Cumulative effects of labor market distortions in a developing country

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Abstract

This paper considers a small open economy with an input-output industrial structure that creates vertical linkages and multiple equilibria. An imperfect labor market is introduced by assuming unionized labor. It is shown that a deregulation of the labor market may trigger a large, discontinuous expansion of industrial output, as reduced wage-costs start a circular, cumulative process in which expansions of the up-and downstream industries promote each other. Centralization of collective bargaining may, however, also be conducive to industrialization.

Keywords: Vertical Linkages, Multiple Equilibria, Labor Unions

JEL classification: F12, O11, J50

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1 Introduction

A number of papers emerging from the "new" trade theory focus on pecuniary externalities, arising in models with imperfect competition and scale economies. Rodrik (1995), Rodriguez - Claire (1996) and Krugman and Venables (1995) are some well-known examples. The interest in such models can partly be explained by the fact that they give rise to multiple equilibria. On the positive side, these models can explain why an economy may be trapped in a bad equilibrium, but they can also provide normative conclusions and prescribe how government policy should be used to push the economy into a superior equilibrium.

Clearly, these properties make such models interesting for analyzing problems in developing economies.[1] The purpose of this paper is to investigate to what extent labor market distortions, in terms of labor unions, can act as impediments to development. It will be shown that even if only a limited share of the population is unionized - a reasonable assumption for a developing country - the costs of this labor market distortion may be disproportionately high, since the economy is kept at a low level of activity.

An open two-sector model, which draws on Venables (1996), is used to make this point. A central feature is then that an input-output structure in the modern, industrial sector creates complementarities or pecuniary externalities between an upstream industry (which uses labor in order to produce intermediate input goods) and a downstream industry (which uses domestic and imported intermediate inputs, together with labor and sector-specific capital, in order to produce final goods).

Workers in each final good producing firm are assumed to be unionized and union wages are determined through wage-bargaining. I start by investigatigating the possible effects of the institutional setting being changed in favor of employers, thereby reducing union wages.

[1] These models formalize some previous ideas in development economics such as Rosenstein-Rodan's (1943) Big Push or Scitovsky's (1954) work on externalities. For a presentation, see Matsuyama (1993) or Krugman (1992).

When there are multiple equilibria, the following picture emerges: If the low-level equilibrium is the initial equilibrium, decreasing union wages will increase the downstream production of final goods and, subsequently, the downstream producers' demand for intermediate inputs. For sufficiently large wage cuts, domestic upstream firms can enter, thereby lowering downstream production costs since a larger variety of inputs becomes available. This, in turn, facilitates additional downstream expansion. A cumulative, circular process is then begun, where expansion in the up- and downstream industries reinforce each other, thereby triggering a discontinuous jump from the low-level equilibrium to the high-level, industrialized equilibrium.

While a deregulation of the labor market may shift equilibrium, I also show that centralization of collective bargaining can be conducive to industrialization. In this case, a central union (which organizes all labor) and an employer's organization (which serves the interests of all firms) negotiate an encompassing wage for the whole industry sector. The union side then internalizes that a reduction in the union wage is compensated by a significant increase in union employment as the economy shifts from the low-level equilibrium to the high-level, industrialized equilibrium.

The model is mainly applicable to developing countries, although the mechanisms described can also be generalized to developed countries. The economy is small on the world market, which implies that the number of foreign intermediate inputs and their price, as well as the world market price of final goods, are taken to be completely exogenous. Domestic intermediate inputs are not exported.[2] Labor market institutions constitute a segmented labor market where workers in the upstream industry and the agricultural sector receive competitive wages, whereas a close relationship between the unions in the rent-yielding final good industry and the political system, enables the unions to extract excess wages.

In relation to the literature, this paper contributes by introducing labor

[2] Exports of upstream goods can easily be included.

unions in a context of vertical linkages and multiple equilibria.[3] Using this new framework, the paper demonstrates how large wage-inequalities in favor of unions in key industries can have considerable effects on industrial output and employment in developing countries. It then points to the importance of maintaining competitive labor markets, or the use of centralized wage-setting, during transition. In different models, Agell and Lommerud (1993) and Moene and Wallerstein (1997) also find that centralized unions, which eliminate inter-industry wage differentials, can improve economic efficiency. In Agell and Lommerud (1993), however, wage inequalities are assumed to arise competitively, whereas this paper assumes wage inequalities to arise from union wages. Hence, competitive labor markets work as an impediment to industrialization in their model, whereas competitive wages promote industrialization in the present model. Moreover, Agell and Lommerud contains no explicit analysis of wage-bargaining.

Moene and Wallerstein (1997) compare bargaining at the level of the firm and the industry, but assume that unions only have preferences over wages. In this paper, union preferences over both wages and employment play an important role for the wage-restraint exercised by the union in central bargaining. Indeed, with utility increasing in employment, the union internalizes not only that a reduced union wage can increase employment in a particular equilibrium, it also takes into account how a reduced union wage can discretely increase employment by *shifting* the equilibrium. This is precisely how centralized wage-setting enables to internalize the vertical linkages.

The paper is organized as follows. Section 2 describes the model and section 3 investigates the relationship between unions and industrialization. Section 4 concludes.

