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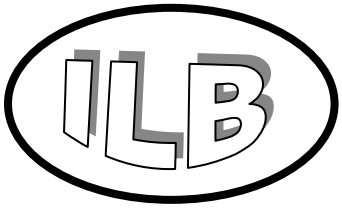

Outsourcing and Offshoring: Sector Implications for Dynamics, Growth, and Sustainability

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Abstract

As national economies have integrated through removal of trade barriers, the potential for offshoring production was quickly recognized as a strategy to enhance firm performance. At the same time, labor market reforms opened the door for outsourcing of labor services to specialist firms that supply labor force teams. The implications of these trends for industries that rely on specialized workforces have drawn considerable attention. Both manufacturing and food processing have seen substantial movement toward oursourced labor, yet little research has considered the implications of these trends. In both manufacturing and food processing, specific labor skills are needed that require training and consistency of supply to ensure efficiency in raw material and plant capacity utilization. Hiring from local labor force in the short-run involves search, training, and adjustment costs. In the longer-term, a sustainable labor pool must be developed and nutured. Hiring through outsourced labor services firms involves a distinctly different cost structure and longer-term dynamics play a different role and performance for the employer as well as the local labor force. Individually, firms face a choice between hiring from a local labor force or outsourcing that task to a specialist firm. Within a labor market, firms competing for labor from the same pools have joint interests in maintaining a sustainable labor force while they compete to fill their demands. However, as some firms initiate use of outsourced labor, the local labor force may be impacted. This issue has not been considered and is taken up by this paper. The paper presents a microeconomic model and uses simulation to evaluate the implications of increased labor service contracting on sustainability of the local labor force. In particular, our results show that as contracted external labor increases, the local labor pool decreases and search costs increase rendering local labor at less attractive choice for employers. A threshold is identified in terms of extent of local labor employment at which the viability of local labor employment collapses. We show that even before this threshold is met, the labor force benefits of the location vanish, reducing the locational rationale for the employer to natural resource access, output market proximity, and fixed investments in plant and equipment. The marginal benefits of the location based on these factors may then be outweighed by those available at other locations and the firm may relocate. We conclude with consideration of implications for labor force policy targeted at sustaining particular industries.

Keywords: *Labor force, Offshoring, Outsourcing, Food System, Sustainability*

1. Introduction

Three aspects of opening of trade barriers have potential effects on labor markets: outsourcing of production or services, insourcing of production or services, and outsourcing of labor services. As national economies have integrated through removal of trade barriers, the potential for offshoring production was quickly recognized as a strategy to enhance firm performance. While the popular press cited this potential as a threat to local national employment levels, economists

argued that removal of trade barriers would result in reallocation of production to regions with greatest competitive advantage and result in reduction of costs of production and globally optimal use of limited resources. The potential nature of these effects has resulted in a hot debate, see e.g. Samuelson (2004) and Blinder (2005) who warn of substantial negative effects and Bhagwati, Panagariya and Srinivasan (2004) and Grossman and Rossi-Hansberg (2008) who have noted potential benefits. These arguments overlooked benefits from parsing and spatial reconfiguration of processes that could allow for substantial cost reduction through spatial placement of component processes as well as through configuration of component processes in parallel forms that could substantially reduce lead time in operations. The net result of such reconfiguration has been noted as substantial cost reduction in delivering final products as well as strategic flexibility is responding to the heterogeneity as well as dynamics of consumer demand. The indirect implications of these changes in product and service process location for labor markets has received considerable analysis. Liu and Trefler (2008) provide recent analysis of the effects of outsourcing and insourcing of services and find evidence of only small effects that tend to cancel.

In addition to trade policy reforms, labor market reforms opened the door for outsourcing of labor services to specialist firms that supply labor force teams. The combination of these trade and labor market reforms has resulted in dramatic change how labor is procured in most industries and across many occupations. Labor outsourcing through contracting of external labor from subnational regions and from foreign sources has become a dominant practice in both in the U.S. and globally in many occupational categories and many industries including agriculture, hospitality, manufacturing, food processing, and even medical services. Agriculture drew considerable attention as external labor was brought into the U.S. to service seasonal demands in fruit, vegetable, and nut processing, see Martin (2005). However, such periodic excess demand situations have long been serviced through special exception legislation over long periods of time when shortage of supply occurred during war time or periods of demographic adjustment. The scope of use of recruitment of labor from external markets is noted by Milner and Pinker (2007) as including services such as engineering, health care, and production of military materials. Dey et al.(2006) note the effects of this outsouring of labor services in U.S. manufacturing as accounting for nearly a 5% expansion in manufacturing employment during the 1990s, a period when overall direct-hire manufacturing direct employment declined 4.1%. By 2004, they note such outsourced labor added an estimated 8.7% to direct-hire labor, nearly 4 times its contribution in 1989.

