Monopsonistic Competition in Formal and Informal Labor Markets*

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Abstract

The workhorse of urban labor theory in development economics is the formal/informal model of labor market segmentation and its variants. The seminal Harris-Todaro model has been extended over the years to cope with various empirical puzzles not explained in the original framework. However, one issue stands out that cannot easily be explained in a competitive framework. Specifically, there is considerable evidence suggesting that many workers choose to work in the informal sector, even though formal sector jobs are available to them and despite the fact that wages are typically higher in the formal sector. One solution is to depart from the usual competitive framework and consider formal and informal labor markets under oligopsony/monopsonistic competition.

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> "...if in fact much of the sector is voluntary, in the sense of workers preferring their present job to one in the formal sector, then the informal job must be at least of equal quality measured along a broader set of relevant job characteristics."
>
> – William F. Maloney, 2004

1 Introduction

The workhorse of urban labor theory in development economics is the formal/informal model of labor market segmentation. The seminal Harris and Todaro (1970) model has been extended over the years to cope with various empirical puzzles, not explained in the original framework. However, one issue stands out that cannot be explained in a competitive framework.[1] Specifically, there is considerable evidence suggesting that many workers, choose to work in the informal sector even though formal sector jobs may be available to them.[2] Indeed, Bosch and Maloney (2005) show that for Mexico, Argentina and Brazil, workers move in either direction between the informal sector and the formal sector.

This presents a problem because wages in the informal sector are often (although not always) lower than in the formal sector (Marcouiller et al., 1997). In a competitive model, if workers have the freedom to move between the formal and informal sectors then in equilibrium, formal and informal wages would equalize (Fields, 2005, 2007). That is, the law of one price implies that the integration of the formal and informal labor markets will result in equality of formal and informal wages.

More generally, the existence of wage dispersion not explained by differences in worker ability is problematic for any competitive model of the labor market. Evidence of wage dispersion in the developed world abounds. Slichter (1950) was an early attempt to quantify the degree of inter-industry wage dispersion and subsequently there have been numerous contributions (for handful of examples see Dickens and Katz (1987), Gibbons and Katz (1992) and Krueger and Summers (1988)). Even within industries, there is evidence that wages vary significantly (Dunlop, 1957; Groshen, 1991). More recently, Abowd et al. (1999) showed, using French

[1] See Fields (2005, 2007) for very good overviews of this literature.

[2] Maloney (2004) provides a comprehensive discussion of the evidence.

matched employer-employee data, that wage differentials are mostly the result of differences in individual characteristics. However, a significant portion can only be explained as being due to differences in firm characteristics. In developing countries, there is a small but growing literature demonstrating the existence of wage dispersion unexplained by differences in worker ability (Arbache, 2001; Cragg and Epelbaum, 1996; Moll, 1993; Teal, 1996).

The alternative to perfect competition are various forms of imperfectly competitive labor markets. Within the realm of imperfectly competitive models of labor markets are efficiency wage models (Albrecht and Vroman, 1998), job search models (Burdett and Mortensen, 1998) and oligopsony/monopsonistic competition models (Bhaskar et al., 2002). Because they are dynamic models, efficiency wages and search involve a good deal of technical machinery and as such are more cumbersome for policy analysis.

Since, at the end of the day, development economists are interested in policy analysis, I model imperfectly competitive formal and informal labor markets using a "monopsony-type" model of the labor market.[3] Spacial models like those used in Bhaskar and To (1999) and Bhaskar et al. (2002) are useful for certain types of analyses. However, because of the difficulty of dealing with entry and exit when employers are heterogeneous (Bhaskar and To, 2003), such models are less useful for looking at dichotomous outcomes in labor markets. For this analysis I will use an alternative formulation where employers interact with one another in a symmetric fashion, similar to the well-known Dixit-Stiglitz model of monopolistic competition.[4]

I consider only two sectors of the labor market – the formal labor market and the informal labor market. The formal labor market is subject to regulation and taxation while the informal labor market is not. The informal market as I model it is not the "staging area" notion of an informal

[3]There is little work in development using monopsony-type models of the labor market. Two exceptions are Basu et al. (2005) where they use a model of monopsony to look at the effects of minimum wage legislation in developing countries where the level of the minimum and enforcement are both endogenous and Basu et al. (2006) where they examine the effect of employment guarantees under perfect competition and under monopsony/oligopsony.

[4]Because of its tractability, variations of the Dixit-Stiglitz model have been in use in the IO, trade, economic geography and development literatures for decades.

labor market but one where workers are free to choose between formal and informal jobs. Under oligopsony, it is assumed that the number of employers in both the formal and informal labor markets is fixed. Under monopsonistic competition, formal and informal employers are free to enter and exit as long as it is profitable to do so.

Without entry or exit, a reduction in the payroll tax results in increased formal wages, an increase in formal sector employment and a decrease in informal sector employment. Overall, the effect on total employment depends on the relative magnitudes of the formal and informal wages. If formal wages are greater then a payroll tax decrease results in lower total employment. If informal wages are greater then a payroll tax decrease results in higher total employment. An increase in the minimum wage does the same.