[3] There is a large literature on collective bargaing, where the effects of various types of externalities are discussed (for a survey, see Flanagan (1999)). Even though input externalities have been noticed (see, for example Wallerstein (1990)), the above context, involving vertical linkages and multiple equilibria is, to my knowledge, new.

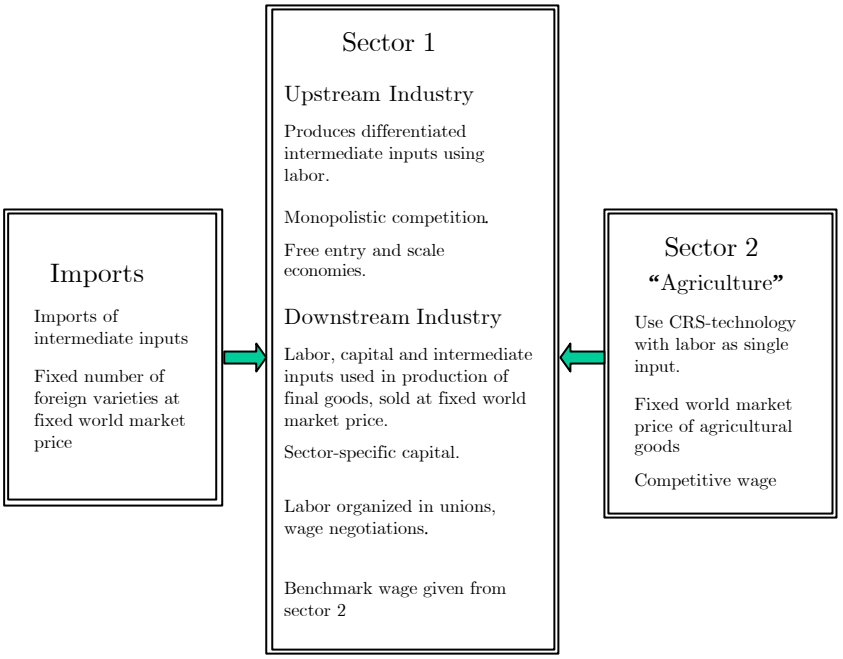

Figure 1: The structure of the model

2 The model

The basic structure of the model is shown in figure 1. The focus is on a small open economy with two sectors and labor as the common factor exogenously fixed at L. The industrial sector, sector 1, has two industries. The upstream industry, X, employs labor for producing differentiated intermediate input goods, which are combined with imported differentiated inputs, labor and sector-specific capital into a final good in the downstream industry, Y. Final goods are tradable on the world market and can be sold at the fixed world-market price q. Sector 2 constitutes the rest of the economy, and will be referred to as the agricultural sector. Agricultural goods, which will be used as numeraire, are produced with labor using a constant returns to scale technology and are also tradable at the world-market price.

2.1 Production

The downstream industry is perfectly competitive. I follow the literature and depict this industry by using a *representative* firm.[4] The production of final goods requires three distinct inputs; labor, capital and intermediate inputs. Using the Cobb-Douglas technology:

$$Y = X^a L_Y^b K^{1-a-b} \tag{1}$$

where a is the expenditure share of intermediate inputs, X is the amount used of a bundle of intermediate inputs (defined below), L_Y is employment in the downstream industry and the production function $Y(\cdot)$ exhibits constant returns to scale (CRS). In the production of final goods, intermediate inputs are assembled into an aggregate input good X, defined in (2):

$$X = \left(\int_0^{\bar{n}} x(\omega^*)^{\frac{\sigma-1}{\sigma}} d\omega^* + \int_0^{n} x(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \tag{2}$$

where x is the amount used of a single variety, whereas ω (ω^*) indicates domestic (foreign) varieties. n and $\bar{n}$ are the number of available domestic and foreign varieties, where the latter is taken to be fixed in accordance with our assumption of a small open economy and $\sigma \in (1, \infty)$ is the elasticity of substitution between two varieties. Using (2), we may define the minimum-cost for one unit of the intermediate input bundle X, P, as:

$$P \equiv \left(\bar{n}\bar{p}^{1-\sigma} + np^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{3}$$

where p is the price of domestic varieties, whereas $\bar{p}$ is the fixed world-market price of foreign varieties. Since varieties of intermediate inputs are imperfect substitutes, additional intermediate inputs enhance the efficiency in downstream production, as illustrated by the price index which is decreasing in n.

The capital stock is sector-specific, so that capital can only be used in final good production. We then normalize so that $\bar{K} = 1$. The production function

[4] See, for example, Oswald (1982).

for final goods (1) then becomes:

$$Y = X^a L_Y^b \tag{4}$$

The representative firm takes the price for the bundle of intermediate inputs P as given. For a given wage in the downstream industry w and a given world-market price for final goods, q, profit-maximizing yields the profit function:

$$\Pi(w) = (1-a-b)\left(\frac{a}{P}\right)^{\frac{a}{1-a-b}}\left(\frac{b}{w}\right)^{\frac{b}{1-a-b}} q^{\frac{1}{1-a-b}} > 0, \tag{5}$$

where $\Pi(w) > 0$ follows from $1-a-b > 0$. This profit may be interpreted as compensation to the owners of the firm's capital stock K (the specific factor). Furthermore, the supply function is:

$$Y(w,P,q) = \left(\frac{a}{P}\right)^{\frac{a}{1-a-b}}\left(\frac{b}{w}\right)^{\frac{b}{1-a-b}} q^{\frac{a+b}{1-a-b}} \tag{6}$$

Next, we turn to upstream firms, where monopolistic competition is the upstream market form. From (3) and (5), it can be shown that the demand faced by an individual domestic intermediate input producer is:

$$x = P^{\sigma-1} p^{-\sigma} aqY \tag{7}$$

In this demand function, the individual upstream firm takes the price index P and the downstream expenditure on differentiated goods, aqY, as given.