The implications of these trends for industries that rely on specialized workforces have drawn considerable attention. Both manufacturing and food processing have seen substantial movement toward outsourced labor, yet little research has considered the implications of these trends. In both manufacturing and food processing, specific labor skills are needed that require training and consistency of supply to ensure efficiency in raw material and plant capacity utilization. Little data is available for outsourcing at the farm level, however, it is likely to growing as well. Hiring from local labor force in the short-run involves search, training, adjustment, and retainment costs. In the longer-term, a sustainable labor pool must be developed and nutured to meet projected demand that may often have a high degree of volatility. Hiring through outsourced labor services firms involves a distinctly different cost structure and longer-term dynamics play a different role. Individually, firms face a choice between hiring from a local labor force or outsourcing. Within a labor market, firms competing for labor from the same pools have joint interests in maintaining a sustainable labor force while they compete to fill their demands.

This paper considers the economics of this problem and focuses on the implications of increased labor service contracting on sustainability of the local labor force. In particular, our results show that as contracted external labor increases, the local labor pool decreases and search costs

increase rendering local labor at less attractive choice for employers. A threshold is identified in terms of extent of local labor employment at which the viability of local labor employment collapses. We show that even before this threshold is met, the labor force benefits of the location vanish, reducing the locational rationale for the employer to natural resource access, output market proximity, and fixed investments in plant and equipment. The marginal benefits of the location based on these factors may then be outweighed by those available at other locations and the firm may relocate. The paper first reviews available evidence of the extent of outsourcing of labor services. Next, the paper identifies the salient features of the outsourcing of labor services and its implications for performance. Drawing on this early discussion, the paper presents a simulation model that considers conditions for sustainability of competitiveness of production.

2. Past Literature

Outsourcing is most often considered with respect particular functions or processes of an enterprise. Key among these functions involves human resources and the recruitment, training, and retainment of a employees to ensure labor that allows full utilization of capacity while at the same time flexibility in adjusting processes to meet changing demand. Imperfections in labor markets imply that a substantial element of the cost of procuring labor services follows from search processes. Where education or other preparation is a prerequisite of employment and demand varies over time, substantial periods of excess demand may exist, see e.g. Ryoo and Rosen (2004). In the engineering market during the 1970s, this resulted in labor services outsourcing by U.S. defense contractors to expand the U.S. supply of engineers with external supply. Changes in trade policy and regional economic integration of labor markets can result in substantial increases in the supply of labor available to a local labor markets as occurred when Germany's labor markets were opened to labor supplies of former eastern bloc states, see. Geishecker (2006). In the U.S., as the labor force has become more highly educated, the labor force prepared for lifelong positions in many occupational categories in manufacturing and service supply has declined increasing search and training costs. In each of these cases, local market employers have found reason to outsource labor procurement to labor services firms. These specialist firms offer recruitment and training at costs not achievable by employers in many industries.

From the firm perspective, outsourcing is not new but instead lies at the root of the specification of the boundaries of the firmin the buy-make decision. If the firm is viewed as an internalized set of processes that create value through external sales of products or services, a wide ranging literature has considered the organization of such a firm from technological, strategic, institutional, and informational perspectives. From a strategic perspective, Grossman (2002) develops an equilibrium model of industrial structure for fully or partially specialized inputs. They analyze the trade-off between vertically integrated firms that can manufacture all the components they need with a relatively high cost of governance and specialized companies that are able to make a specific component at low cost but have to search for buyers and partners. Shy (2005) specifies an equilibrium of partial outsourcing which requires monitoring cost when the final product needs a large number of heterogeneous inputs. Alvarez (2007) extends Shy (2005) though considers the case where multiple sources exist that enable partial outsourcing. They formulate the firm's outsourcing problem of how to decide the timing and quantity of outsourcing to maximize the firms' profit using a general state variable imposing multiplicative shock to the profit flows. According to their model, the firm has to make an irreversible investment in order to benefit from the advantages of (partial) outsourcing. Given the irreversibility of the decision, optimal thresholds for timing of outsourcing are considered. Tsai (2007) use a mathematical programming approach to develop a joint products decision model incorporating capacity ex-

pansion and three particular outsourcing conditions: two types of capacity expansion (Stepwise process-level activity cost and Piecewise direct labor cost), and one type of asset specificity (Stepwise cost of asset specific). Using this model, firms that produce joint products can make optimal decisions about capacity expansions or outsourcing under the situation in which there is lack of sufficient capacity to meet market demand. Stahler (2007) considers outsourcing as well as foreign direct investment. Outsourcing is shown to require costly training and create a positive spillover. Geishecker (2006) empirically finds international outsourcing considerably reduces individual employment security across most skill levels though finds some variation with employment duration (tenure). Manasse (2004) shows firm-level evidence that the relative stability of the aggregate wage premium and employment share hides offsetting disaggregate forces: technical progress raises the relative demand for skilled labor within firms, whereas demand changes associated with trade reduces the relative demand for skills in Italian manufacturing during the nineties. Moreover, most actions take place within the class of non-manual workers: The wage premium of executives increases substantially while that of clerks decreases. Thus, the authors claim that the labor market in Italy looks rigid but it's not indeed. They used data for the study as follows: non-manual wage bill share; skill premium; skill intensity; average wage; employment; non-manual employment; etc. Yashiv (2007) analyze U.S. labor market dynamics by utilizing discrete labor force flow model and data obtained from two main sources: the Current Population Survey (CPS) and the Job Opening and Labor Turnover Survey (JOLTS). Yashiv tries to clarify U.S. labor market dynamics by (i) listing data facts that can be agreed upon; (ii) presenting the business-cycle facts of key series; (iii) pointing to specific gaps in the data picture (Note: This might be a good example of how to utilize labor flow model to analyze a specific labor market using real data). Ghosh (2007) does theoretical work connecting internal-labor-market wage and promotion practices with turnover outcomes. In more detail, Ghosh (2007) incorporate wage and promotion dynamics with turnover in a single model. Calvo et al. (2007) present wage and employment dynamics model in network setting. In their model, agents can hear about jobs through the social network. Also, they analyze the agents' decisions of staying or leaving the job market.