With free entry and exit, a reduction in the payroll tax results in increased formal wages, more formal sector employers enter, formal sector employment increases and informal sector employers exit. However, the effect on total employment depends on both the relative wages and the establishment level elasticity of labor supply. As without free entry and exit, if the formal sector wage is greater than the informal sector wage then total employment falls. But if the informal sector wage is greater than the informal sector wage *and* if the establishment level elasticity of labor supply is sufficiently high (i.e., jobs are highly substitutable) then total employment will rise. Again, a marginal increase in the minimum wage gives rise to qualitatively similar (although quantitatively different) employment effects.

In a recent and related contribution, Galiani and Weinschelbaum (2006) construct a model with some similarities and use it to conduct various policy experiments. In their model, workers choose between working in the competitive formal and informal sectors. Rather than having heterogeneous preferences, workers have heterogeneous abilities. The choice between formality and informality is driven by a fixed cost of participating in the formal market – low ability workers prefer informal employment to formal employment because the formal participation costs are large relative to the magnitude of their labor endowment (ability).

In the next Section, I present a Dixit-Stiglitz model of oligopsonistic competition. In Section 3 I analyze the effect of a payroll decrease and a minimum wage increase on formal, informal and total employment. In Section 4, rather than fixed numbers of employers, formal and informal employers can freely enter and exit the market. Finally, in Section 5 I offer some conclusions and suggestions for future research.

2 The Model

To ensure that labor supply is imperfectly elastic, I assume that different jobs have different non-wage characteristics. These include the job specification, hours of work, distance of the firm from the worker's home, the social environment in the workplace, etc. The importance of non-wage characteristics has been recognized in the theory of compensating differentials, which is a theory of vertical differentiation. Some jobs are good while other jobs are bad, and wage differentials compensate workers for these differences in characteristics. I assume that jobs are *horizontally differentiated* so that workers have heterogeneous preferences over these characteristics. McCue and Reed (1996) provide survey evidence of horizontal heterogeneity in worker preferences. Heterogeneous preferences over non-wage characteristics ensures that each employer has market power in wage setting, even if it competes with many other employers.

Suppose that a representative worker has utility function:

$$U = I^{\alpha} L^{1-\alpha} \tag{1}$$

where I is money income, L represents the utility that the worker gets from leisure and α determines the representative worker's preferences between income and leisure. If w_j is the wage rate at job j and l_j is the time spent at job j, then total income is

$$I = \sum_{j=1}^{N} w_j l_j$$

and utility from leisure is

$$L = 1 - \left(\sum_{j=1}^{N} {l_j}^{\rho} \right)^{\frac{1}{\rho}}$$

where $(\sum {l_j}^{\rho})^{1/\rho}$ represents the aggregate disutility of labor supplied, N is the number of employers and ρ determines the elasticity of labor supply.

The term, $(\sum {l_j}^{\rho})^{1/\rho}$, can also be thought of as a labor quantity index,[5] similar to the wage index that will later be defined. Assume U is concave; a sufficient condition for concavity is $\rho > 1$.

Consider this to be the reduced form utility function for the labor market as a whole where workers have heterogeneous preferences over jobs and work only for a single employer. For example, Anderson et al. (1992) have demonstrated for the product market that consumers with heterogeneous preferences and who consume just a single variety of a product can be represented in aggregate with a constant-elasticity-of-substitution representative utility function similar to that given above.

Given a set of wage offers, the worker maximizes utility by choosing how to allocate her work time amongst the N employers. Her first order condition is:

$$\frac{\partial U}{\partial l_k} = \alpha w_k \left(\frac{L}{I}\right)^{1-\alpha} - (1-\alpha)\left(\frac{I}{L}\right)^{\alpha}\left(\sum_{j=1}^{N} {l_j}^{\rho}\right)^{\frac{1}{\rho}-1} l_k^{\rho-1} = 0. \tag{2}$$

Multiplying by l_k, summing over all k and some straightforward manipulation shows that

$$L = 1 - \alpha \tag{3}$$

That is, at a utility maximum, the utility from leisure activities is constant at $1-\alpha$. The representative worker's problem in this case becomes the simpler one of maximizing income subject to the condition that total disutility equal to α (i.e., $(\sum l_j^{\rho})^{1/\rho} = \alpha$).

Using the methods in Dixit and Stiglitz (1977), it is straightforward to show that labor supply is given by:

$$l_k = \alpha \left(\frac{w_k}{\tilde{w}}\right)^{\frac{1}{\rho-1}} \tag{4}$$

where $\tilde{w}$ is a wage index given by:

$$\tilde{w} = \left(\sum_{j=1}^{N} {w_j}^{\beta}\right)^{\frac{1}{\beta}} \tag{5}$$

[5] It is inaccurate to think of 1 as the total amount of labor/leisure available and $1 - (\sum {l_j}^{\rho})^{1/\rho}$ as the quantity of leisure since it is possible for total labor supply to exceed 1. For example, when equilibrium wages are equal across all establishments, if $\rho > \frac{\ln N}{\ln N + \ln \alpha}$ then $\sum l_j > 1$. It would be more accurate to think of 1 as being a bound on the disutility from supplying leisure.

and $\beta = \rho/(\rho - 1)$. When N is relatively large, the effect of a change in w_k on $\tilde{w}$ is approximately zero. As such, the establishment level elasticity of labor supply is approximately

$$\varepsilon = \frac{1}{\rho - 1}. \tag{6}$$

Since $\rho > 1$, labor supply is not infinitely elastic at the establishment level, as would be the case under perfect competition.