There is a unit labor requirement in production and a fixed cost F in terms of labor for entering the market. Assuming free entry and exit, and using the demand function (7), the pricing condition and zero-profit condition can be written as:

$$p\left[1-\frac{1}{\sigma}\right] = \bar{w}, \qquad px = \bar{w}(x+F), \tag{8}$$

where $\bar{w}$ is the wage paid to upstream workers. These two equations determine a unique size of each domestic firm:

$$x = (\sigma-1)F \tag{9}$$

We can use (3), (7), (8) and (9) to derive the number of domestic intermediate input producers n, for a given level of final good production Y and a given upstream wage $\bar{w}$:

$$n = \frac{\frac{aqY}{F(\sigma-1)\left(\frac{\sigma}{\sigma-1}\bar{w}\right)^{\sigma}} - \bar{n}\bar{p}^{1-\sigma}}{\left(\frac{\sigma}{\sigma-1}\bar{w}\right)^{1-\sigma}} \tag{10}$$

Note that (10) implies a minimum level of final good production to be associated with active domestic production of differentiated inputs. Setting $n = 0$ in (10), we can derive:

$$Y_C = A_1 \bar{w}^{\sigma} \left(\bar{n}\bar{p}^{1-\sigma}\right), \tag{11}$$

where $A_1 = \frac{F(\sigma-1)\left(\frac{\sigma}{\sigma-1}\right)^{\sigma}}{aq}$. Inserting the number of firms given by (10) into (3) and using the pricing rule (8), the unit cost of input bundles X, $P^S(Y)$, becomes:

$$P^S(Y) = \begin{cases} \left(\frac{Y}{A_1 \bar{w}^{\sigma}}\right)^{\frac{1}{1-\sigma}} & \text{if } Y > Y_C \\ \left(\bar{n}\bar{p}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} & \text{if } Y \leqslant Y_C \end{cases} \tag{12}$$

Equations (10), (11), (12) and (6) describe the *vertical linkages* in the model. Note that $P^S(Y)$ then consists of two segments. For $Y \leqslant Y_C$, no domestic production of differentiated inputs occurs. The demand from final good producers is insufficient for the existence of any domestic upstream firm, as entry costs cannot be recovered. Foreign imports only are used, so that final good producers face a fixed price for the aggregate input good X.

If final good production increases so that $Y > Y_C$, domestic upstream firms will enter; this is the *demand linkage* (cf. equation (10)). An increasing number of suppliers of differentiated input goods enhance productivity in the downstream industry, since a larger range of differentiated inputs becomes available. This lowers downstream production costs as the unit cost of the input bundle $P(Y)$ decreases; this is the *cost linkage* (cf. equation (12)). A lower unit cost of the aggregate input good will then increase the supply of final goods Y (cf. equation (6)), and an increase in output may become cumulative, due to these vertical linkages.

2.2 Labor market

The downstream industry is unionized and each final good producing firm is assumed to have a separate union. The wage for downstream workers is determined in negotiations between the representative firm and the representative union. Using the Nash-bargaining solution, the negotiated wage w is defined as $w_f = \arg\max G_f$, where:

$$\begin{aligned} G_f &= [\Pi(w) - \Phi]^c [U(w) - \Psi]^{1-c} \\ U(w) &= (L_Y)^\gamma (w - \bar{w})^\theta, \qquad c, \gamma, \theta \in (0,1), \end{aligned} \tag{13}$$

where c is the bargaining power of the firm, profits $\Pi(w)$ are given by (5) and the demand for labor $L_Y = -\frac{\partial \Pi(w)}{\partial w}$ follows from Hotelling's Lemma.[5] The status quo pay-offs of the firm and the union are defined as as arbitrary constants $\Psi \geq 0$ and $\Phi \geq 0$.[6] The union has preferences over excess wage $(w - \bar{w})$ and downstream employment L_Y of the Stone-Geary type, where θ and γ are the excess wage and employment elasticities of the utility function.[7] The comparison wage of an individual employed in the industrial sector is defined as $\bar{w} = f'_L$, where f'_L is the constant marginal product of labor in agricultural production. In other words, $\bar{w}$ is simply the competitive wage paid in agricultural production and accordingly, the wage union members will receive if not employed in the downstream industry. Finally, note that the price of the intermediate input bundle P is treated as fixed in the profit function $\Pi(w)$. At the level of an individual firm, the size and scope of the vertical linkages are too large to be internalized.

As shown in the appendix, the union wage then fulfills:

$$w_f = (\bar{w}, w_m), \qquad \frac{dw_f}{dc} < 0 \tag{14}$$

[5] See Varian (1992).

[6] It will be assumed that $U(w_f) + \Pi(w_f) > \Phi + \Psi$ holds.