3. The Model

We consider a firm that may hire workers in a particular occupation from a local labor force or the firm may outsource that labor procurement to a labor services firm that draws from an external labor market. We consider these labor types to be perfect substitutes in production though they involve cost structures that differ in wages, search costs, transistion costs, and training costs. Search within the local labor market is conditional on size of the labor force. We limit our focus in this paper to the case where wages are exogenous to the firm and infrastructure is exogenous.

Define wages as w_k for the local labor and w_f for labor supplied by a labor services contractor from sources that are external to the local labor market. If the local labor market is limited to a commuting area, then the external market would include both subnational and foreign sources. If, instead, we consider the local market to be a national labor market, then the external market would include only foreign labor markets. We suppose both wage rates are exogenous to the employer. We suppose the firm attempts to maximize the profit, $\pi(t)$, over time recognizing dynamics in the processes under management, i.e.

$$\max J = \int_{t_0}^{\infty} e^{-\delta t} \pi(t) dt \tag{1}$$

where $e^{-\delta t}$ is a discount factor. The firm produces a single output $y(t)$ that is marketable in a

competitive market for price p and produced at total cost $c(t)$ at time t. The profit at time t, $\pi(t)$ is defined as:

$$\pi(t) = py(t) - c(t) \quad (2)$$

where we assume the price, p, is exogenous due to the small size of the firm. The output, $y(t)$, is

$$y(t) = \alpha q^{\gamma_q} s^{\gamma_s}(t) x^{\gamma_x}(t) \quad (3)$$

where αq^{γ_q} reflects the exogenous state of productivity of the technology, s indicates labor force training effort that augments the productivity of labor, and x is the total labor employed, equal to the sum of labor drawn from local market $x_k(t)$ and the external market $x_f(t)$ as supplied by the labor services contractor. Thus, employment is written:

$$x(t) \equiv x_k(t) + x_f(t) \quad (4)$$

and the instantaneous change for each employment type is defined as:

$$d_k(t) \equiv \frac{dx_k(t)}{dt} \quad (5)$$

$$d_f(t) \equiv \frac{dx_f(t)}{dt} \quad (6)$$

where $d_k(t), d_f(t) \in \mathrm{P}$. Total cost of production involves wages, but also adjustment, recruitment and training costs:

$$\begin{aligned} c(t) &= w_f x_f(t) + w_k x_k(t) \\ &\quad + c_f(t) d_f(t) + c_k(t) d_k(t) + r s_k(t) + w_s s(t) \end{aligned} \quad (7)$$

where w_f and w_k are wage rates in the external and local market, respectively, $c_f(t)$ and $c_k(t)$ are the unit costs of adjustment associated with change in employment from the external and local markets, respectively, $s_k(t)$ is effort applied at unit price r for local market recruitment, and w_s is the unit cost of employee training. We consider only one occupational type (job level). We define the local labor force available for hire at time t, $x_p(t)$ as the number of people who are currently working plus those unemployed but willing to work:

$$x_p(t) \equiv x_k(t) + u_k(t)$$

where u_k is the local unemployment at time t. Search costs c_k and c_f are specified as varying with the extent of new hiring, and local market search costs are conditional on the extent of unemployment:

$$c_k(t) = \varepsilon_k d_k u_k^{\alpha_k}(t) \quad (8)$$

$$c_f(t) = \varepsilon_f d_f(t) \quad (9)$$

where ε_k and ε_r unit costs that exogenous to the firm and $\alpha_k < 0$. The dynamics of the local

force are specified as conditional on local market recruitment, the wage rate relative to a reservation wage $\underline{w}_k$, and unemployment: Our specification here deserves comment. We suppose labor force dynamics are driven by three forces. First, we specify that the local wage w_k in the occupation relative to the occupation's opportunity cost wage rate $\underline{w}_k$ has a positive effect on labor force. Second, we specify that specific recruitment effort s_k positively affects labor force growth. Finally, we specify an immiserating effect of local unemployment. That is, as local unemployment in the occupation increases, we specify that workers leave the occupation, despite any wage advantage. This is consistent with observed effects of unemployment on occupational choice.

$$\dot{x}_p^r(t) \equiv \lambda_w(w_k - \underline{w}_k) + \lambda_s s_k^{\beta_k}(t) + \lambda_k u_k^2(t) \quad (10)$$

where λ_w, $\lambda_e \in \mathrm{P}^+$, $\lambda_k \in \mathrm{P}^-$ and

$$\frac{dx_p(t)}{dt} = \dot{x}_p^r(t) \quad (11)$$

Finally, we assume that the scale of the external labor market is competitive and not influenced by the firm's decisions.