Assume that there are n_f and n_i employers (where $n_f + n_i = N$) in the formal and informal labor markets where formal sector employers are numbered $k = 1, 2, \ldots, n_f$ and informal sector employers are numbered $k = n_f + 1, n_f + 2, \ldots, N$. In the formal labor market, in addition to the wage, employers are subject to a payroll tax of t_f per dollar per hour. Employers have marginal revenue products of ϕ_f and ϕ_i. Note that I make no assumptions about the relative magnitudes of ϕ_f and ϕ_i so that, employers in the formal labor market may or may not be more productive than employers in the informal labor market.

Employer k chooses w_k to maximize its profit:

$$\pi_k = (\phi_k - (1 + t_k)w_k)l_k \tag{7}$$

where $t_k = t_f$ if employer k is a formal market employer and $t_k = 0$ if employer k is an informal market employer. Employer k's first order condition is:

$$(\phi_k - (1 + t_k)w_k)\frac{\partial l_k}{\partial w_k} - (1 + t_k)l_k = 0$$

implying an equilibrium wage of

$$w_k^* = \frac{\phi_k}{(1 + t_k)\rho}. \tag{8}$$

Since $\rho > 1$, workers are paid less than their marginal product net of the payroll tax, t_k. Denote the equilibrium formal and informal wages by w_f^* and w_i^*. Note that depending on the relative magnitudes of $\phi_f/(1 + t_f)$ and ϕ_i, workers in the formal labor market may or may not be paid more than those in the informal labor market. Since all formal market employers pay wage w_f^* and informal market employers pay w_i^*, establishment level employment is given by:

$$l_\tau^* = \alpha \left(\frac{w_\tau^*}{(n_f {w_f^*}^\beta + n_i {w_i^*}^\beta)^{\frac{1}{\beta}}} \right)^{\frac{1}{\rho - 1}} \tag{9}$$

where $\tau = f, l$.

Under a minimum wage, as long as $w_m < \phi_f/(1+t_f)$, the marginal revenue product of labor net of payroll taxes will be greater than the marginal cost of labor and therefore a formal sector employer will hire as many workers as are willing to work for it at w_m so that

$$l_f^m = \alpha \left(\frac{w_m}{(n_f {w_m}^{\beta} + n_i {w_i^*}^{\beta})^{\frac{1}{\beta}}} \right)^{\frac{1}{\rho-1}}. \tag{10}$$

Informal employment under a minimum wage is given by l_i^* where w_f^* is replaced by w_m.

3 No entry or exit

Suppose that the numbers of formal and informal sector employers are fixed at n_f and n_i. Since the government policies on which I focus affect equilibrium wages in a straightforward manner, I begin by looking at how a change in the formal or informal wage rate affects formal, informal and total employment.

The equilibrium expressions for formal and informal employment are symmetric, so without loss of generality, consider just the comparative statics with respect to the formal wage. Differentiating (9) with respect to w_f^* yields:

$$\frac{\partial l_f^*}{\partial w_f^*} = \frac{l_f^* \varepsilon}{w_f^*} \frac{n_i {w_i^*}^{\beta}}{n_f {w_f^*}^{\beta} + n_i {w_i^*}^{\beta}} > 0 \tag{11}$$

and

$$\frac{\partial l_i^*}{\partial w_f^*} = -\frac{l_i^* \varepsilon}{w_f^*} \frac{n_f {w_f^*}^{\beta}}{n_f {w_f^*}^{\beta} + n_i {w_i^*}^{\beta}} < 0. \tag{12}$$

Since there is no entry or exit, if establishment level formal employment increases then total formal employment increases. Similarly since establishment level informal employment falls, total informal employment must fall.

Looking at total employment, $E = n_f l_f^* + n_i l_i^*$,

$$\begin{aligned}\frac{\partial E}{\partial w_f^*} &= n_f \frac{\partial l_f^*}{\partial w_f^*} + n_i \frac{\partial l_i^*}{\partial w_f^*} \\ &= \frac{(n_f l_f^* + n_i l_i^*)\varepsilon}{w_f^*} \left(\frac{n_f w_f^{*\beta-1}}{n_f w_f^{*\beta-1} + n_i w_i^{*\beta-1}} - \frac{n_f w_f^{*\beta}}{n_f w_f^{*\beta} + n_i w_i^{*\beta}} \right).\end{aligned} \tag{13}$$

The function $n_f w_f^{*b}/(n_f w_f^{*b} + n_i w_i^{*b})$ is strictly increasing in b if $w_f^* > w_i^*$ and strictly decreasing in b if $w_f^* < w_i^*$. Thus the overall employment effect will depend on the relative magnitudes of w_f^* and w_i^*. If $w_f^* > w_i^*$ then the overall employment effect must be negative. Conversely, if $w_f^* < w_i^*$ then the overall employment effect must be positive.

