Monitoring Labor Standards in a Macroeconomic Context

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Abstract

This paper considers the problem of independent monitoring of labor standards in developing countries. Using a consumer flow optimal control model embedded in a stylized CGE, it is shown that the effects of improving labor conditions are dependent upon macroeconomic conditions and initial market share. A standard Washington Consensus policy environment is compared with more populist setting in which the there is government intervention to raise female wages. It is seen that the optimal degree of adherence to international labor standards depends on the initial market share as well as the evolution of capacity, an essentially macroeconomic variable.

1. Introduction

One of the most obvious inadequacies of the orthodox model is that consumers bear a bilateral, subject-object relationship to the goods they consume. As a result, the traditional outlook has been under a more or less sustained attack recently, especially in the environmental and applied microeconomic literature, as

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analysts consider the implication of consumer awareness of the conditions of production. Externalities appear to be far more prominent than has been recognized in the past and production and consumption are increasingly more integrated. Academic research reflects real concerns as expressed in society at large, from the anti-sweatshop movement in advanced countries to biodiversity in the Amazon. The critique of food and meat packing industries in the U.S., motivated by advances in the field of animal cognition, is a particularly graphic example of how consumers scrutinize the production process. In essence, Fuerbach's assertion that "you are what you eat" is refined in the late 20th and early 21st century to "you are what you eat eats."

This paper continues the effort to analyze policymaking in a context in which international labor standards have become a concern of at least some consumers. The study adapts an optimal control model of consumer dynamics to the case in which producers face a market partially conscious of the conditions under which their goods have been produced. But while the core model is microeconomic in nature, the setting is explicitly macroeconomic. We embed the customer flow model into a two-sector, dynamic structuralist macroeconomic model based on a social accounting matrix (SAM) for Korea for 1990. In this illustrative model, the traded goods sector is assumed to be dominated by a firm that maximizes profits subject to customer dynamics while the nontraded goods sector operates in the traditional structuralist fashion, with mark-up pricing and quantity adjustment. The resulting amalgam is studied via numerical simulations. The key question addressed is: to what extent should a progressive government promote monitoring of labor standards if it is concerned with general welfare, i.e., growth, employment, poverty and income distribution. The principal result of the paper is that sponsoring improved labor conditions in the traded good sector is an inherently complex project. Policies that are appropriate when market share is low can backfire when market share is higher and *vice-versa*. An attempt to promote higher labor standards through tax and wage policies, for example, may fail if policymakers are unable to properly assess the state of penetration of the market and the rate at which conscious consumers are likely to accumulate. Success in these predictions may stretch the competency of firms, not to mention government policymakers.

The paper is organized as follows. Section 2 frames the problem of labor standards from the perspective of consumers and develops, step by step, the consumer flow model. Section 3 presents the essential elements of the dynamic structuralist computable general equilibrium model. Section 4 considers several simulations, including a tax break for monitoring firms and a wage increase for female workers. The fifth section concludes. Both the social accounting matrix (SAM) and the GAMS program that was used to generate the simulations are included in the appendix.

2. The Micro Model

Labor standards in developing countries is a highly charged, often emotional issue. One on hand, activist consumers in developed countries may claim that "sweat-shop" conditions prevail on the shop floor and that some resistance in the form a partial consumer boycott of the final good is required. Activists feel that firms must improve working conditions, increase shop floor safety and security, shorten hours, ban child labor, and even institute collective bargaining so that products produced there do not carry the stain of exploited labor. Workers in developing countries may support foreign labor standards as a form of protectionism, justifying the demand on the grounds that there must be a "level playing field."

More cynically, the movement for higher labor standards may ally with protectionist forces, significantly diluting the inherent altruism of the project [3], [10]. Efforts to palliate working conditions in developing countries can, of course, hurt those they intend to help. If higher wage costs lead to lower employment, the nontraded goods sector can shrink, causing more unemployment, slower economy-wide growth, more poverty and a worsening distribution of income. But higher wages may also help and initial conditions most certainly matter. "Stagnationist" or wage-led growth models have led the debate stretching back to the early 1900s. The argument is a straightforward application of Keynes' principle of effective demand: for any given level of output, a redistribution of income from capital to labor will raise capacity utilization. With limited capital mobility, as in Korea in the 1970s and 1980s, higher wages may have stimulated capital deepening, thereby raising worker income and promoting development generally.[1]

What the older models lack is attention to the decision making process in an environment in which some consumers are concerned with the effect of *how* products are produced on the human beings that produce them. Firms that perceive a threat of boycott or reduced market share face a dilemma. On one hand they could try to improve working conditions, at higher costs in order to satisfy their consuming clientele. On the other hand, they may defer, wondering

[1] This point is due to Stephanie Seguino in private conversation.

why rational consumers are even interested, how *long* the movement might last, *who* the people are and *how* to find them.

Formally speaking, there is some basis in the rational model for the concerns these firms perceive. Shopfloor working conditions can be thought of as an "impure public good", a commodity with jointly produced public and private characteristics [1], [14]. Some, but not all, consumers are willing to pay a premium for impure public goods because of the "warm glow" effect they derive. Fair trade coffee is an example in which consumers express a preference for higher farm gate prices, cutting out middlemen, and enhanced "social justice" as they perceive it. There are many other examples, such as green electricity for which consumers pay a higher price for less polluting technology. Dolphin-safe tuna is also more expensive, but satisfies some consumers' desire to protect an intelligent and physically attractive species.

Workers in developing countries are not unlike dolphins, in this regard, and protecting their interests produces a warm glow good for some advanced country consumers. Unlike environmental public goods, however, consumers typically do not have the option of directly contributing to an alternative pure public good that would improve working conditions in LDCs. Consumers who want impure public goods must be matched to the firms who produce products with high labor standards.

Freeman and others have observed that it is difficult for consumers to assess shop-floor conditions [11]. Consumers are unable to infer product quality from higher prices and so the high labor standard goods are not *experience goods* [22]. They are rather "credence goods" whose characteristics or qualities cannot be determined before or even after use. [5] Consumers are forced to rely on claims made by producers about their working conditions which causes an informational asymmetry referred to above. Rational consumers discount claims because they are aware that firms have an incentive to misrepresent the nature of conditions under which the goods were produced. The market-for-lemons problem engenders a race to the bottom for worker's rights since most firms offer only the cheapest products produced under the worst working conditions. [2] Basu *et al.* point out that the prisoner's dilemma applies. [3]

Monitoring of labor conditions arose as essentially an information-based policy framework that can help remedy some of these market failures. Several institutions, governmental, NGOs and nonprofit organizations now provide certification for worker's rights. The credibility of the organization is the key factor, but once established, they provide the proper incentive for firms to upgrade their labor standards and in effect produce differentiated products. The advantages are clear; an independent audit carries more weight than the simple claim by the firms that conditions on the shop floor meet some standard. But the downside is equally obvious: to satisfy the social auditors, firms must incur the costs of shop-floor changes that are responsive to worker's needs. Moreover, firms must pay for the auditing itself.