We consider types of sustainability constraints on the firm. Initially, we suppose this threshold is defined by political and social processes exogenous to the industry. We follow this case with consideration of the optimal threshold. Second, we require that the firm does not operate at a loss in any time periods. To consider local labor force viability, we define $\underline{x}_p$ as floor above which the local labor force must be maintained. Thus, the sustainability and viability constraints are:

$$R(t) = py(t) - c(t) \geq 0 \quad (12)$$

$$\underline{x}_p \leq x_p(t) \quad (13)$$

4. Analytical Solution

We apply the general maximum principle to consider analytic solution of the model summarized as:

$$\max J = \int_{t_0}^{\infty} e^{-\delta t} \pi(t) dt \quad (14)$$

Subject to

$$\frac{dx_p(t)}{dt} = \lambda_w(w_k - \underline{w}_k) + \lambda_s s_k^{\beta_k}(t) + \lambda_k u_k^2(t) \quad (15)$$

$$\frac{dx_k(t)}{dt} = d_k(t) \quad (16)$$

$$\frac{dx_f(t)}{dt} = d_f(t) \quad (17)$$

$$x_k(0) \;=\; x_{k0}, x_f(0) = x_{f0}, x_p(0) = x_{p0}, s(0) = s_0 \quad (18)$$

where x_{k0}, x_{f0}, x_{p0} and e_0 are given. Before proceeding, we summarize the model's partition of variables into state and controls as follows:

$$\text{StateVariables} \;:\; x_k(t), x_f(t) \text{ and } x_p(t)$$
$$\text{ControlVariables} \;:\; d_k(t), d_f(t), s_k(t) \text{ and } s(t)$$

The Hamiltonian for our problem is as follows:

$$H = e^{-\delta t}\pi + \lambda_1\left(d_k + \lambda_w\left(w_k - \underline{w}_k\right) + \lambda_s s_k^{\beta k} + \lambda_k u_k^2\right) + \lambda_2 d_k + \lambda_3 d_f$$

where λ_1, λ_2 and λ_3 are adjoint variables for the state dynamics. The maximum principle requires

$$\begin{bmatrix} d_k \\ d_f \\ s_k \\ s \end{bmatrix} = \arg \begin{bmatrix} \dfrac{\partial H}{\partial d_k} \\ \dfrac{\partial H}{\partial d_f} \\ \dfrac{\partial H}{\partial s_k} \\ \dfrac{\partial H}{\partial s} \end{bmatrix} \quad (19)$$

Consequently, maximum principle (19) can be stated as:

$$e^{-\delta t}\{(-w_k + ps^{\gamma s} q^{\gamma q} \alpha\gamma_x x^{-1+\gamma_x})d_k - c_k\} + \lambda_1 + \lambda_2 \;=\; 0 \quad (20)$$

$$e^{-\delta t}\{(-w_k + ps^{\gamma s} q^{\gamma q} \alpha\gamma_x x^{-1+\gamma_x})d_f - c_f\} + \lambda_3 \;=\; 0 \quad (21)$$

$$e^{-\delta t} r + \beta_k \lambda_1 \lambda_s s_k^{-1+\beta_k} \;=\; 0 \quad (22)$$

$$-w_e + e^{-\delta t}\gamma_s s^{-1+\gamma_s} \alpha p q^{\gamma_q} (x)^{\gamma_x} \;=\; 0 \quad (23)$$

and the adjoint dynamics as:

$$\frac{d\lambda_1}{dt} \;=\; -\frac{\partial H}{\partial x_p} \quad (24)$$

$$\frac{d\lambda_2}{dt} \;=\; -\frac{\partial H}{\partial d_k} \quad (25)$$

$$\frac{d\lambda_3}{dt} \;=\; -\frac{\partial H}{\partial d_f} \quad (26)$$

and (24)-(26) become

$$\frac{d\lambda_1}{dt} \;=\; w_k - ps^{\gamma s} q^{\gamma q} \alpha\gamma_x (x)^{-1+\gamma_x} \quad (27)$$

$$\frac{d\lambda_2}{dt} \;=\; -\lambda_1 - \lambda_2 + c_k \quad (28)$$

$$\frac{d\lambda_3}{dt} \;=\; -\lambda_3 - c_f \quad (29)$$

To proceed, the solution is derived by solving (27)-(29) together with the transversality conditions:

$$\lambda_1(t_f) = 0 \quad (30)$$

$$\lambda_2(t_f) = 0 \quad (31)$$

$$\lambda_3(t_f) = 0 \quad (32)$$

While our model highlights the structure of the problem faced by firms looking to outsource or hir local labor, the model's complexity prevents further analysis at the theoretic level. While substantial simplification could render it tractable for traditional comparative-dynamics, we choose instead to illustrate its properties using simulation based on a specific parameterization intended to illustrate a typical industrial setting.