Regardless of whether total employment increases or decreases in response to an increase in the formal wage rate, it should be clear that worker surplus increases. With no entry or exit, workers can choose from the same set of jobs and non-wage characteristics. But for formal sector jobs, the wage rate has gone up so total worker surplus must increase. More precisely, utility maximizing work choices imply that utility from leisure is fixed at $1 - \alpha$ so the effect on worker utility depends on the effect of wage changes on total income. Differentiating $I = n_f w_f^* l_f^* + n_i w_i^* l_i^*$,

$$\begin{aligned}\frac{\partial I}{\partial w_f^*} &= n_f \left(l_f^* + w_f^* \frac{\partial l_f^*}{\partial w_f^*} \right) + n_i w_i^* \frac{\partial l_i^*}{\partial w_f^*} \\ &= n_f l_f^* > 0.\end{aligned}$$

3.1 Payroll taxes

So how does this relate to changes in tax policy? Since equilibrium wages are a decreasing function of the rate of payroll taxation (i.e., $\partial w_f^*/\partial t_f = -\phi_f/\rho(1+t_f)^2 < 0$), a decrease in the payroll tax will lead to an increase in the formal sector wage rate, leading to an increase in formal sector employment and a decline in informal sector employment. Total employment will decrease if $w_f^* > w_i^*$ and increase if $w_f^* < w_i^*$. As discussed earlier, regardless of whether total employment increases or decreases, worker income (and utility) must increase.

However, the increased worker utility must be balanced against potentially lost tax revenues (assuming that tax receipts are used for welfare enhancing purposes) and lost profits. To do so, I look at changes in worker income rather than utility. This has the advantage that incomes, tax receipts and profits are all in monetary terms and are therefore more directly comparable.

Total tax receipts are $T = t_f n_f w_f^* l_f^*$. Differentiating gives,

$$\begin{aligned}\frac{\partial T}{\partial t_f} &= n_f w_f^* l_f^* + t_f n_f \left(l_f^* + w_f^* \frac{\partial l_f^*}{\partial w_f^*} \right) \frac{\partial w_f^*}{\partial t_f} \\ &= n_f w_f^* l_f^* [1 - (1+\varepsilon)\nu]\end{aligned} \tag{14}$$

where $\nu = t_f/(1+t_f)$ is the elasticity of the formal wage with respect to changes in the rate of payroll taxation. The tax elasticity of the formal wage is 0 when $t_f = 0$ and, assuming that the rate of payroll taxation cannot exceed 100%, reaches its maximum of $1/2$ when $t_f = 1$ and is negative when $t_f < 0$ (a wage subsidy). Thus when the tax rate is low or negative, a payroll tax decrease will result in lower tax revenues. But if the tax rate is high and the establishment labor supply elasticity is high then a "Laffer" effect is possible and a tax reduction may result in increased tax revenues. It is interesting to note though that as long as $\varepsilon \leq 1$ and t_f is bounded by 1, a Laffer effect is not possible.

Finally, since there is no entry or exit, producer surplus is affected by payroll tax changes. A type τ firm's indirect profit function is $\pi_\tau = \frac{\phi_\tau}{1+\varepsilon} l_\tau^*$. Hence the effect of a decrease in the payroll tax on total profits $\Pi = n_f \pi_f^* + n_i \pi_i^*$ is:

$$\begin{aligned}\frac{\partial \Pi}{\partial t_f} &= \left(n_f \frac{\phi_f}{1+\varepsilon} \frac{\partial l_f^*}{\partial w_f^*} + n_i \frac{\phi_i}{1+\varepsilon} \frac{\partial l_i^*}{\partial w_f^*} \right) \frac{\partial w_f^*}{\partial t_f} \\ &= -n_f w_f^* l_f^* \frac{n_i w_i^{*\beta}}{n_f w_f^{*\beta} + n_i w_i^{*\beta}} \nu\end{aligned} \tag{15}$$

so that total profit rises with a payroll tax decrease.

An overall measure of the change in total surplus can be had by adding the effect of a tax change on total income, tax receipts and total profits. This gives,

$$\frac{\partial I}{\partial t_f} + \frac{\partial T}{\partial t_f} + \frac{\partial \Pi}{\partial t_f} = -n_f w_f^* l_f^* \left(\varepsilon + \frac{n_i w_i^{*\beta}}{n_f w_f^{*\beta} + n_i w_i^{*\beta}} \right) \nu \tag{16}$$

If there is no requirement for a balanced budget, this implies that a wage subsidy (negative payroll tax) can increase total surplus. Of course, in order to truly be surplus enhancing, the government must have alternative means for financing these wage subsidies and provide for government services.

3.2 Minimum wage

For a minimum wage increase, as long as $w_m < \phi_f/(1+t_f)$ (i.e., it is still profitable for formal sector employers to operate), the same comparative statics determine the employment and income effects.

With a minimum wage increase, since formal sector employment increases and the wage increases, payroll tax receipts must increase.

$$\begin{aligned}\frac{\partial T}{\partial w_m} &= t_f n_f \left(l_f^m + w_m \frac{\partial l_f^m}{\partial w_m} \right) \\ &= t_f n_f l_f^m \left(1 + \frac{n_i w_i^{*\beta}}{n_f {w_m}^\beta + n_i w_i^{*\beta}} \varepsilon \right)\end{aligned} \tag{17}$$

The effect on employer profitability, for a just binding minimum wage is:[6]

$$\begin{aligned}\left.\frac{\partial \Pi}{\partial w_m}\right|_{w_m = w_f^*} &= n_f \left.\frac{\partial \pi_f^m}{\partial w_m}\right|_{w_m = w_f^*} + n_i \frac{\phi_i}{1+\varepsilon} \frac{\partial l_i^*}{\partial w_m} \\ &= -n_f l_f^* \left(\frac{n_f w_f^{*\beta}(1+t_f) + n_i w_i^{*\beta}}{n_f w_f^{*\beta} + n_i w_i^{*\beta}} \right)\end{aligned} \tag{18}$$