2.1. A two period model

Consider an industry located in a developing country using a combination of skilled and unskilled labor and imported capital equipment to produce consumer goods for a mass consumer market in developed countries. Highly productive but low wage labor is combined with capital intensive advanced technology to produce the product at low unit cost, more than offsetting the significant transportation costs involved in getting the product to fickle and time sensitive markets abroad. There is competition in the world market, but products are differentiated such that a firm can build a loyal consumer base and employ various strategies to maintain and possibly expand its market share through independently monitored improvements in working conditions.

We will elaborate a full dynamic path for the monitoring problem in the next section, but first it will be instructive to consider a two-period case. With no monitoring, the firm sets marginal revenue equal to marginal cost in both periods in order to determine its profit maximizing combination of price and quantity. A firm that undertakes a monitoring effort expects demand to increase, as well as become more inelastic as some brand loyalty develops. With monitoring, the problem is more complex in that firms must monitor *before* they derive the benefits of rising demand. Thus the simplest model would have the firm monitoring in the first period and reaping the benefits in the second. The solution is entirely straightforward; the firm increases monitoring effort until the marginal cost of monitoring is equal to the discounted value of the marginal benefit in the second period, both measured in terms of profits.

Monitoring is assumed to raise both fixed and variable costs. Effective labor costs increase if the efficiency wage effect is inadequate to compensate for the higher administrative and nonwage costs. It would be reasonable to say that costs C rise by a rate m that

$$C(q,t) = [1 + m(t)]C(q,t)$$

where C is total (unmonitored) costs of production and q is the level of output. Marginal cost, c, at time t is then

$$c = (1+m)C_q$$

where the subscript indicates partial differentiation and the t subscript has been suppressed.

In the first period, the demand curve for quantity q as function of price, p and monitoring m is:

$$q = q(p, m) \tag{2.1}$$

and generates revenue $R = pq$. Revenue is unaffected by monitoring in the first period and so profit maximizing output is determined by the solution for p and q in the system of equations including 2.1 and the first order condition for profit maximization.

$$p(1 - \frac{1}{\eta}) = (1+m)c \tag{2.2}$$

where $\eta = -q_p \frac{p}{q}$ is the elasticity of demand. Straightforward comparative static result show that in the first period, $dp/dm > 0$ and $dq/dm < 0$, that is, an increase in monitoring effort causes the first period price to increase and quantity to fall.

In the second period, however, demand shifts due to the increase in monitoring. Equations 2.1 and 2.2 are used to resolve for q and p. Differentiating p with respect to m[2]

$$\frac{dp}{dm} = \frac{(1+m)cq_m + c - \frac{p}{\eta^2}\frac{d\eta}{dm}}{(1-\frac{1}{\eta}) - (1+m)cq_p}$$

The term $(1 - \frac{1}{\eta})$ is positive so long as the marginal revenue is concave. Since $q_p < 0$, the denominator is positive for constant or increasing marginal costs. In the simplest case of constant marginal cost, and no impact of monitoring on elasticity, the effect of monitoring on the price is positive.

[2] Differentiate the system 2.1 and 2.2 with respect to m, for the moment a given parameter.

$$\frac{dq}{dm} = q_p \frac{dp}{dm} + q_m$$

$$\frac{dp}{dm}(1 - \frac{1}{\eta}) + \frac{p}{\eta^2}\frac{d\eta}{dm} = (1+m)c\frac{dq}{dm} + c$$

Solving gives the result in the text.

These results are straightforward and intuitive. Less certain is the impact of monitoring on output. Differentiating equation 2.1:

$$\frac{dq}{dm} = -\frac{\eta q}{p}\frac{dp}{dm} + q_m$$

Clearly if there is no effect of monitoring on demand, output falls in proportion to the elasticity of demand. But if monitoring is sufficiently powerful, consumers who abandon the brand because of its high price are offset by new customers attracted to the product by its credible record on labor rights.

The effect of a change in monitoring on profits is given by differentiating $\pi = pq - (1+m)C$ with respect to m :

$$\frac{d\pi}{dm} = [p - (1+m)c]\frac{dq}{dm} + q\frac{dp}{dm} - C$$

where the total derivatives $\frac{dq}{dm}$ and $\frac{dp}{dm}$ are from the solution to the comparative statics problem for the system as a whole. After the simplifications shown in the footnote, we can write:[3]:

$$\frac{d\pi}{dm} > 0 \ \text{ iff } \ q_m > \frac{\eta C}{pq}$$

This result simply says that for profits to increase the percentage change in output generated by monitoring must be greater than the product of the elasticity of demand and the share of costs in output. This seems unlikely at best. The expression implies that if costs are two thirds of output and have the absolute value of the elasticity of demand is 2, monitoring that *doubles* product demand will still cause profits to fall no matter how small the effort may be.

With a theoretical barrier of this magnitude in the way, it seems that few firms in the world would monitor labor conditions on their own. In order to

[3] This expression can be simplified by substituting the first order condition for static profit maximization $p(1-\frac{1}{\eta}) = (1+m)c$ so that we have:

$$\frac{d\pi}{dm} = \frac{p}{\eta}\frac{dq}{dm} + q\frac{dp}{dm} - C$$

Noting that $\frac{dq}{dm} = q_p\frac{dp}{dm} + q_m$ write:

$$\frac{d\pi}{dm} = \frac{pq}{\eta}\frac{q_m}{q} - C$$

from which we obtain the result in the text.

make improving labor standards profitable, some way would have to be found to reduce the negative impact on profits. In essence there are only three ways available: The first is progressive state subsidies, that is direct transfers by the public sector in support of improving labor conditions. The second is more theoretical in nature. It might be true that the simple two-period analysis above fails to capture some essentially longer term dynamic elements of monitoring that when properly integrated would not produce such a starkly negative result. And third, efficiency wage considerations might well rescue monitoring. If improved monitoring of labor conditions leads to higher labor productivity, profitability may not suffer to the extent that the simple model suggests.

Each of these remedies will be considered in the discussion to follow; but there is a more fundamental problem associated with monitoring that lurks just beneath the surface: does monitoring make sense from a social point of view? Even if a developing country had the resources to promote higher labor standards, would they necessarily want to spend public resources in this way? In an globalized world economy in which local employment is threatened by specialization, high productivity capital intensive production processes, runaway shops and restricted public sector support for education and job training, is it entirely advisable to recommend policies that raise labor costs and reduce the number of jobs that a given amount of capital might support? On the other hand, if the firm is confident that a large untapped market exists for its credence good, an improvement in labor conditions may well correlate with *more* rather than less employment.

Formally, monitoring is equivalent to an "efficiency wage" effect that operates on the *demand* rather than supply side. The efficiency wage is itself an embedded game in which workers select a strategy that compensates for the perception that they are mistreated. The implicit compensation come from slacking off. The alternative strategy is, of course, to work harder in response to an offer of higher than market wage.. Table 2.1 shows the outcome with two Nash equilibria on the diagonal of the payoff matrix.