[7] Pemberton (1988) derives $U(\cdot)$ as the maximand of a "managerial union" with a leadership interested in size (employment) and union members (median worker) interested in excess wages. Parameters θ and γ then correspond to the bargaining power of workers and leadership, respectively.

where w_m is derived from the limiting case of a monopoly union ($c = 0$). Since upstream workers are paid the competitive wage $\bar{w}$, it is clear from (14) that downstream workers earn a wage premium compared to upstream and agricultural workers. All workers are then assumed to have the same skills, that is, the labor market is segmented. There is, however, no unemployment. The labor market condition $L = L_X + L_Y + L_A$, where the first two terms represent the demand for labor in industrial production, determines the level of employment in agriculture L_A, which, in turn, determines the size of the agricultural sector.

2.3 Solving the model

A simple intersection of supply and demand price curves is used for solving the model. Following Markusen (1989), it will be solved by using the price of the aggregate intermediate input good X, rather than the price of an individual variety, x. Due to the presence of vertical linkages in this model, these prices will be expressed in final good production Y.

The supply function for *final* goods, $Y(w, P)$, is given in (6). This function may be inverted in order to derive the maximum price that final good producers are prepared to pay for the aggregate intermediate input good X, for a given level of output Y, $P^D(Y)$:

$$P^D(Y) = A_2 \left(Y^{1-a-b} w^b \right)^{-\frac{1}{a}}, \tag{15}$$

where the union wage w is given from (14) and $A_2 = aq^{\frac{a+b}{a}} b^{\frac{b}{a}}$.

A corresponding supply price must also be found in order to derive an equilibrium. That is, we need to find the minimum price at which the upstream suppliers will supply the aggregate intermediate input good. However, this is only the unit cost for X, $P^S(Y)$, which was derived in (12) by using the pricing rules of the individual firms (8).

The graphical solution is depicted in figure 2. First, note the segmented supply price curve $P^S(Y)$. Again, $P^S(Y)$ is constant for $Y \leqslant Y_C$, since final good production is too small to admit domestic input production and only a

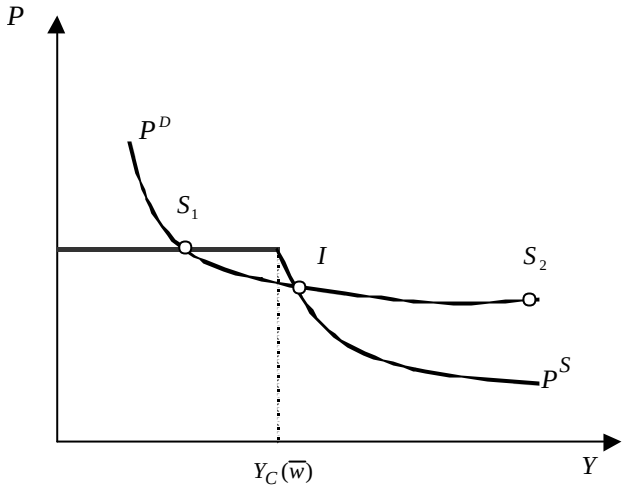

Figure 2: Multiple equilibria

fixed number of foreign varieties enter the price index at a fixed price. However, as downstream output expands beyond $Y > Y_C$, entry of upstream firms occurs, thereby lowering the price index P (c.f equation (3)). The demand price curve $P^D(Y)$ is downward-sloping for all levels of final good production Y, due to the diminishing returns in final good production arising from the fixed factor. This reduces the price the downstream industry can pay for inputs at successively higher output levels.

As shown in the appendix, multiple equilibria arise if the cost- and demand linkages are sufficiently strong. In Figure 2, there are three equilibria S_1, I and S_2, the stability of which can be examined as follows: Due to profit maximization, final-good producers increase production whenever the demand price for the aggregate input good exceeds the supply price, $P^D(Y) > P^S(Y)$, whereas they reduce production whenever $P^D(Y) < P^S(Y)$. In addition, assuming that upstream producers enter in response to instantaneous profits, upstream firms will enter whenever $P^D(Y) > P^S(Y)$, given that downstream supply is initially sufficiently large, $Y \geq Y_C$. To see this, note that the former condition states an excess demand on the aggregate intermediate input good X, thereby imply-

ing that there must also be an excess demand for individual varieties x. Since $P^S(Y)$ is derived by imposing zero profits on upstream firms, individual firms must make positive profits and entry takes place. For the same reason, upstream firms exit when $P^D(Y) < P^S(Y)$ and $Y \geq Y_C$.

Making use of this information, I must be unstable, whereas S_1 and S_2 are stable. Note that S_1 occurs for $Y \leqslant Y_C$, so that final good production cannot sustain any domestic upstream production and only imported intermediate inputs are used. One the other hand, S_2 is an equilibrium where the economy is completely specialized in industrial production and all labor resources are devoted to industrial production.

3 Unions and development

In this section, I will study how labor market policy be can used to affect the economy. I will discuss two quite opposite policies: First, I will examine a deregulation of the labor market, then, the effects of centralization of wage-negotiations.