The overall effect of a just binding minimum wage on the sum of income, tax receipts and total profits is:

$$\left.\frac{\partial I}{\partial w_m}\right|_{w_m = w_f^*} + \left.\frac{\partial T}{\partial w_m}\right|_{w_m = w_f^*} + \left.\frac{\partial \Pi}{\partial w_m}\right|_{w_m = w_f^*} = t_f n_f l_f^* (1+\varepsilon) \frac{n_i w_i^{*\beta}}{n_f w_f^{*\beta} + n_i w_i^{*\beta}}$$

That is, a minimum wage increases total income and payroll tax receipts by more than employer profits are reduced so that a just binding minimum wage is welfare increasing. However, unlike a wage subsidy, a minimum wage actually improves the government's fiscal balance sheet. Thus a judiciously chosen minimum wage could be employed in conjunction with

[6] Keep in mind that the comparative static for the formal sector is found by differentiating (7) since under a (not too large) minimum wage the firm's constrained maximum has it hiring as many workers as are willing to work at the minimum and its indirect profit function is not given by $\frac{\phi_f}{1+\varepsilon} l_f$.

a welfare enhancing tax cut that would not adversely affect the government's finances.

4 Free entry and exit

Now consider free entry, so that n_f and n_i adjust to eliminate profits. Assume that because of limited capital available for formal enterprises, formal employers have a fixed production cost of $c_f(n_f)$ that is increasing in the number of formal employers, n_f. On the other hand, informal employers' capital requirements are much more flexible and as a result, they have constant fixed production cost of c_i. Free entry and exit imply equilibrium employment:

$$l_k^* = \frac{c_k \beta}{\phi_k}. \tag{19}$$

where $c_k = c_f(n_f)$ if firm k is a formal market employer and $c_k = c_i$ if firm k is an informal market employer. Note that this implies that under monopsonistic competition, informal market establishment sizes remain constant.

The equilibrium number of employers in free entry, n_f^* and n_i^*, is given by the solution to equations (9) and (19), i.e., n_f^* and n_i^* solve:

$$(n_f w_f^{*\beta} + n_i w_i^{*\beta}) \left(\frac{c_f(n_f)\beta}{\phi_f \alpha} \right)^{\rho} = w_f^{*\beta} \tag{20}$$

and

$$(n_f w_f^{*\beta} + n_i w_i^{*\beta}) \left(\frac{c_i \beta}{\phi_i \alpha} \right)^{\rho} = w_i^{*\beta}. \tag{21}$$

These can be straightforwardly solved for n_i as a function of n_f:

$$n_i^f(n_f) = \left[\left(\frac{\phi_f \alpha}{c_f(n_f)\beta} \right)^{\rho} - n_f \right] \left(\frac{w_f^*}{w_i^*} \right)^{\beta}$$

and

$$n_i^i(n_f) = \left(\frac{\phi_i \alpha}{c_i \beta} \right)^{\rho} - n_f \left(\frac{w_f^*}{w_i^*} \right)^{\beta}.$$

To consider conditions under which a solution exists, differentiate each of these with respect to n_f,

$$\frac{\partial n_i^f}{\partial n_f} = -\left[\left(\frac{\phi_f \alpha}{c_f(n_f)\beta}\right)^\rho \frac{c_f'(n_f)\rho}{c_f(n_f)} + 1\right]\left(\frac{w_f^*}{w_i^*}\right)^\beta$$

and

$$\frac{\partial n_i^i}{\partial n_f} = -\left(\frac{w_f^*}{w_i^*}\right)^\beta .$$

Note first that since $c_f(n_f)$ is increasing in n_f, $\partial n_i^f/\partial n_f < \partial n_i^i/\partial n_f < 0$. Thus a necessary condition for a solution is that $n_i^f(0) > n_i^i(0)$ for which $(\phi_f/c_f(0))^\rho(\phi_f/(1+t_f))^\beta > (\phi_i/c_i)^\rho {\phi_i}^\beta$ is both necessary and sufficient. Next note that in order that there is an intersection, two conditions must be satisfied: i) $c_f'(n_f)/[c_f(n_f)]^{\rho+1}$ should not fall too quickly and ii) the difference between $n_i^f(0)$ and $n_i^i(0)$ is not too large. An illustrative example is:

$$c_f(n_f) = \rho\left(\frac{1}{K - n_f}\right)^{\frac{1}{\rho}}$$

for some constant K and $n_f < K$. In this case, $c_f'(n_f)/[c_f(n_f)]^{\rho+1}$ is constant at 1. As long as the difference between $n_i^f(0)$ and $n_i^i(0)$ is not too large then (20) and (21) intersect. Conditions for the existence of an equilibrium where there are both formal and informal enterprises is illustrated in Figure 1. The non-bold line represents $n_i^i(n_f)$. The solid, bold curve represents an example of n_i^f where n_i^f and n_i^i intersect so that there is a solution such that $n_f^* > 0$ and $n_i^* > 0$. The dashed bold curves represent examples of n_i^f where n_i^f and n_i^i do not intersect and where the above conditions do not hold.