5. Example

5.1 Case 1. Local labor replaced with outsourced labor

For this case, we specify the local wage to be three fold the external wage, and local market recruitment effort is expensive (nearly equal to the external wage rate).

	p	q	α	γ_q	γ_s	γ_x	w_k	w_f	$\underline{w}_k$	r	w_s
Values	100	6	5	0.2	0.3	0.3	15	5	8	5	0.2

	ε_k	ε_k	α	λ_w	λ_s	λ_k	β_k
Values	16	5	-0.8	2	2	-0.001	2

and use initial values for controls as follows:

	x_p	x_k	x_r	s
Values	200	50	50	50

The result graphs are as follows. In Figures 1.a and 1.b, employment dynamics show that while local labor is initially employed, it is rapidly replaced with external labor. This substitution occurs rapidly, though with a nonlinear time path as illustrated in Figure 1.b. Steady-state employment is reached at $x = x_f = 1094$ at $t = 96$. Figure 1.c illustrates the immiserating effects the dynamics on the local labor force, as local labor is replaced with external sourced labor the labor force is reduced to a steady-state (125 units) and all are unemployed. The model

allows for recruitment of local labor and training. As illustrated in Figure 1.d, for this case $s_k = 0$, local labor recruitment is not profitable. However, effort for training that affects both local and external labor is profitable and training converges to a steady-state of $s = 100$. This training increases the productivity of labor which in the steady-state is entirely external labor.

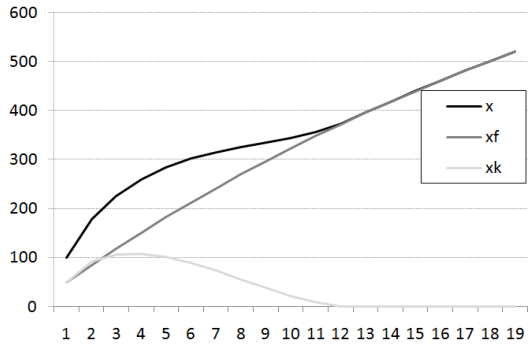

Figure 1.a Labor Trend over Time

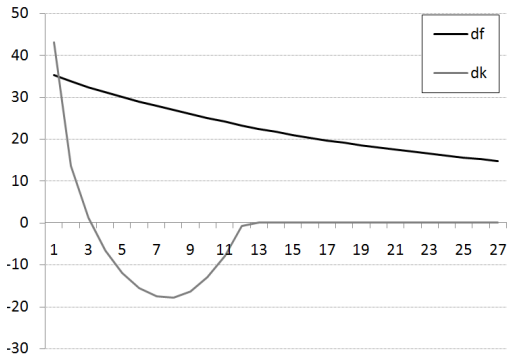

Figure 1.b d_f and d_k over Time

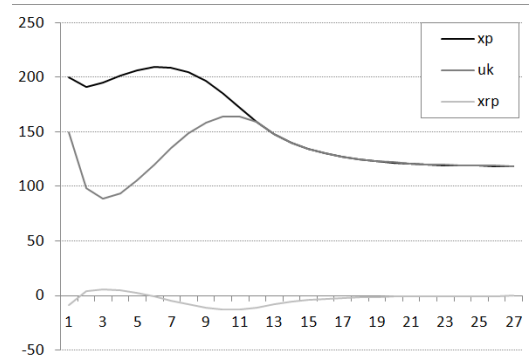

Figure 1.c Pool, Unemployment, and Rate Change in Pool over time

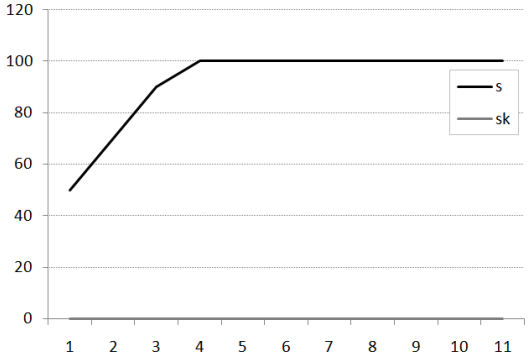

Figure 1.d Effort and Training over Time

5.2 Case 2. Local labor partially replaced with outsourced labor, unemployment results in occupational shift

For this case, we specify the local wage to be only slightly higher then the external wage, and local market recruitment effort as fivefold less expensive.

	p	q	α	γ_q	γ_s	γ_x	w_k	w_f	$\underline{w}_k$	r	w_s
Values	100	6	5	0.2	0.3	0.3	9	8	8	1	0.2

	ε_k	ε_k	α	λ_w	λ_s	λ_k	β_k
Values	16	5	-0.8	2	2	-0.001	2

and use the same initial values for controls as in Case 1.