3.1 Deregulating the labor market

To put the analysis in a developing country-context, suppose the economy is in the low-level equilibrium S_1. Then, assume that an institutional change occurs, where the government intervenes on the labor market by weakening the unions' ability to mark-up wages in final good production.[8] In this model,

[8] Union bargaining power will depend on the unions' right to organize the supply of labor and their ability to inflict damage on firms during a conflict. The right to organize and the right to strike is governed by the institutional framework in the economy, however. Institutional changes may then affect their bargaining power in several ways. Such changes may decrease the incentive to become a member of a union. With a smaller number of members, the union is weaker in its negotiations with the firm, which will be the result if union control over labor supply is diminished by limiting the legal bargaining monopoly of the unions. Reformation of employment security laws is another example. In this case, the firing costs for the firms will decrease.

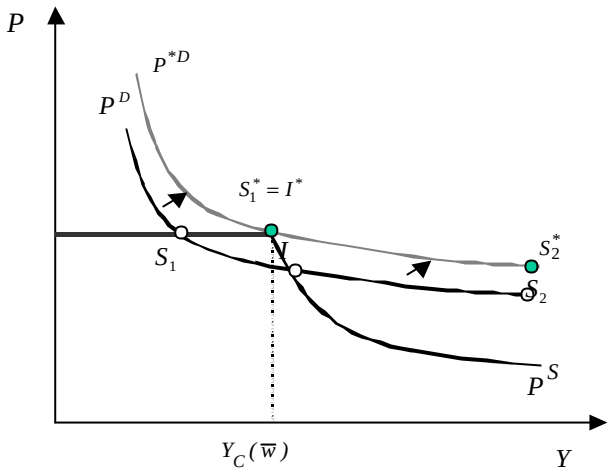

Figure 3: Deregulating the labor market

I simply assume that this will increase the bargaining power of the firms in the downstream industry, c. By (14), this implies a decreased wage mark-up and thus a decreased union wage w_f, which will shift the demand price curve $P^D(Y)$ upwards, due to decreasing downstream wage costs, but will not affect the supply price curve $P^S(Y)$, as upstream workers are still paid the competitive wage. Thus, downstream output expands as S_1 is shifted to the right, as is illustrated in figure 3. It can also be noted that the unstable equilibrium I moves backwards. Indeed, if the increase in c is sufficiently large, the wage cuts in the downstream industry may cause S_1 and I to coincide, as $P^D(Y)$ shifts upwards to $P^{*D}(Y)$.

By inducing further wage cuts, the deregulation may shift the demand price curve outside the supply price curve. When $P^D(Y)$ shifts further to the right in figure 3, so that $P^D(Y) > P^S(Y)$, this generates entry of domestic upstream firms which, in turn, further reduces the production costs of the downstream firms through a greater range of available inputs, thus facilitating additional downstream expansion. A circular, cumulative process is begun where the expansion in the up- and downstream industries reinforce each other. Cumulative

causation will take the economy out of the low-level equilibrium S_1 and into the new industrial equilibrium S_2^*, where the economy is completely specialized in industrial production.[9]

In summary:

Proposition 1 *A deregulation of the labor market can have potentially very large effects. It can generate a shift from the low-level equilibrium to the high-level equilibrium.*

3.2 Centralized wage-setting

Proposition 1 indicates that the government should restrict union power. However, as argued in the literature on macro-economic performance and collective bargaining (for a survey, see Flanagan (1999)), wage-externalities are more effectively internalized when wage-setting becomes more centralized. This section therefore investigates if industrialization can be achieved by a reform of the wage-setting process. To keep the exposition simple, I will present the case of centralized wage-setting in the industrial sector, where a common wage is negotiated for upstream- and downstream labor.

Suppose that the government can influence the labor market, so that a central union and a central employer organization are created in the industry sector[10]. The union, which organizes all labor, and the employer federation, which

[9] This result is quite extreme, but arises as the competitive wage is unaffected by industrial expansion. It is, however, easy to "convexify" the model by introducing a fixed factor, that is, land, in agriculture. Then, as industrial expansion draws labor from the agricultural sector, an increasing land/labor ratio increases the competitive wage. Adding this general equilibrium effect to the cost-linkage will tend to make the supply price curve U-shaped, which, in turn, makes it possible to derive the high-level equilibrium S_2 through intersecting demand and supply price curves, so that S_2 becomes an equilibrium without specialization. This improved realism, however, comes at the cost of analytical tractability. But it is easily shown that the qualitative effects of a deregulation do not change in the extended model

[10] I shall just assume that the government can provide a forum through which negotiations can be initiated. Having established contacts, the parties may find that there are gains from cooperation to be exploited, as is shown in the example of centralized wage-setting and "solidaristic wage policy" in the industrial sector.

serves the interests of all firms, then negotiate an encompassing wage for the whole industrial sector. The wage in the agricultural sector continuous to be set competitively.