4.1 Payroll taxes

Having established conditions for the existence of an equilibrium where both n_f^* and n_i^* are positive, I can now consider how n_f^* and n_i^* change in response to a change in the rate of payroll taxation. Totally differentiating

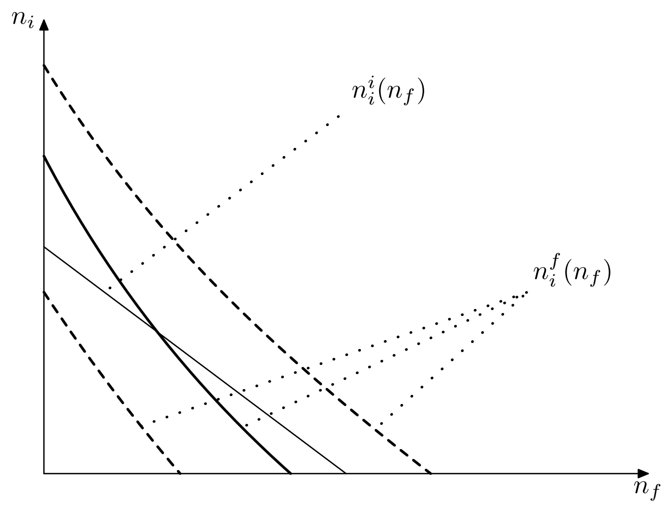

Figure 1: Equilibrium number of employers

(20) and (21) with respect to n_f^*, n_i^* and w_f^* and rewriting in matrix notation:

$$\begin{bmatrix} w_f^{*\beta}\left(\frac{c_f(n_f^*)\beta}{\phi_f\alpha}\right)^{\rho}\left(1+\frac{n_f^* w_f^{*\beta}+n_i^* w_i^{*\beta}}{n_f^* w_f^{*\beta}}\rho\xi_f\right) & w_i^{*\beta}\left(\frac{c_f(n_f^*)\beta}{\phi_f\alpha}\right)^{\rho} \\ w_f^{*\beta}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^{\rho} & w_i^{*\beta}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^{\rho} \end{bmatrix}\begin{bmatrix} \frac{dn_f^*}{dw_f^*} \\ \frac{dn_i^*}{dw_f^*} \end{bmatrix} = \begin{bmatrix} -\beta w_f^{*\beta-1}\left[n_f^*\left(\frac{c_f(n_f^*)\beta}{\phi_f\alpha}\right)^{\rho}-1\right] \\ -\beta w_f^{*\beta-1} n_f^*\left(\frac{c_i\beta}{\phi_i\alpha}\right)^{\rho} \end{bmatrix} \quad (22)$$

where ξ_f is the formal-employer, fixed-production-cost elasticity with respect to n_f^*. Let D be the determinant of the first matrix; after some simplification,

$$D = \frac{w_f^{*\beta} w_i^{*\beta}}{n_f^*}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^{\rho}\rho\xi_f > 0$$

Using Cramer's rule and simplifying, an increase in the formal-employer wage rate (e.g., from a payroll tax decrease) will have the following effects on the number of employers in the formal and informal labor markets:

$$\frac{dn_f^*}{dw_f^*} = \frac{\beta w_f^{*\beta-1} w_i^{*\beta}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^{\rho}}{D} > 0 \quad (23)$$

and

$$\frac{dn_i^*}{dw_f^*} = -\frac{\beta w_f^{*2\beta-1}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^\rho \left[1 + n_f^*\left(\frac{c_f(n_f^*)\beta}{\phi_f\alpha}\right)^\rho \frac{n_f^* w_f^{*\beta} + n_i^* w_i^{*\beta}}{n_f^* w_f^{*\beta}}\rho\xi_f\right]}{D}$$
$$= -\frac{\beta w_f^{*2\beta-1}\left(\frac{c_i\beta}{\phi_i\alpha}\right)^\rho (1+\rho\xi_f)}{D} < 0 \tag{24}$$

(The second line of (24) follows from (20).)

Since establishment level employment in the formal (informal) sector is increasing (constant) and the formal (informal) number of employers increases (decreases) with an increase in the formal sector wage rate, total formal (informal) employment increases (decreases). By extention, since a decrease in the payroll tax leads to an increase in the formal sector wage, a payroll tax decrease results in an increase in formal sector employment and a decrease in informal sector employment.

In other words, a decrease in the payroll tax reduces formal sector employer costs, prompting entry. As a result of this entry, fixed production costs in the formal sector increase and establishments must grow in order to continue breaking even. The shift of workers to the formal sector reduces informal sector labor supply, reducing the profitability of informal sector enterprises resulting in exit from the informal sector.

So formal sector employers become both larger and more numerous while informal sector employers remain the same size but some exit. The overall employment effect therefore depends on the relative magnitudes of these effects. After some manipulation, the overall effect can be computed as:

$$\frac{\partial E}{\partial w_f^*} = \left(n_f^*\frac{\partial l_f^*}{\partial n_f^*} + l_f^*\right)\frac{dn_f^*}{dw_f^*} + l_i^*\frac{dn_i^*}{dw_f^*}$$
$$= \frac{n_f^* l_f^* \varepsilon}{w_f^* \xi_f}\left[(1+\xi_f) - \frac{w_f^*}{w_i^*}(1+\rho\xi_f)\right] \tag{25}$$

Since $\rho > 1$, it follows that if $w_f^* \geq w_i^*$ then a decrease in the payroll tax will result in a decline in total employment. However, if w_i^* is greater than w_f^* and ρ is close to 1 then a decrease in the payroll tax will result in an increase in total employment.