Table 2.1: An Efficiency Wage Game

	Workers	
Firms	Work hard	Slack off
High wage	(+,+)	(-,+)
Low wage	(+,-)	(+,+)

The possibility of monitoring converts this two dimensional matrix game into a three-dimensional tensor game. Change the row labels in Table 2.1 from "high wage" to "monitor" and from "low wage" to " do not monitor" and add the game below as a third dimensional facet:

Table: 2.1 (con't) An Efficiency Wage Game

	Customers	
Firms	Respond	Do not respond
Monitor	(+,+)	(-,+)
Do not monitor	(+,-)	(+,+)

Now if firms elect to monitor, customers respond by increasing demand for the good and and workers respond by increasing productivity, we have a Nash equilibrium. But if workers fail to respond, then firms may switch to "do not monitor" and consumers will retreat or switch to a lower cost competitor. A new lower level Nash equilibrium will be established. The question addressed in the simulations below is precisely what macroeconomic policy options are available to promote the first equilibrium over the second. But first we must recognize more explicitly that the game described above is in fact a control problem. Depending on the level of the state variables of this problem, the solution may switch endogenously between the two Nash equilibria. We shall see that indeed it does.

2.2. Monitoring as an optimal process

The foregoing analysis treats monitoring parametrically, introduced as a random or arbitrary shock. A more realistic assumption is that it is a *control variable* that can be used to maximize profits dynamically. The two-period model studied above ignores the fact that reputational effects created by monitoring programs persist and accumulate into the future. Begin by letting the market for a given product be made up of consumers who care about how the product was made and those who do not. For a firm contemplating a monitoring program, the *carrying capacity* of the market is crucial. If only a small fraction of potential consumers are judged to be interested in the process by which their consumables were brought to market, monitoring will never make sense. There must be a critical mass of social consciousness for monitoring to even exist as a theoretical possibility.[4]

Given this critical mass, the issue a firm must resolve is how to attract those consumers to their product so that in the process a higher price can be charged and the costs of higher labor standards recouped. The problem is made more complex by the fact that higher product prices will drive away consumers who are oblivious to labor conditions. Here we adapt the consumer dynamics model of the classic article of Phelps and Winter [18]. The principal theoretical hypothesis is that the process of locating and retaining these high quality consumers will follow a sigmoid or logistic curve in market *share*, $x(t)$ as shown in 2.1

With a low market share, the rate of increase in $x(t)$ is also low because the probability of finding a conscious consumer is approximately equal to their proportion in the population and described by the binomial distribution. If the firm continues its commitment to high labor the standards, the dynamic process evolves over time.

Let the fraction of conscious consumers be K, taken as given. This is the proportion of consumers who, if they had accurate information about firm working conditions, would pay a premium to consume the monitored good. At any given moment, the share of demand is $x(t)/K \leq 1$. If the firm monitors indefinitely, $x(\infty) = K$. What is the probability that a given consumer switches from an unmonitored to a monitored firm? Two considerations guide the modeling choice here; one is that if the market share of firms with monitored labor standards is small, then few consumers will know that these kinds of programs even exist and the probability of a switch will be low. Consumers engage in a process of "comparing notes" [18] to discover whether it is the general market price that has risen, or simply the price of the good offered by "their" source of supply, due to legitimate costs of higher labor standards. Second, and symmetrically, when the

[4] Let N be the set of consumers. There are two kinds of consumers with different utilities, u_i, of high labor standards, S. For a subset $i \in N$

$$u_i(S) = 0$$

while for $j \in N$

$$u_j(S) \geq C(S)$$

where $C(S)$ is the cost of labor standards. We call the ratio

$$\frac{i \in N}{N} = K$$

See [21].

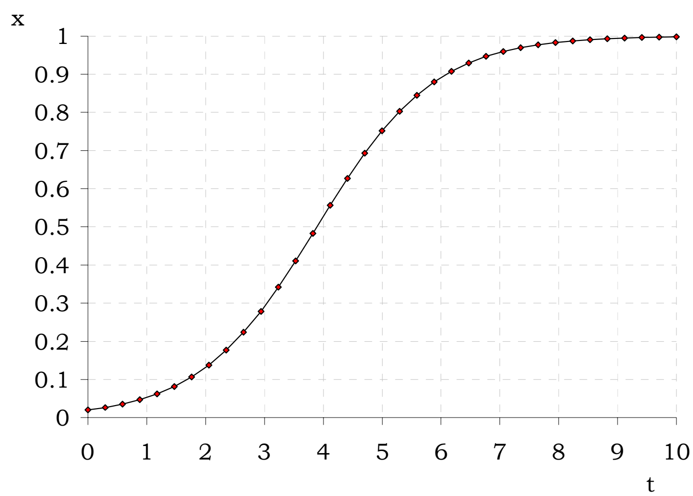


Figure 2.1:

proportion of monitoring firms is high, the probability of a switch is again low since not every consumer cares about the conditions of production of their consumables and the stock of those who do is nearing exhaustion. These considerations suggest that the probability that a consumer switches to a monitoring firm is given by the *logistic* function. The rate of growth of the market share is then given by:

$$\dot{x}(t) = m(t)x(t)[1 - x(t)/K] \tag{2.3}$$

i.e., a function of the product of the market share of monitored firms and the market share of unmonitored firms. The speed of adjustment is controlled by the level of monitoring, $m(t)$. Clearly, if there is no monitoring, then the share of the industry accruing to our firm remains constant over time.

Price also matters. Let $\delta = \delta(p)$ be the continuous demand function for the *industry as a whole* where $\delta'(p) < 0$, and $0 \leq \delta''(p) \leq \frac{2x'^2}{x}$. These assumptions ensure that the marginal revenue curve is downward sloping and convex to the origin. Demand for the product of "our" firm is thus $x(t)\delta(p)$ and profit is

$$\tilde{\pi}(x, m, p, t) = p(t)x(t)\delta(p) - [1 + m(t)]C[x(t)\delta(p)] \tag{2.4}$$

where $C(.)$ is the cost function. The cost function will be embedded eventually in a full computable general equilibrium model, responding to changes in macroeconomic conditions.

At any point in time, the state variable $x(t)$ is known to the firm. The firm then sets its price, p, according to the short-run rule of marginal cost equals marginal revenue. Price is therefore a "jump variable" and is instantaneously determined by

$$p + \frac{\delta}{\delta'} - (1+m)c = 0 \tag{2.5}$$

where c is the marginal cost, taken for simplicity as a constant.

The assumption that price is a jump variable deserves some comment since it is at variance with the standard consumer dynamics of the Phelps and Winter variety [18]. In their model, monopolists chose a price to maximize profits subject to customer flow dynamics. At time t the firm has share $x(t)$ of the market at reference price $\bar{p}$. Thereafter, a price higher than $\bar{p}$ will cause customers to seek alternative sources of supply; but there is friction in the model and consumers depart gradually, allowing the monopolist to exploit them in the short run. Alternatively, the instantaneous price p can be set below $\bar{p}$ capturing some additional clientele from competitors. Since this price is below that which maximizes profits, the concession amounts to the cost of investment in additional patronage that pays off in the future when it can be reconverted into cash through price increases. Over a finite horizon, the price will necessarily return to $\bar{p}$ since toward the end, there will be no reason to offer discounts to attract future customers. The same result applies over an infinite horizon, as the present value of future profits created in this way is diminished by the discount factor.