The result graphs are presented below and illustrate how even with a relatively smaller wage differential, substitution of external for local labor occurs. In Figures 2.a and 2.b, employment dynamics show that while local labor is initially employed, it is rapidly replaced with external labor. However, in this case, local labor is retained in employment though substantial unemployment characterizes the steady-state. This substitution occurs more slowly than in Case 1 and follows a nonlinear time path as illustrated in Figure 2.b. In Figure 2.c and Figure 2.d it is clear that total employment is reduced to a steady state scale below initial values, however, the labor force is solely composed of external labor. Under this parameterization, no effort is devoted to local laborforce recruitment. Similar results follow as the local wage is reduced to equal the wage for external labor. In all cases, we see the effect of unemployment of local labor on the reduction of the local labor force as specified in equation (10). Although the labor force initially expands due to the local wage being greater than the opportunity cost wage, unemployment expands and results in a discouragement of workers who drop out of the labor force by moving to other occupations.

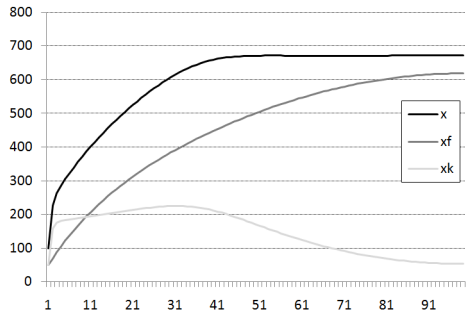

Figure 2.a Labor Trend over Time

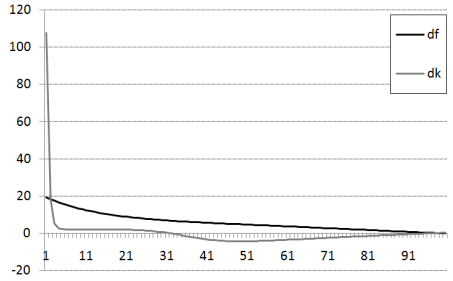

Figure 2.b d_f and d_k over Time

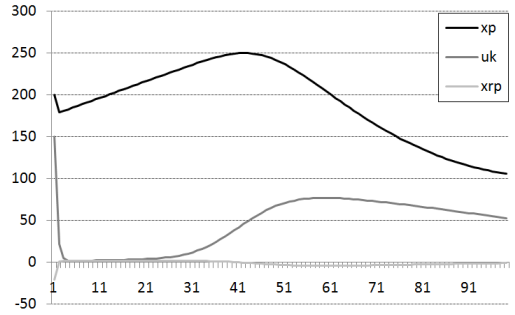

Figure 2.c Pool, Unemployment, and Rate Change in Pool over time

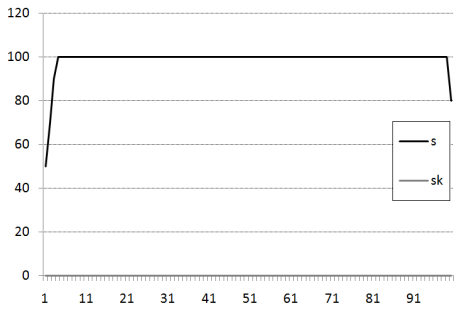

Figure 2.d Effort and Training over Time

5.3 Case 3. Local full employment

For this case, we specify the local wage to be only slightly greater than the external wage, and local market recruitment effort cost is retained at the level considered in Case 2.

	p	q	α	γ_q	γ_s	γ_x	w_k	w_f	$\underline{w}_k$	r	w_s
Values	100	6	5	0.2	0.3	0.3	8.01	8	8	1	0.2

	ε_k	ε_k	α	λ_w	λ_s	λ_k	β_k
Values	16	5	-0.8	2	2	-0.001	2

and initial values for controls used in Case 1 are adopted.

The result graphs are as follows. Not unexpectedly, local employment in increased in the steady-state relative to Case 2, see Figures 3.a and 3.b. In this case, local full employment is achieved. However, because local labor force recruitment is costly, it is set to zero and as the local wage is nearly equal to its opportunity cost, the labor force is not explanded. The expansion of use of external labor occurs rapidly, though with a nonlinear time path as illustrated in Figure 3.b. In Figure 3.c it is clear that total employment is reduced to a steady state scale below initial values, however, the labor force is solely composed of external labor. In order to explore the robustness of this type of result, we reduced $r = 0.10$ and found similar results.