It is also straightforward to consider the effect of a payroll tax decrease on total surplus. Since free entry and exit imply zero profits, policy changes have no effect on producer surplus. As before, the utility from leisure will be constant at $L = 1 - \alpha$ so that worker utility depends only on total income, $I = n_f^* w_f^* l_f^* + n_i^* w_i^* l_i^*$. Differentiating this with respect to w_f^* and some manipulation and substitution reveals,

$$\begin{aligned}\frac{\partial I}{\partial w_f^*} &= n_f^* l_f^* + w_f \left[l_f^* + n_f^* \frac{\partial l_f^*}{\partial n_f^*} \right] \frac{dn_f^*}{dw_f^*} + w_i^* l_i^* \frac{dn_i^*}{dw_f^*} \\ &= 0\end{aligned} \tag{26}$$

In other words, cutting payroll taxes, while redistributing jobs and income between different workers, results in no change in total worker income.

As a result, the effect of a payroll tax decrease depends only on its effect on total tax receipts, $T = t_f n_f^* w_f^* l_f^*$. After differentiating and some simplification,

$$\begin{aligned}\frac{\partial T}{\partial t_f} &= n_f^* w_f^* l_f^* + t_f \left[n_f^* l_f^* + w_f^* \left(l_f^* + n_f^* \frac{\partial l_f^*}{\partial n_f^*} \right) \frac{dn_f^*}{dw_f^*} \right] \frac{\partial w_f^*}{\partial t_f} \\ &= n_f^* w_f^* l_f^* \left[1 - \left(1 + \frac{(1+\xi_f)\varepsilon}{\xi_f} \right) \nu \right]\end{aligned} \tag{27}$$

Thus when the payroll tax is low (i.e., ν is small), the effect of a tax decrease is to reduce tax receipts and therefore total surplus falls. But if the payroll tax is high, the establishment level labor supply elasticity is highly elastic and the fixed-production-cost elasticity is low then a reduction in the payroll tax can increase tax receipts, increasing total surplus.

4.2 Minimum wages

Now consider the effect of a minimum wage on entry, exit and employment. With minimum wages, provided that $w_m < \phi_f/(1+t_f)$, the profit maximizing calculus changes and as a result, free entry instead implies:

$$(\phi_f - (1+t_f)w_m) l_f = c_f(n_f)$$

or

$$l_f^m = \frac{c_f(n_f^m)}{\phi_f - (1+t_f)w_m}. \tag{28}$$

Like the analysis of payroll taxes, a minimum wage will increase the size of formal sector establishments under free entry and exit.

Together (28) and (9) imply:

$$(n_f^m {w_m}^\beta + n_i^* w_i^{*\beta}) \left(\frac{c_f(n_f^m)}{\alpha}\right)^\rho = {w_m}^\beta (\phi_f - (1+t_f) w_m)^\rho \tag{29}$$

Totally differentiating (29) and (21) with respect to n_f^m, n_i^m and w_m and evaluating at $w_m = w_f^*$:

$$\begin{bmatrix} w_f^{*\beta} \left(\frac{c_f(n_f^*)}{\alpha}\right)^\rho \left[1 + \frac{n_f^* w_f^{*\beta} + n_i^* w_i^{*\beta}}{n_f^* w_f^{*\beta}} \rho \xi_f\right] & w_i^{*\beta} \left(\frac{c_f(n_f^*)}{\alpha}\right)^\rho \\ w_f^{*\beta} \left(\frac{c_i \beta}{\phi_i \alpha}\right)^\rho & w_i^{*\beta} \left(\frac{c_i \beta}{\phi_i \alpha}\right)^\rho \end{bmatrix} \begin{bmatrix} \frac{dn_f^m}{dw_m} \\ \frac{dn_i^*}{dw_m} \end{bmatrix} = \begin{bmatrix} -\beta w_f^{*\beta-1} n_f^* \left(\frac{c_f(n_f^*)}{\alpha}\right)^\rho \\ -\beta w_f^{*\beta-1} n_f^* \left(\frac{c_i \beta}{\phi_i \alpha}\right)^\rho \end{bmatrix} \tag{30}$$

Let D_m be the determinant of the first matrix:

$$D_m = w_f^{*\beta} \left(\frac{c_f(n_f^*)}{\alpha}\right)^\rho w_i^{*\beta} \left(\frac{c_i \beta}{\phi_i \alpha}\right)^\rho \left(\frac{n_f^* w_f^{*\beta} + n_i^* w_i^{*\beta}}{n_f^* w_f^{*\beta}}\right) \rho \xi_f > 0.$$

Again, we can use Cramer's rule to derive the effect of a change in the minimum wage on the equilibrium number of firms. After simplifying:

$$\left.\frac{dn_f^m}{dw_m}\right|_{w_m = w_f^*} = 0 \tag{31}$$

and

$$\left.\frac{dn_i^*}{dw_m}\right|_{w_m = w_f^*} = -\frac{\beta w_f^{*\beta-1} n_f^*}{w_i^{*\beta}} < 0 \tag{32}$$

Interestingly, an increase in a just binding minimum wage results in no exit of formal employers but induces exit among informal employers.