The two cases of interest are (1) a saddle-point (un)stable equilibrium and (2) a divergent "fly-by-night" solution. In case 1, the price follows a trajectory convex to the origin, in which marginal revenue is always *less* than marginal cost. It produces more output and charges a lower price in order to build up its customer base for the future. The monopoly price implied by equation 2.5 above is an *upper bound* that would ever be charged in the optimal process for the control variable $p(t)$. The process converges to a steady state in which the firm either takes over the entire market, or not, depending upon how quickly costs increase and how fast consumers respond to the price signal. [5]

[5] The "fly-by-night" case is not considered as interesting since it fails to converge to a steady-state. The firm ultimately disappears, dissipating its customer base throughout the dynamic process. However realistic this might be as a model of firms investing in developing countries, the absence of a platform for comparative dynamic analysis has prevented its gaining much traction in the literature. It may be of interest to note that simulating a saddle-point gives

The present model is thus greatly simplified by assuming that equation 2.5 determines p in a continuous equilibrium. Since our control variable is the level of monitoring, an improvement in labor conditions raises marginal costs which in turn increases the price. But unlike the pure customer flow model, profits can increase if the monitoring itself induces an increase in patronage that outweighs the loss due to higher prices. In this regard the model is also similar to advertising with word-of-mouth diffusion models.[6]

With $p = p^*$ known, $\delta(p^*, t)$ is also known and profit $\tilde{\pi}(.)$ in equation 2.4 can be more simply expressed as a function of only the state variable x and the monitoring control, m. The model then assumes firms maximize the discounted value of profits:

$$\begin{aligned} \max V &= \int_0^\infty e^{-rt}\pi(x,m)dt \\ st &: \dot{x}(t) = m(t)x(t)[1 - x(t)/K] \\ x(0) &= x_0 \end{aligned}$$

where e is base of the natural log system, r is the given discount rate and the initial share of industry demand is given by $x(0) = x_0$. The present value Hamiltonian for this problem is:

$$H^d(x, m, \lambda) = e^{-rt}\{\pi(x, m) + \lambda m x(1 - x/K)\} \tag{2.6}$$

where the argument t has been suppressed and we have the customary $H^d = e^{-rt}H$. Profit π can expressed as:

$$\pi = p\delta x - (1 + m)C(\delta, x) \tag{2.7}$$

Price p depends on the level of monitoring by equation 2.5 above. The auxiliary or costate variable is $\lambda = \lambda(t)$ and is interpreted as the *shadow price of monitoring.*

The solution to the control problem is given by trajectories for the control, m, state, x, and costate λ variables that satisfy the differential equations:

$$\begin{aligned} H_m &= 0 \\ H_\lambda &= \dot{x} \\ r\lambda - H_x &= \dot{\lambda} \end{aligned} \tag{2.8}$$

unstable trajectories as well since machine precision is ultimately insufficient to remain on the simulated path.

[6] See [20], [15], [13], and [16] for the original models.

Explicitly

$$
\begin{aligned}
0 &= -C + \lambda x(1 - x/K) \\
mx(1 - x/K) &= \dot{x} \\
\lambda r - \pi_x - m\lambda(1 - 2x/K) &= \dot{\lambda}
\end{aligned}
$$

Substituting the second expression into the first

$$\frac{mC}{\lambda x} = \frac{\dot{x}}{x}$$

which is similar to the result of the static model. It says that market share would have to increase in direct proportion to costs and inversely proportional to the value of market share. Note, incidentally, that this equation suggests that in a steady state, monitoring would have to be zero. Firms will apparently cease monitoring *before* they exhaust the politically conscious clientele.

The costate variable λ determines the contribution that an increase in monitoring makes to the discounted value of profits. With $\dot{\lambda} = 0$, we have $\pi_x = \lambda[r - m(1 - 2x/K)]$ so that when monitoring is zero, we have the costate

$$\frac{\pi_x}{r} = \lambda$$

as the discounted value of the change in profits with respect to monitoring.

Rather than proceed with steady-state analysis of the phase plane of this dynamic system, we shall instead examine the macroeconomic interactions with the optimization problem as they both adjust in the medium run.[7] In the section that follows we embed the microeconomic optimizing model in an economy-wide framework to study constraints that the macroeconomic environment might impose on the monitoring solution. Analytical results will largely be unavailable, so we employ a simulation methodology.

3. The Macro Foundations of Monitoring

Our task is to examine the monitoring model when embedded in a larger macroeconomic framework. As noted above, the model is calibrated to a social accounting

[7] See [12] which raises some methodological criticisms of comparative steady state analysis from a structuralist perspective.

matrix for Korea for the year 1990 and is solved by GAMS code that appears in the appendix.[8] The model is essentially a two sector, traded-nontraded goods model, but monitoring would occur only in the traded goods sector and there is no assumption that wages in the nontraded sector equalize. In the traded goods sector, exports adjust to bring about a balance of supply and demand once the micro model determines the price and quantity there. The nontraded goods sector is traditional Keynesian, with quantity adjustment and mark-up pricing. Exports in that sector are given. There are three social classes, male workers, female worker and nonworkers. Investment by destination is determined in both sectors by an accelerator term that depends on capacity utilization and a weak crowding in term that depends on government investment. Labor productivity depends on the monitoring in the traded goods sector.

Capacity grows according to net investment and capacity utilization is the ratio of current demand to available capacity. All this is entirely standard for structuralist models. The innovation in this paper is to allow the equality of traded good marginal cost and marginal revenue to determine the price and quantity in that sector as a function of the monitoring control variable. As above, monitoring affects all costs not just labor. [9]

3.1. Model structure in detail

As noted, the CGE is a standard structuralist model but with the optimal process in the traded goods sector and Keynesian adjustment in the nontraded goods sector. Output is given by the vector equation

$$X = C + I + G + E - M^c$$

where output is the vector:

$$X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

of traded, nontraded good and noncompetitive imports respectively. Consumption, C, is a $3x3$ matrix with columns for female workers, male workers and nonworkers. Investment, I is also a matrix with 3 rows and 4 columns; the latter

[8] The model broadly follows [23],[24] and [25]. For computable general equilibrium models with monopolisitic competition built in see [6].

[9] At present, the excess supply/demand for labor in the monitored sector has no effect on the nominal wage rate. It should and this could be built in a later version of the model.

corresponds to investment by destination for traded, nontraded, government and change in stocks. Government consumption, G, is a column vector, as are exports, denoted by E, and competitive imports M^c. The consumption matrix is given by a linear expenditure system with intercepts and propensities to consume calibrated to the base SAM using Frisch parameters. The consumption equation is:

$$C = \theta + \hat{m}\hat{P}^{-1}[\hat{Y}(1-\hat{s})(1-\hat{t}) - P\theta]$$

where θ is a $3x3$ matrix of intercepts, $\hat{m}$ is a diagonal matrix of marginal (equals) average propensities to consume for each good and each social class. The matrix $\hat{P}^{-1}$ is an inverse diagonal matrix of prices. The price of traded goods comes from the optimal process discussed above. The price of the nontraded good is given by:

$$p_2 = (1+\tau)(PA_2 + \hat{w}L_2 + ep^*M_2)$$

where τ is the given mark-up, $\hat{w}$ is a diagonal matrix with wages of female and male workers. The subscript indicates the second *column* of the intermediate demand A and the direct labor L matrices. The latter gives the labor per unit of output of both kinds of labor, male and female. The matrix M describes the noncompetitive intermediate imports of the productive sectors and again the subscript indicates the second column of that matrix. Here e is the nominal exchange rate and $\hat{p}^*$ is the diagonal matrix of foreign prices.