In contrast to decentralized bargaining, the central union and the employer federation can take into account the vertical linkages between downstream and upstream firms. It is then useful to derive the maximum encompassing union wage, $\tilde{w}$, which is compatible with industrialization and a shift from the low-level equilibrium to the high-level equilibrium. Note that since upstream workers receive union wages, the critical level of final output Y_C can be found by simply substituting the competitive wage $\bar{w}$ for the critical union wage $\tilde{w}$ in (11), to get:

$$Y_C(\tilde{w}) = A_1 \tilde{w}^{\sigma} \left(\bar{n}\bar{p}^{1-\sigma}\right) \tag{16}$$

Setting downstream supply (6) equal to the critical output (16) and using (12), we have:

$$\tilde{w} = (A_3)^{\frac{1-a-b}{\sigma(1-a-b)+b}} \tag{17}$$

where A_3 consists of the various parameters in the model.[11]

This exercise is illustrated in figure 4. At an industry wage $w > \tilde{w}$, there are three equilibria S_1, I and S_2. In S_1, the union wage, w_1, say, leads to a supply of final output insufficient to sustain domestic upstream firms as downstream production is below the critical level, $Y_C(w_1)$. To push the economy to S_2, the industry wage must be reduced which, in turn, shifts the demand price curve $P^D(Y)$ upwards and the supply-price curve $P^S(Y)$ downwards. The latter shift occurs since lower wage costs for the upstream firms reduce the price of individual varieties of inputs.[12] At $w = \tilde{w}$, the two curves coincide, $\tilde{P}^D(Y) =$

[11] It is tedious, but straightforward, to show that:

$$A_3 = \frac{\left(qa^{1-b}b^b\right)^{\frac{1}{1-a-b}} \left(\bar{n}\bar{p}^{1-\sigma}\right)^{\frac{(\sigma-1)(1-a-b)+a}{(\sigma-1)(1-a-b)}}}{F(\sigma-1)\left(\frac{\sigma}{\sigma-1}\right)^{\sigma}}$$

[12] To see this, substitute the competitive wage $\bar{w}$ for the critical union wage w in equation (8). That a reduction in the encompassing wage indeed reduces the supply price, can be seen

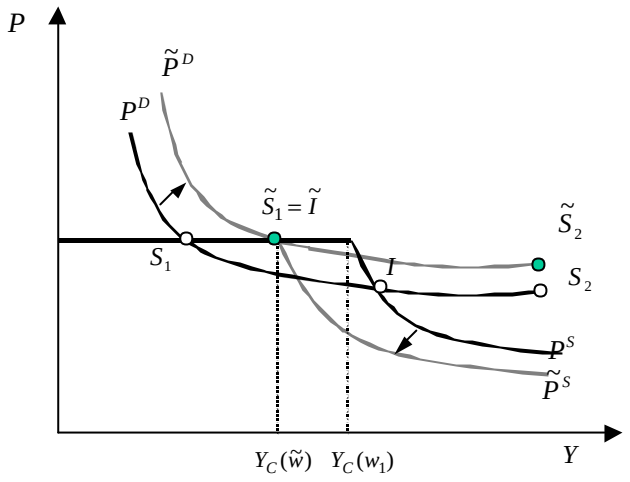

Figure 4: Centralized wage-setting

$\tilde{P}^S(Y)$. It is then clear that if the union wage is set marginally below $\tilde{w}$, downstream firms will expand their production beyond $Y_C(\tilde{w})$. As the demand price exceeds the supply price, $P^D(Y) > P^S(Y)$, upstream firms enter and the cumulative forces working through the cost- and demand linkages will push the economy to the high-level equilibrium $\tilde{S}_2$.

In summary:

Lemma 2 *To facilitate industrialization and shift the economy from the low level equilibrium to the high-level equilibrium, the encompassing union wage must fulfill (18):*

$$w < \tilde{w} \tag{18}$$

3.2.1 Why may centralization be conducive to development?

Formally, the industrial wage negotiated by the central union and the employer federation can be derived by using the Nash-bargaining solution, defined as

by substituting the competitive wage $\bar{w}$ for the critical union wage w in equation (12).

$w_e = \arg\max G_e$, where:

$$\begin{aligned} G_e &= [U(w) - \Sigma]^{1-c} [S(w) - \Phi]^c \\ S &= \Pi + n\pi_x, \quad U = (L_{Ind})^{\gamma} (w - \bar{w})^{\theta}, \quad L_X = n(x + F) \end{aligned} \tag{19}$$

The employer-federation's pay-off is the aggregated profit made by upstream and downstream firms at the union wage w, $S(w)$. The central union's pay-off is $U(w)$, where we can note that union employment now becomes industrial employment, $L_{Ind} = L_Y + L_X$, as labor in both upstream and downstream firms receive the union wage w. The status quo pay-offs of the central union and the employer federation are defined as arbitrary constants Σ and Φ.[13]

Due to non-linearities, it is very difficult to explicitly solve (19). However, as proved in the appendix, the following proposition holds:

Proposition 3 *If the labor force is sufficiently large and the central union is sufficiently employment-oriented, centralized wage-setting induces industrialization and shifts the economy from the low-level equilibrium to the high-level equilibrium.*

The intuition is straightforward. The proposition simply describes conditions which need to be fulfilled for both parties to prefer a low union wage leading to industrialization ($w < \tilde{w}$) to a higher wage which does not ($w \geq \tilde{w}$).

Employers always prefer a low wage associated with industrialization: First, profits increase when wage costs are reduced. In addition, downstream firms gain from having a larger range of inputs available as the entry of domestic upstream firms also improves productivity. The latter is easily seen from figure 4, where the supply price P^S in S_1 exceeds the corresponding supply price in $\tilde{S}_2$.