Although at the establishment level, a minimum wage reduces formal sector profitability and induces exit, in aggregate, a minimum wage results in exit from the informal sector, resulting in an increase in labor supply to the formal sector thereby increasing profitability. In net, these opposing effects cancel with the result that there is no entry or exit to the formal labor market. However, this result must be kept in perspective. Similar to the envelope theorem arguments used in Card and Krueger (1995) and Rebitzer and Taylor (1995), at the margin, a minimum wage will have a negligible effect on formal employer profitability but a large enough increase in the minimum wage will undoubtedly result in the exit of formal sector employers. Since some informal sector workers move to the formal sector, labor supply in the informal sector falls, reducing profitability of informal sector employers, resulting in firm exit in the informal sector.

Using these results, consider total employment:

$$E = n_f^m l_f^m + n_i^* l_i^*$$

Differentiating this with respect to w_m and simplifying,

$$\begin{aligned} \left.\frac{\partial E}{\partial w_m}\right|_{w_m = w_f^*} &= n_f^* \frac{\partial l_f^m}{\partial w_m} + l_i^* \frac{dn_i^*}{dw_m} \\ &= \frac{n_f^* l_f^*}{(\rho - 1) w_f^*} \left[1 - \rho \frac{w_f^*}{w_i^*}\right] \end{aligned} \tag{33}$$

Similar to the effects of a payroll tax decrease, since $\rho > 1$, if $w_f^* > w_i^*$ then $\partial E / \partial w_m|_{w_m = w_f^*} < 0$ and in aggregate, employment falls. On the other hand, when $w_i^* > w_f^*$, if ρ is sufficiently small then $\partial E / \partial w_m|_{w_m = w_f^*} > 0$ and a minimum wage can, at the margin, result in an increase in total employment.

As before, since in equilibrium the disutility from work is constant, whether or not worker surplus increases depends on how total worker income changes as a result of a minimum wage. Differentiating income, $I = n_f^m w_m l_f^m + n_i^* w_i^* l_i^*$,

$$\begin{aligned} \left.\frac{\partial I}{\partial w_m}\right|_{w_m = w_f^*} &= n_f^* \left(l_f^* + w_f^* \left.\frac{\partial l_f^m}{\partial w_m}\right|_{w_m = w_f^*} \right) + w_i^* l_i^* \left.\frac{dn_i^*}{dw_m}\right|_{w_m = w_f^*} \\ &= 0 \end{aligned} \tag{34}$$

Similar to the effect of a payroll tax cut or hike, a just binding minimum wage redistributes income between different workers but total income remains constant.

But since employment in the formal sector has increased, payroll tax receipts must increase. This can be evaluated precisely by differentiating,

$T = t_f n_f^m w_m l_f^m$,

$$\left.\frac{\partial T}{\partial w_m}\right|_{w_m=w_f^*} = t_f n_f^* \left(l_f^* + w_f^* \left.\frac{\partial l_f^m}{\partial w_m}\right|_{w_m=w_f^*} \right) = t_f n_f^* l_f^* (1+\varepsilon) \tag{35}$$

Since tax receipts increase with the imposition of a just binding minimum wage, total surplus must increase as a result. In contrast to a cut in the rate of payroll taxation, a just binding minimum wage unambiguously increases total surplus. A minimum wage redistributes income between different workers, keeping total income the same but higher formal employment leads to higher tax receipts.

5 Conclusions

In this chapter, I considered an alternative model for looking at formal and informal labor markets in developing countries. Empirical evidence suggests that in many developing countries, workers often willingly transition in either direction between the formal and informal sectors. The traditional, competitive "Harris-Todaro" framework cannot be reconciled with voluntary participation in informal labor markets unless the formal and informal labor markets are fully integrated. But full integration of competitive markets requires equalization of the formal and informal wage rates and this is not corroborated by the evidence. I offer oligopsony and monopsonistic competition as an alternative modeling technique that: 1) can capture the notion that some workers voluntarily work in the informal sector and 2) is tractable enough to conduct interesting policy exercises.

Nevertheless there are at least two directions that future research should take. Firstly, in order to be fully satisfactory, a model of developing economy labor markets should be able to explain under-/unemployment. One might interpret changes in unemployment as being the negative of the change in employment. However, this interpretation has the clear drawback that unemployment is purely voluntary. Maloney (2004) acknowledges that the informal sector is likely itself to be heterogeneous with a voluntary tier and an involuntary tier. One possible solution may be to construct a hybrid model which incorporates features of both oligopsony/monopsonistic-competition and the Harris-Todaro framework.

Secondly, a feature of the model constructed here is that there are no spillover wage effects. That is, one would expect that following a policy change that affects the formal sector wage, wages in the informal sector would also be affected through competitive linkages between the formal and informal labor markets. For example, if the payroll tax is reduced and formal wages rise, it would not be unreasonable to believe that informal sector employers might raise their wages in an effort to retain workers. Indeed, Gindling and Terrell (2005) find that in Costa Rica, informal sector wages can rise in response to an increase in the minimum wage. One way to capture such wage spillovers is to allow marginal revenue products of labor to vary depending on either the number of establishments or total employment in each sector.

Finally, it may be interesting to consider a combination of oligopsony and monopsonistic competition. In particular, formal sector jobs are sometimes equated with government jobs. As such, the number of "formal establishments" is in some sense fixed but one would certainly expect free entry and exit of informal establishments.

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