Income of each social class, Y, including transfers, T (foreign and domestic) is given by:

$$Y = \hat{w}LX + \hat{\pi}X + T$$

where $\hat{\pi}$ is the level of profits per unit in each sector given by the vector equation:

$$\hat{\pi} = \hat{P} - PA - \hat{w}L - e\hat{p}^*M$$

In the current period, exports of the traded goods sector is determined as a residual, after output as a whole has been determined by the optimal control.

Periods are linked by changes in productive capacity, Q in both the traded and nontraded goods sectors which depend upon capital stock, K. The rate of growth of capacity is determined by net investment by destination, so that

$$\dot{Q}/Q = \dot{Q}_0 + \kappa(I - \delta K_{t-1})/Q_{t-1}$$

where κ is the marginal capacity output-capital ratio and δ is the rate of capital depreciation. At time t, then, we can define capacity utilization as:

$$u_t = X_t/Q_{t-1} \tag{3.1}$$

essentially the ratio of current output as determined to productive capacity available at the beginning of the period, $Q_{t-1.}$ Investment by destination is then determined by

$$I/K_{t-1} = g_0 + g_1 u + g_2 I_g/Q_{t-1}$$

to take into account an accelerator on capacity utilization and a crowding in term that depends on the ratio of government investment, I_g to capacity.

3.2. How the model works

It might be useful to the reader if we walk through a simple comparative static adjustment to, say an exogenous increase in government investment in the macromodel. Since government investment demand affects both traded and nontraded goods, as well as noncompetitive imports, demand for all three rise. Holding price and quantity in the traded goods sector fixed for the moment, the rise in government investment causes exports to *shrink* there and the current account to instantaneously worsen, but there is no endogenous effect on the nominal exchange rate. In the nontraded sector, however, output adjusts to the increase in demand. There is no effect on nominal wages, or the exchange rate, so the markup price remains fixed. In both sectors the increase in government investment spurs a rise in investment by destination so that capacity rises.[10] Since there is both an increase in demand and an increase in capacity, capacity utilization could go either way, up or down.

Once monitoring changes, then prices and quantities in the traded goods sector adjust according to the optimal process. The monitored price is also used as an input for domestic goods and thus the disturbance is transmitted there. Labor productivity, incomes and demand all adjust accordingly as well.

The dynamics equations for capacity are of great importance in the model. Optimal control models often produce "bang-bang" solutions in which the value of the control variable reaches a bound, stays at that value for a while and then falls to zero for in second phase. This pattern can repeat itself over the trajectory, with the control alternating between the bounds. In the simulations below, we

[10] This effect is very small in the calibrated model.

impose both upper and lower bounds on the control variable, monitoring. But the dynamic equations that the derive from the macroeconomic environment effectively prevent these bounds from paying any role in the solution. To see why, consider a moment in the trajectory in which the optimization calls for significant monitoring, possibly pushing the monitoring beyond its exogenously imposed bound. At this level, the share of market demand would rise according to equation 2.3. But if the implied level of output exceeds capacity, the utilization ratio in equation 3.1 will, of course, rise above one. This is judged here as unrealistic so we impose a constraint on the capacity utilization of both sectors, traded and nontraded.

This can (and does) have an important impact on how the model responds to an increase in government investment. If the nontraded goods sector is at full capacity, then any increase in government investment cannot be accommodated without a change in some other variable. The only variable in the material balance for the *nontraded* good that can adjust is monitoring. By assumption, monitoring raises *all* costs in the first sector, including intermediate demand for the nontraded good. From the perspective of the material balance in the nontraded goods sector, the monitoring variable is free to adjust; and so it does. On the other hand, if government investment raises capacity in either sector, monitoring can increase. The rise in capacity induced by government investment must be forward looking however, since its capacity in the $t-1$ period that effectively constrains monitoring in period t.[11].

It is evident then that the evolution of the macroeconomy and the implicit rate of accumulation in both sectors can then effectively constrain monitoring of labor conditions. The link between the micro and macroeconomics of the model is now forged.

[11] Note additionally that even if the relative prices do not change, monitoring can still adjust in the dynamic model. The objective functional in the applied model below is the discounted value of *real* profits, deflated in this case by the consumer price index. The rise in government investment causes income to rise and thus consumption. Consequently the consumption *weights* in the CPI can change to some degree and rebalance the CPI. This change in the value of real profits can induce small changes in monitoring since real profits are dynamically optimized. We would not expect the change to be large and the simulations (not shown) confirm this, but there is some movement in monitoring with respect to this parametric change.

4. Simulation Results

Table 4.1 shows the results of a 20 year run of the model starting at a low level of $x = 0.05$ (see Figure 2.1 above). Observe that the level of monitoring rises in the first and second period and then drops off to zero by the 10th period and then picks up again in the 17th period. The market share responds accordingly, rising from 5% to 6.5% of the market. This is nowhere near the 70% of the market that is assumed to be concerned with working conditions on the shop floor, but more on that issue later. Traded good output increases accordingly, but note the significant dip in the second and third period when monitoring is first introduced. The price rises rapidly by 7% and 6%; It is evident that while market share is rising, consumers are also abandoning the firm and moving on to other suppliers as a result of the price increase.[12]