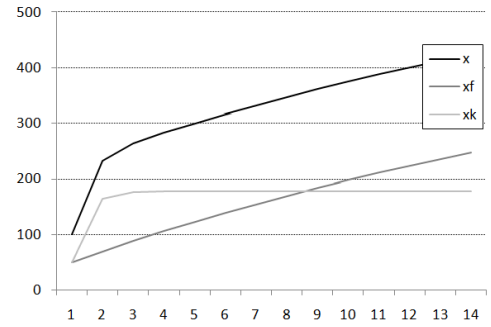

Figure 3.a Labor Trend over Time

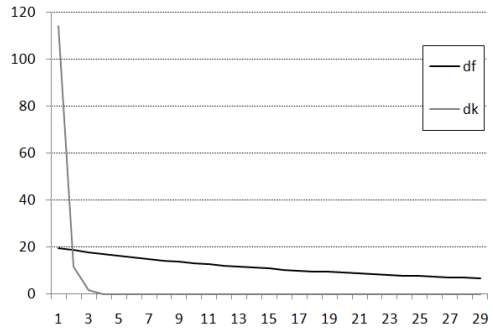

Figure 3.b d_f and d_k over Time

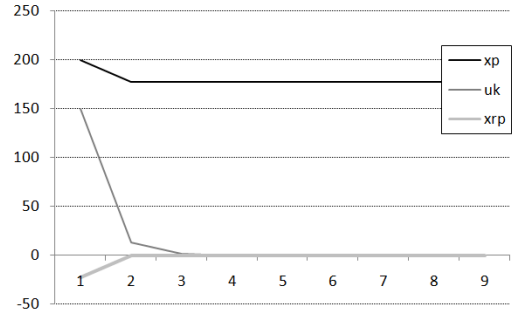

Figure 3.c Pool, Unemployment, and Rate Change in Pool over time

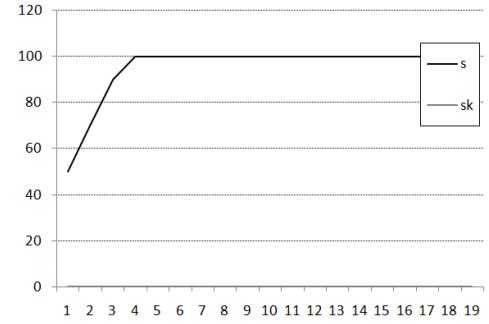

Figure 3.d Effort and Training over Time

6. Case 4. Local labor is discounted relative to external labor, occupational advantage retained.

In this case, we suppose local labor is less expensive than external labor. This could be induced through a tax of external labor, or a natural decline in the local wage to a level that is below the external wage, though greater than the local opportunity cost. As can be seen from Figure 4.a below external labor is initially accessed to expand employment however it is replaced with local labor as the local labor force expands due to attraction of new workers as a result of the local wage relative to the opportunity cost. A steady state is reached in time period 254. As is clear from the other panels, training is employed as well to expand the productivity of labor,

though no recruitment effort is applied. This result is robust as γ_s is reduced.

	p	q	α	γ_q	γ_s	γ_x	w_k	w_f	$\underline{w}_k$	r	w_s
Values	100	6	5	0.2	0.3	0.3	3	8	1.5	1	0.2