The intuition to why the union-side might prefer to restrict its wage demands stems from the fact that choosing a wage below $\tilde{w}$ is compensated by a massive, *discrete* expansion of union employment. To see this, note that at a high wage $w > \tilde{w}$, union members originate solely from downstream firms,

[13] We shall assume that $U(w_e) + S(w_e) > \Sigma + \Phi$ holds.

as the economy is kept in the low-level equilibrium S_1. By agreeing to a low wage, $w < \tilde{w}$, domestic upstream firms enter and the cumulative forces push the economy towards the high-level equilibrium $\tilde{S}_2$. However, in $\tilde{S}_2$ the economy specializes in industrial production and both upstream and downstream workers are organized in the encompassing union[14]. Given that the union values employment sufficiently (i.e. when $\frac{\theta}{\gamma}$ is sufficiently low) and the economy is sufficiently large (in terms of L), the central union will prefer a low wage leading to industrialization to a high wage which does not.

As shown in the appendix, this is the case whenever:

$$\frac{L}{L_Y(w_1)} > \left(\frac{w_1 - \bar{w}}{w_2 - \bar{w}}\right)^{\frac{\theta}{\gamma}}, \tag{20}$$

where I have generally defined two alternative wages $w_1 > \tilde{w}$ and $w_2 < \tilde{w}$.

4 Conclusion

In this paper, I have shown that labor market imperfections may have considerable effects in an environment with scale economies and imperfect competition, where pecuniary externalities and vertical linkages exist between firms.

It was shown that a "deregulation" of the labor market may trigger a discontinuous expansion of output, as the economy moves between equilibria. This process worked through the "positive feedbacks" inherent in this type of economy. As final good producers increased production in response to reduced wage costs, upstream producers benefitted through higher demand for inputs. This permitted entry of additional upstream firms, which reduced production costs for final good producers even further, through a more efficient use of intermediate inputs.

[14] Again, specialization is an extreme result which originates from simplifying assumptions. The mechanism is, however, more general. Even if the the high-level equilbrium would not entail specialization, the union would still trade off that a reduced wage increases employment far beyond the usual continuous expansion, as the economy shifts from the low- to the high level industrialized equilibrium.

As noted by several writers, the existence of such "positive feedbacks" indicates a coordination failure between firms, since the pecuniary externalities are not internalized by, for example, vertical mergers.[15] Union wage policy may worsen this coordination failure, which is the very reason for the potentially considerable effects of policies aiming at deregulating the labor market.[16]

However, the large potential costs arising from high union wages in key industries also imply that there are large potential gains from centralization of wage bargaining. Indeed, the model shows that when the union is an encompassing union eliminating the wage differential between upstream and downstream labor, the union internalizes the wage externality and lowers its wage demands in return for a very large increase in industrial employment and, hence, a large increase in union membership.

Government policies may then aim at weakening the unions or try to accomplish a centralization of collective bargaining to prevent wage inequalities which might impede development.[17] Centralization of collective bargaining might be difficult to implement in practice, since it requires that coalitions of heterogenous agents have to be formed on both the employer- and the union side.[18] A deeper understanding of the relationship between different wage-setting institutions and economic development, however, requires a more elaborate framework which also models government behavior and the interaction within coalitions more explicitly. I believe that the type of model used in this paper could be

[15] Such internalization may fail to materialize, partly because the scope of the linkages may be considerable, but also because the incentives for an individual firm to take these "positive feedbacks" into account, are much smaller than the social benefit.

[16] High union wages is only one factor among several which may preserve the economy in a low-level equilibrium. As is shown in Venables (1996), import substitution policies through tariffs on imported inputs may also reduce industrial output by increasing downstream costs.

[17] It is then interesting to note that among the East-Asian NIC countries, wages have remained at market clearing levels and wage inequalities due to segmentation have been absent during their transition (World Bank (1993)). In Singapore, the government has used a "wage-correction" policy (Fields (1992)).

[18] As argued by Lindbeck (1997), conflicts may arise within organizations rather than between peak organizations which may lead to a situation where centralized bargaining is not sustainable.

fruitfully applied for such a task.

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A Appendix:

First, I briefly derive the union wage in the firm-level bargaining. Then, I show under what conditions multiple equilibria arise. Finally, I derive conditions for which centralized bargaining leads to industrialization.

A.1 The union wage in firm-level bargaining

Proof. The first-order condition for (13) is:

$$\left(\frac{U(w)}{U(w)-\bar{U}}\right)\left(\frac{1-c}{c}\right)\eta=\beta\left(\frac{\Pi(w)}{\Pi(w)-\bar{\Pi}}\right), \tag{A.1}$$

where $\varepsilon=-\frac{dL}{dw}\frac{w}{L}$, $\beta=-\frac{d\Pi}{dw}\frac{w}{\Pi}$ and where:

$$\eta=\frac{dU}{dw}\frac{w}{U}=\frac{\theta w}{w-\bar{w}}-\gamma\varepsilon \tag{A.2}$$

Note that $c\in(0,1)$, implies that $U(w)-\bar{U}>0$ and $\Pi(w)-\bar{\Pi}>0$. This ensures that $w>\bar{w}$ and $\eta>0$. Furthermore, totally differentiating (A.1), it can be shown that:

$$\frac{dw}{dc}=-\frac{\frac{w}{1-c}}{\beta\left(\frac{\bar{\Pi}}{\Pi(w)-\bar{\Pi}}\right)+\varepsilon\left(\frac{\bar{U}}{U(w)-\bar{U}}\right)+\frac{1}{\eta}\left(\frac{\theta w}{w-\bar{w}}\right)\left(\frac{\bar{w}}{w-\bar{w}}\right)}<0 \tag{A.3}$$