Table 4.1: The base run

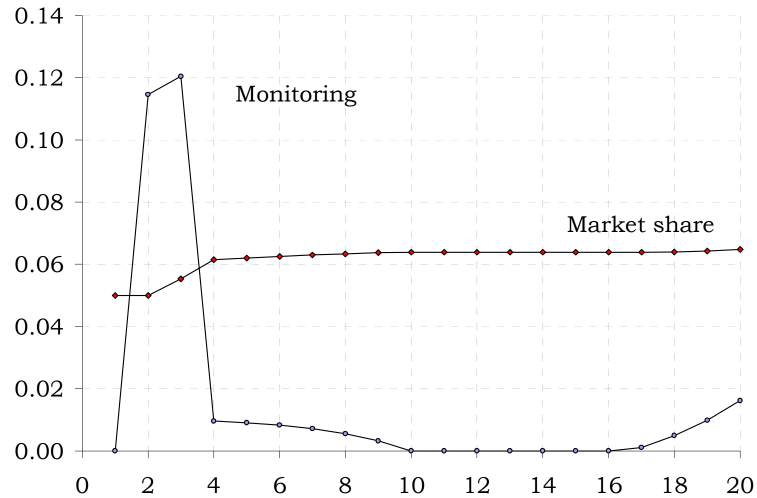
Time	Level of Monitoring	Market Share	Output Traded	Output Non-Tr	Real Wage	Employ -ment	Price	PSBR /Y	Foreign Sav/Y
1	0.000	0.050	167	237	1.00	1.00	1.00	0.9	0.9
2	0.115	0.050	83	201	0.73	0.74	1.07	5.2	23.8
3	0.120	0.055	96	213	0.78	0.80	1.06	4.4	21.3
4	0.010	0.061	214	286	1.19	1.23	0.99	-0.8	-0.8
5	0.009	0.062	217	291	1.21	1.25	0.99	-0.8	-0.4
6	0.008	0.063	220	298	1.23	1.27	0.99	-0.8	0.0
7	0.007	0.063	223	305	1.26	1.30	0.99	-0.8	0.4
8	0.006	0.063	227	311	1.28	1.33	0.99	-0.8	0.7
9	0.003	0.064	230	318	1.31	1.35	0.99	-0.8	1.1
10	0.000	0.064	234	326	1.33	1.38	0.99	-0.8	1.4
11	0.000	0.064	234	331	1.35	1.40	0.99	-0.7	2.1
12	0.000	0.064	234	337	1.36	1.41	0.99	-0.6	2.9
13	0.000	0.064	234	343	1.38	1.43	0.99	-0.6	3.7
14	0.000	0.064	234	348	1.40	1.45	0.99	-0.5	4.5
15	0.000	0.064	234	354	1.42	1.47	0.99	-0.4	5.3
16	0.000	0.064	234	360	1.43	1.49	0.99	-0.3	6.1
17	0.001	0.064	233	366	1.45	1.50	0.99	-0.2	7.0
18	0.005	0.064	230	371	1.46	1.51	0.99	-0.1	8.2
19	0.010	0.064	227	376	1.47	1.52	0.99	0.1	9.5
20	0.016	0.065	224	381	1.47	1.53	1.00	0.2	10.7
Period Average[1]		0.014	0.02	0.03	0.02	0.02	1.00	0.10	5.43

Source: Model computations.

Note: 1. Average percentage change for market share, output, real wage and employment.

[12] The elasticity of demand in the calibrated model is perhaps too high to be realistic and thus the actual reduction would not be as severe.

Figure 4.1: Monitoring level and market share with $x_0 = 0.05$.



The income generated by the monitoring spawns the growth of the nontraded goods sector and output and employment, economy-wide, rise in step. The real wage declines slightly in response to the higher prices of both goods due to monitoring in the traded goods sector (since non-traded goods require higher priced traded inputs.) The public sector borrowing requirement (PSBR) declines nicely owing to the growth in direct and indirect tax revenues as the modelled economy expands.[13] The growth in exports does not match the rate of expansion however, and the current account goes into deficit, as seen in the last column of the table. Figure 4.1 plots the monitoring variable and the resultant market share.

The path of employment and the real wage in the model are plotted in Figure 4.2. Initially there is a loss in employment and a decline in the real wage but after 4 periods employment recovers and then grows from then on. The real wage remains stable and declines only slightly.

The first simulation certainly seems to be successful. Monitoring of labor standards raises growth and employment; the distribution of income improves in the process. Starting from a low initial share is difficult for the model since the benefits of monitoring are discounted and the derivative of the logistic curve is low as seen in Figure 2.1 and discussed above. In this simulation, the market

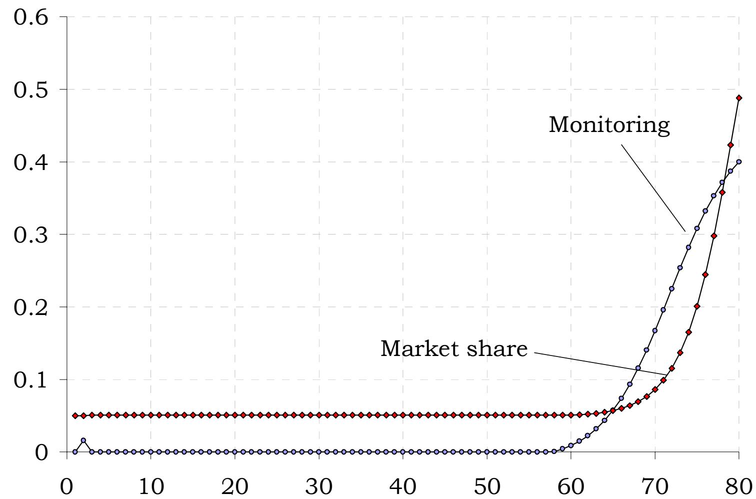
[13] The PSBR is defined as government investment less government savings.

Figure 4.2: Real wage and employment with $x_0 = 0.05$.

share improves by 1.5% but had we started at a higher level, say $x = 0.15$, market share rises to 0.19 or by 4% and for an initial share of 25% market share rises by 6%.

Running the model for 80 periods allows us to see cumulative effect of changes; the results of the ultra-long run are shown in Figure 4.3. Note that monitoring does not take off at all until close to the 60th period. Why does it then? This is an exit strategy or "fly by night solution" for the firm. The reason is that any small computational pertubation that causes the price to rise will create an incentive for the firm to monitor as a last ditch effort to increase profits. During the long run at a constant level, capacity in the model is building. This causes capacity utilization to fall unless demand keeps pace. In this example, u in the 60th period is a mere 0.281. This allows the control variable to rise to its boundary and at that rate of increase in the state variable, x, profitability can improve. But this is dynamic instability and ultimately leads to ruin since the higher price required by the monitoring reduces demand to the point that output goes to zero and the firm disappears. In short, the tail end of this trajectory is uninteresting and we can conclude that for the medium run at least, once monitoring stops, it is over

Figure 4.3: Monitoring over 80 periods



and not like to be resuscitated.[14]

4.1. The macroeconomic environment

The preliminary conclusion is that we should not expect a significant degree of improved labor standards given the parameter settings of the model. It is simply too costly compared to any reasonable flow of future benefits. But how could the macroeconomic context be changed to promote more monitoring? We consider a two stylized policy packages now, one a tax cut matched to corresponding reduction in government spending, loosely, a "Washington Consensus" [15]. A second approach is to enforce higher labor standards directly, by for example, raising the wages for female labor. In this policy package, again loosely referred to as "macroeconomic populism," there is less concern with the fiscal deficit, some real exchange rate appreciation can be tolerated and an emphasis on increasing

[14]The beginnings of a fall in nontraded goods can also be observed in Table 4.1 for the last four periods.

[15]The Washington Consensus also includes a competitive exchange rate, restrictive monetary policy, deregulated labor markets, and trade liberalization among other things. These restrictions could be built into the model at a later date. See [26].

the social wage through government investment.[16]

4.2. A tax cut

Consider a simulation in which indirect taxes for the nontraded sector are reduced to zero. But since the tax cut causes the public sector borrowing requirement (PSBR) to expand some adjustment has to be made to bring it back in line with a given target. We assume in the simulation that government investment falls, rather than public sector transfers or government wages, to reestablish the PSBR to GDP ratio in the same range as in the base solution. The main effect of this adjustment mechanism is to reduce private sector investment in both sectors through the (small) crowding in effect in the investment function. The results are shown in Table 4.2.

