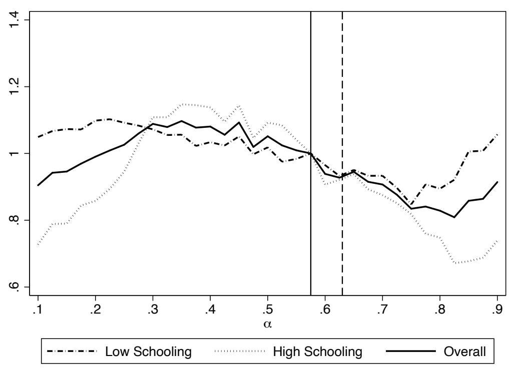
Figure D.1: Robustness for Different Values of the Bargaining Parameter (α) and the Matching function Parameter (ι)



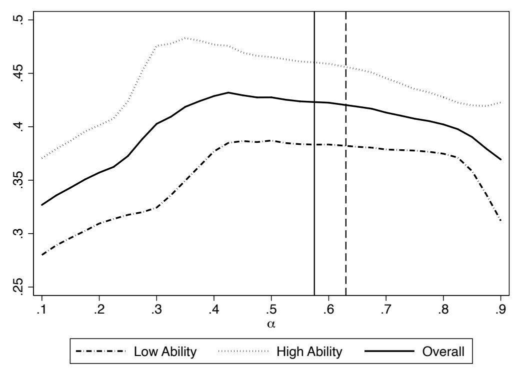
(a) Welfare, $\iota = 0.73$ (benchmark)



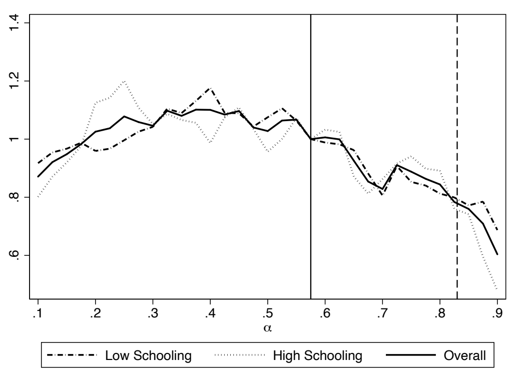
(b) Schooling, $\iota = 0.73$ (benchmark)



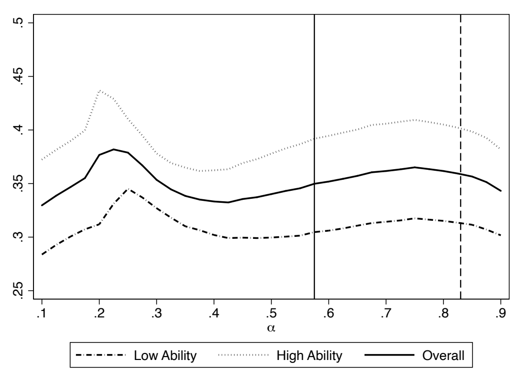
(c) Welfare, $\iota = 0.63$



(d) Schooling, $\iota = 0.63$



(e) Welfare, $\iota = 0.83$



(f) Schooling, $\iota = 0.83$

Note: The figures report outcomes from counterfactual experiments that change the bargaining power parameter α from 0.1 to 0.9. The vertical continuous lines are set at the estimated value of the bargaining power parameter ($\hat{\alpha}$) and the vertical dashed lines are set at the estimated value of the matching elasticity parameter ($\hat{\iota}$). *Welfare* is the overall flow welfare in steady state (see Section 6). *Schooling* is the proportion of individuals with High Schooling in the population.

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