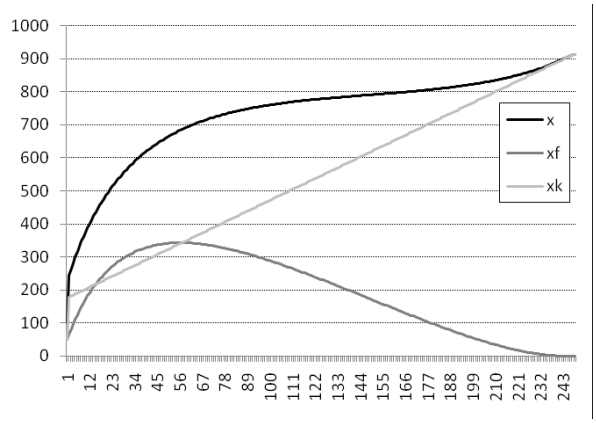

Figure 4.a Labor Trend over Time

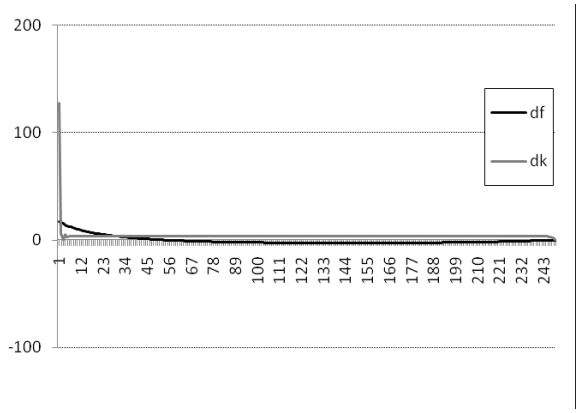

Figure 4.b d_f and d_k over Time

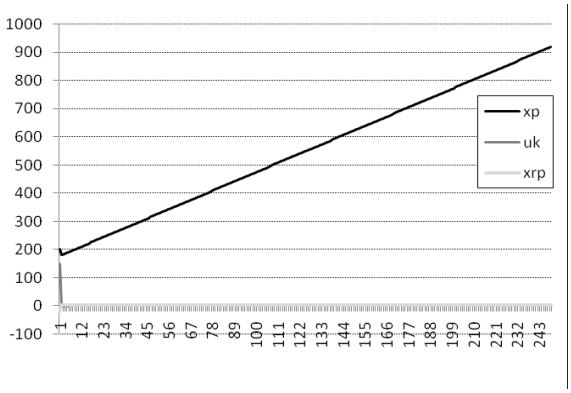

Figure 4.c Pool, Unemployment, and Rate Change in Pool over time

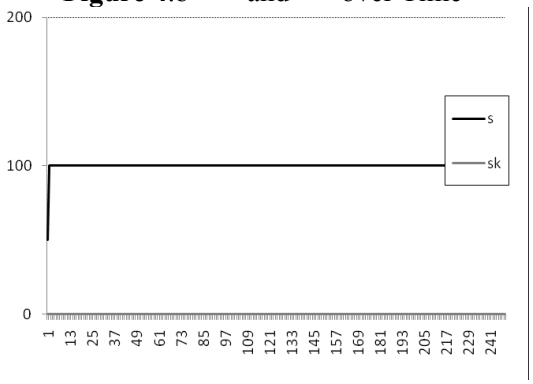

Figure 4.d Effort and Training over Time

7. Case 5. Local labor productivity enhanced relative to external labor

For this case, we consider the possibility that local labor policy encourages local labor biased technology or training that results in local labor being more productive than external labor. Specifically, we differentiate the productivity of local vs. external labor such that external labor is 20% less productive than local labor. Here, we see local labor being fully employed again with local labor force growth due to the wage rate being greated than the opportunity cost rate.

	p	q	α	γ_q	γ_s	γ_x	w_k	w_f	$\underline{w}_k$	r	w_s
Values	100	6	5	0.2	0.3	0.3	9	8	8	1	0.2

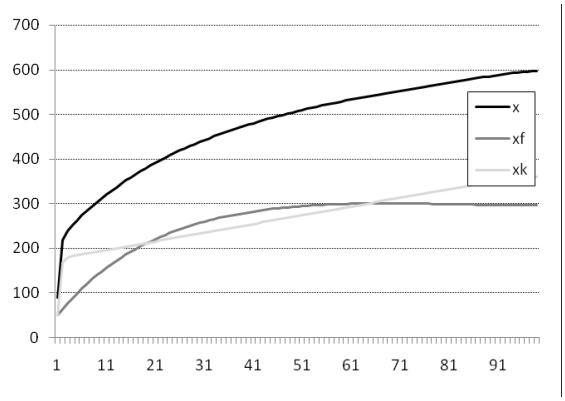

Figure 5.a Labor Trend over Time

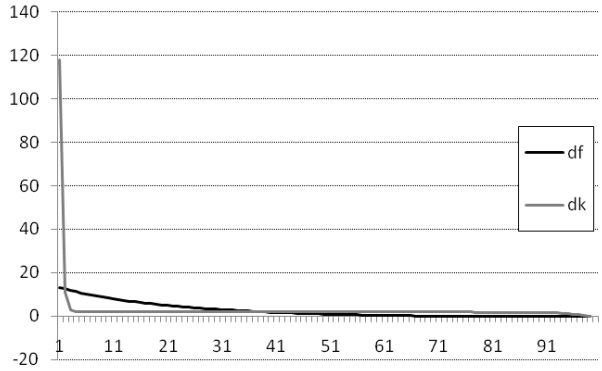

Figure 5.b d_f and d_k over Time

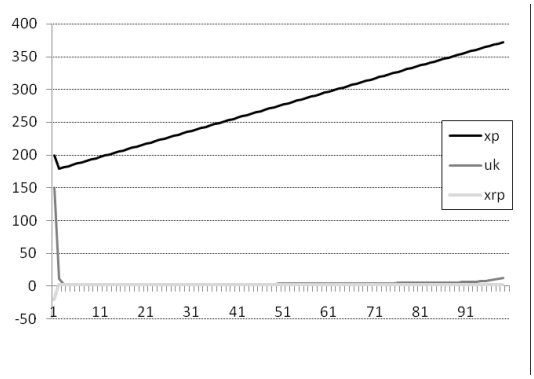

Figure 5.c Pool, Unemployment, and Rate Change in Pool over Time

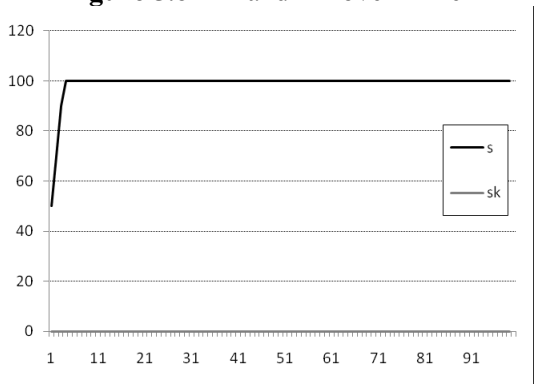

Figure 5.d Effort and Training over Time

8. Conclusions

This paper illustrates the conundrum associated with use of contracted labor from external markets. From the local firm's perspective, if labor force recruitment is costly, effort to recruit local labor will not always be economic. Instead, outsourcing search, recruitment, and training to a labor services specialist firm may be very attractive. This paper shows, however, that as firms pursue this strategy, the local labor force is impacted such that costs of local labor are driven up, making use of external labor more attractive. We show that two policies can be pursued to support sustainability of the local labor force, 1) tax and subsidy policy, and 2) augmentation of local labor force productivity through capital investment, technological change, or publically supported education and training, Further work underway will consider the presence of alternative internal labor markets to which local labor can switch, endogenous internal wage rate, and relocation of the firm into the external market.

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