Table 4.2: Tax cut and reduction in government investment

Time	Level of Monitoring	Market Share	Output Traded	Non-Tr	Real Wage	Employ -ment	Price	PSBR /Y	Foreign Sav/Y
1	0.000	0.050	167	237	1.00	1.00	1.00	1.1	1.2
2	0.132	0.050	83	201	0.74	0.74	1.07	7.4	31.0
3	0.057	0.056	164	254	1.03	1.05	1.02	2.1	8.5
4	0.011	0.059	214	286	1.20	1.23	0.99	0.1	-0.4
5	0.011	0.060	217	292	1.22	1.25	0.99	0.0	0.0
6	0.011	0.060	220	298	1.24	1.27	0.99	-0.1	0.4
7	0.011	0.061	223	304	1.27	1.30	0.99	-0.2	0.8
8	0.010	0.061	227	310	1.29	1.32	0.99	-0.3	1.2
9	0.009	0.062	230	317	1.31	1.35	0.98	-0.4	1.6
10	0.007	0.063	234	323	1.34	1.37	0.98	-0.5	1.9
11	0.005	0.063	238	330	1.36	1.40	0.98	-0.6	2.2
12	0.002	0.063	242	337	1.39	1.43	0.98	-0.7	2.5
13	0.000	0.063	244	344	1.41	1.45	0.98	-0.8	3.0
14	0.000	0.063	244	349	1.43	1.47	0.98	-0.8	3.9
15	0.000	0.063	244	354	1.44	1.48	0.98	-0.8	4.8
16	0.000	0.063	244	360	1.46	1.50	0.98	-0.8	5.7
17	0.000	0.063	244	365	1.47	1.52	0.98	-0.8	6.6
18	0.000	0.063	244	371	1.49	1.53	0.98	-0.8	7.5
19	0.002	0.063	243	376	1.50	1.55	0.98	-0.7	8.7
20	0.004	0.063	241	381	1.51	1.56	0.98	-0.7	9.9
Period Average[1]		0.013	0.02	0.03	0.02	0.02	0.99	0.10	5.06

Source: Model computations.

Note: 1. Average percentage change for market share, output, real wage and employment.

One might be led to the conclusion that lower taxes would stimulate monitoring of labor conditions and that a progressive government would attempt to encourage

[16] Again there is much more to macroeconomic populism that this. See [9].

higher labor standards in this way. Can this conclusion be substantiated by model simulation? The results shown in the table suggest that the strategy is working: lower costs plus fiscal discipline leads to higher monitoring and higher output of the traded goods sector. It seems that the Washington Consensus policies might be consistent with higher labor standards.

But we can peer more deeply into this simulation: marginal costs are lower and thus the first order condition, $H_x = 0$ suggests that the marginal benefit of monitoring should be lower. Were the Hamiltonian convex in this region, we would expect that monitoring would increase in order to lower the marginal benefit. But as seen in Figure 4.4, the benefits of monitoring follow the logistic curve, increasing to maximum at the inflection point and then falling. This implies that, in this region of $x = 0.05$, *monitoring should fall with lower taxes.* Additional simulations confirms that this does indeed occur. Without the reduction in government investment, monitoring indeed ends sooner and leads to a lower market share and traded output. We would have to conclude that an aggressive tax policy alone is not adequate to get monitoring off the ground.

On the other hand, the reduction in government investment causes the output of the nontraded sector to fall relative to capacity. This allows monitoring to *increase* for precisely the reasons discussed above. The rate of capacity utilization in the second sector would rise above one with the tax cut, were it not bounded in the control problem solution. This in itself would reduce monitoring in the model due to the binding constraint on domestically produced nontraded inputs.[17] Here, the reduction in government investment reduces effective demand *more than it reduces capacity through crowding-in.* Hence, the capacity constraint is *less* binding with the fall in government spending on capital goods.[18]

If however, the firm already has a high share of the market, the implications of a tax cut can be different. Figure 4.4 shows that the marginal benefit of monitoring is declining above $x = 0.5$. Hence a falling marginal cost that calls for a declining marginal benefit must act to increase monitoring.

[17] Certainly those inputs could be imported and perhaps a more realistic model would allow that. But here the capacity constraint imposed by the domestic economy is not entirely capricious. Capacity limitations in the construction sector, for example, are sometimes built into econometrically estimated investment functions.

[18] This is obviously a product of how the model was calibrated; with a larger crowding in effect, capacity utilization could easily rise with the reduction in government infrastructural expenditure and monitoring would increase.

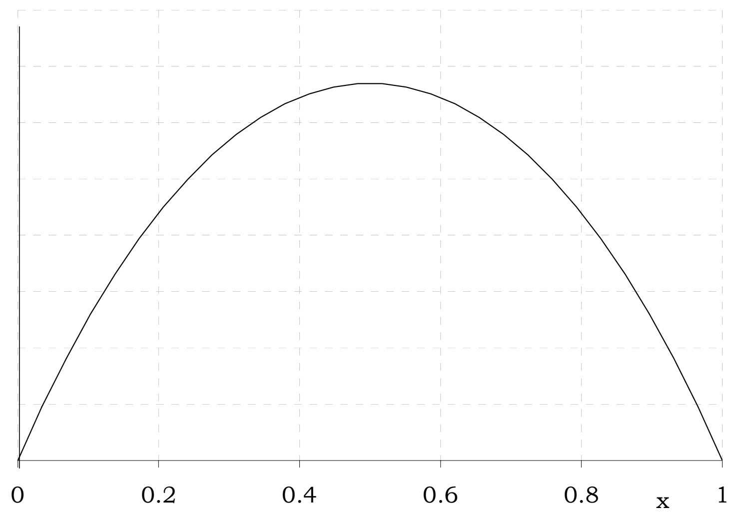


Figure 4.4: Marginal benefit of monitoring

Table 4.3 shows the impact of cutting taxes on the modelled economy (with no corresponding reduction in government expenditure) but starting at $x = 0.6$. Note that the duration of monitoring is longer and the ultimate share is higher with the tax cut. The impact of the policy is more pronounced with a higher initial starting point; output of the traded good rises from a maximum of 221 to 244 whereas when $x = 0.05$, the increase was only 10. The table also confirms that the price of the traded good is lower at the end of the simulation as would be expected. Observe, nonetheless, that a large reduction in output, is necessary to get monitoring underway and as in Figure 4.2 there is a corresponding decline in employment and real wage. This is a feature of the optimization problem that is independent of the initial condition on market share.