■

A.2 Multiple equilibria

Proof. First, define the inequality (A.4):

$$a\sigma+(1-\sigma)(1-b)>0 \tag{A.4}$$

Suppose there exists an equilibrium S_1 for which $Y<Y_C$. Then, if (A.4) holds, equilibria I and S_2 must also exist. To see this, define the elasticity $EL_Y P^D=-\frac{\partial P^D}{\partial Y}\frac{Y}{P^D}$ and similarly $EL_Y P^S$. By calculation:

$$EL_Y P^D=\frac{1-a-b}{a},\qquad EL_Y P^S=\begin{cases}\frac{1}{\sigma-1} & if\ Y>Y_C\\ 0 & if\ Y\leqslant Y_C\end{cases} \tag{A.5}$$

Then, note that for any Y such that $P^D(Y) = P^S(Y)$, it must be that:

$$EL_Y P^D - EL_Y P^S = \begin{cases} -\frac{a\sigma+(1-\sigma)(1-b)}{(\sigma-1)a} & if\ Y > Y_C \\ \frac{1-a-b}{a} > 0 & if\ Y \leqslant Y_C \end{cases} \tag{A.6}$$

From the existence of S_1 and the segmented shape of the supply price curve (12), it then follows that a second equilibrium I exists if (A.4) holds. This is easily seen in figure 2, since (A.4) implies that $EL_Y P^D - EL_Y P^S < 0$, which, in turn, ensures that the demand price curve intersects the supply price curve from above at I. Due to profit-maximizing behavior, there must also exist a third equilibrium S_2 at which $P^D > P^S$. ■

Moreover, it should be noted that (A.4) is directly related to the strength of the demand- and cost linkages (cf. equations (10), (11), (12) and (6)). Intuitively, the demand linkage is stronger when intermediate inputs are relatively important in final-good production. This comes at a large cost-share of intermediate inputs a and a smaller cost-share of capital b, which translates into a more elastic, or flatter, demand price curve $P^D(Y)$[19]. Furthermore, at a smaller substitution elasticity σ, downstream firms value variety in intermediate inputs more highly, as efficiency is enhanced in a more pronounced way by additional inputs. As upstream entry occurs in response to an increase in demand from downstream firms, the price index P will decrease at a greater rate, thus producing a stronger cost-linkage. This translates into a less elastic, or steeper, supply price curve $P^S(Y)$[20]. Indeed, both these prerequisites - an elastic demand price curve and an inelastic supply price curve - are more likely to ocurr when condition (A.4) holds.

A.3 Proposition 3

Proof. To show that proposition 3 is true, we need only show that the central union and the employer federation prefer a union wage below the critical wage $\tilde{w}$, defined by (18).

[19] A given decrease in the price index P results in a larger expansion of final output.

[20] A given increase in final output Y results in a larger decrease in the price index P.

Without loss of generality, suppose the parties are contemplating two alternative wages: $w_1 \geq \tilde{w}$ associated with low-level equilibrium S_1 and $w_2 < \tilde{w}$ associated with $\tilde{S}_2$ in figure 4. To assure positive union utility, both wages exceed the competitive wage $\bar{w}$. To summarize:

$$w_1 > w_2, \qquad w_1 \geq \tilde{w} > \bar{w}, \qquad w_2 \in (\bar{w}, \tilde{w}) \tag{A.7}$$

The *employer side* will always prefer w_2: Downstream firms benefit from lower input prices, since (i) wage costs are lower $w_2 < w_1$ and (ii) the price of the aggregate input good X is lower, $P^S_{\tilde{S}_2}(Y) < P^S_{S_1}(Y)$. The latter follows directly from substituting the competitive wage $\bar{w}$ for the union wage w in equation (12) and noting that $w = w_1$ leads to equilibrium S_1 and $n = 0$, whereas $w = w_2$ leads to equilibrium $\tilde{S}_2$ and $n > 0$. Furthermore, since $P^D > P^S$ holds in $\tilde{S}_2$, we know from section 2.3 that upstream firms make nonzero profits, $\pi_x(\tilde{w}) > 0$.

Turning to the *union side*, note that the source of union employment in S_1 is $L_{Ind}(w_1) = L_Y(w_1)$. On the other hand, in $\tilde{S}_2$, union employment is $L_{Ind}(w_2) = L$. The central union then prefers w_2 whenever $U(w_2) > U(w_1)$. Using the above information and the union's preferences defined in (19), this condition can be written as:

$$(L)^{\gamma} (w_2 - \bar{w})^{\theta} > (L_Y(w_1))^{\gamma} (w_1 - \bar{w})^{\theta}$$

Rearranging, we have that:

$$\frac{L}{L_Y(w_1)} > \left(\frac{w_1 - \bar{w}}{w_2 - \bar{w}} \right)^{\frac{\theta}{\gamma}}$$

Hence, if the union values employment sufficiently (i.e. when $\frac{\theta}{\gamma}$ is sufficiently low) and the economy is sufficiently large (in terms of L), the central union prefers the lower wage, $w_2 < w_1$. ■