Table 4.3: Tax cut and reduction in government investment
$x_0 = 0.6$

Time	Base Mon	Base Share	Base Traded	Base Price	Tax Cut Mon	Tax Cut Share	Tax Cut Traded	Tax Cut Price
1	0.000	0.600	167	1.00	0.000	0.600	167	1.00
2	0.115	0.600	83	1.07	0.132	0.600	83	1.07
3	0.127	0.610	83	1.07	0.147	0.611	83	1.07
4	0.141	0.620	83	1.07	0.163	0.623	83	1.07
5	0.155	0.630	83	1.07	0.179	0.634	83	1.07
6	0.169	0.640	83	1.07	0.195	0.645	83	1.07
7	0.000	0.649	221	0.97	0.023	0.655	223	0.97
8	0.000	0.649	221	0.97	0.020	0.656	226	0.97
9	0.000	0.649	221	0.97	0.017	0.656	230	0.97
10	0.000	0.649	221	0.97	0.014	0.657	233	0.96
11	0.000	0.649	221	0.97	0.010	0.658	237	0.96
12	0.000	0.649	221	0.97	0.005	0.658	241	0.96
13	0.000	0.649	221	0.97	0.000	0.658	244	0.96
14	0.000	0.649	221	0.97	0.000	0.658	244	0.96
15	0.000	0.649	221	0.97	0.000	0.658	244	0.96
16	0.000	0.649	221	0.97	0.000	0.658	244	0.96
17	0.000	0.649	221	0.97	0.000	0.658	244	0.96
18	0.000	0.649	221	0.97	0.000	0.658	244	0.96
19	0.000	0.649	221	0.97	0.000	0.658	244	0.96
20	0.000	0.649	221	0.97	0.000	0.658	244	0.96
Period Average[1]		0.004	0.01	0.00		0.65	0.02	0.00

Source: Model computations.

Note: 1. Average percentage change

4.3. Rising female wages

In the second simulation, we introduce a 3% increase in female *nominal* wages. As indicated in the SAM (see the appendix) the intensity of female labor is low in both sectors, magnified, of course, by the wage differential. Female labor is concentrated in the nontraded sector, but since the traded goods sector uses nontraded inputs, cost increases in the latter can be passed along to the former.

Table 4.4: A 3% increase in the female nominal wage rate.

Time	Level of Monitoring	Market Share	Output Traded	Non-Tr	Real Wage	Employ -ment	Price	PSBR /Y	Foreign Sav/Y
1	0.000	0.050	167	237	1.00	1.00	1.00	0.9	0.9
2	0.112	0.050	83	201	0.97	0.74	1.07	5.2	23.7
3	0.059	0.055	142	241	1.00	0.97	1.03	1.7	10.2
4	0.138	0.058	83	208	0.97	0.77	1.08	5.3	25.4
5	0.019	0.066	217	291	1.01	1.25	1.00	-0.8	-0.2
6	0.018	0.067	220	297	1.01	1.27	1.00	-0.8	0.2
7	0.017	0.068	223	304	1.01	1.30	1.00	-0.8	0.6
8	0.016	0.069	227	311	1.01	1.32	1.00	-0.9	1.0
9	0.015	0.070	230	318	1.01	1.35	1.00	-0.9	1.4
10	0.012	0.071	234	325	1.01	1.38	1.00	-0.9	1.7
11	0.009	0.072	237	333	1.01	1.41	1.00	-0.9	2.0
12	0.005	0.072	241	341	1.01	1.44	1.00	-1.0	2.3
13	0.000	0.072	245	349	1.01	1.47	1.00	-1.0	2.6
14	0.000	0.072	242	353	1.02	1.48	1.00	-0.8	3.7
15	0.000	0.072	239	357	1.02	1.48	1.00	-0.7	4.8
16	0.000	0.072	235	361	1.02	1.49	1.00	-0.6	5.9
17	0.000	0.073	232	366	1.02	1.50	1.01	-0.4	7.0
18	0.000	0.073	229	371	1.02	1.51	1.01	-0.3	8.1
19	0.000	0.073	225	375	1.02	1.52	1.01	-0.2	9.2
20	0.000	0.073	222	380	1.02	1.53	1.01	0.0	10.2
Period Average[1]		0.020	0.02	0.03	0.00	0.02	1.01	0.10	6.03

Source: Model computations.

Note: 1. Average percentage change for market share, output, real wage and employment.

From the last experiment, we would suspect that the impact of an increase in female wages depends upon the initial degree of capacity utilization and where on the logistic function the economy initially resides. Table 4.4, compared to the base run in 4.1, shows that *monitoring does indeed increase* with a rise in wage of female labor when the initial share of the market is low. But 4.5 shows that traded good output, however, is essentially the same in both simulations. Still, the growth rate of GDP is higher in this demand driven economy, due to the rapid expansion of the nontraded goods sector. The government deficit falls as result since government spending is the same in both simulations. But the effect is more demand driven than a product of monitoring. This is confirmed by the last column of these last mentioned tables which show that foreign savings increases with the wage increase. In the tax cut, the monitoring driven expansion causes the trade deficit to fall.

Prices of both traded and nontraded goods are higher in this simulation compared to the base; the CPI rises by an average of 2.7% rather than 2.2% in the base. The nontraded price increases by more than the traded good price given the relative factor proportions in the former, but this filters into the cost structure

Figure 4.5: Traded good output with an increase in the female wage rate

of nontraded goods as well. Thus, the marginal costs shift up requiring an *increase* in marginal benefits in contrast to the tax cut. Since this can be obtained through higher monitoring, the result is an increase in market share, $x(t)$, with higher female wages. But costs rise faster than benefits, given that the objective functional is specified in real terms, and thus there is a decrease in the maximized value by some 15% as a result of the wage induced inflation.[19]

One final simulation is to raise female wages by 3% with a higher market share. The results are shown in Table 4.5. Comparing this to the base run starting at $x = 0.6$ in the same table, we can immediately see that *monitoring no longer increases* with an increase in wage, but in fact falls slightly compared to the base.

[19] Note that while 4.5 suggests that an increase in wages makes little difference in traded good output, the market share is higher than in the base and substantially so. The reason is that higher marginal cost leads to a higher price along the demand curve and thus our sector has a larger share of a smaller world-wide pie. These effects roughly cancel as seen.

Table 4.5: A 3% increase in the female nominal wage rate.

$x_0 = 0.6$

	Base				Female Wage Increase			
Time	Mon	Share	Traded	Price	Mon	Share	Traded	Price
1	0.000	0.600	167	1.00	0.000	0.600	167	1.00
2	0.115	0.600	83	1.07	0.112	0.600	83	1.07
3	0.127	0.610	83	1.07	0.122	0.610	83	1.07
4	0.141	0.620	83	1.07	0.132	0.619	83	1.07
5	0.155	0.630	83	1.07	0.143	0.629	83	1.07
6	0.169	0.640	83	1.07	0.154	0.638	83	1.07
7	0.000	0.649	221	0.97	0.000	0.647	208	0.98
8	0.000	0.649	221	0.97	0.000	0.647	206	0.98
9	0.000	0.649	221	0.97	0.000	0.647	204	0.98
10	0.000	0.649	221	0.97	0.000	0.647	203	0.98
11	0.000	0.649	221	0.97	0.000	0.647	201	0.98
12	0.000	0.649	221	0.97	0.000	0.647	199	0.99
13	0.000	0.649	221	0.97	0.000	0.647	196	0.99
14	0.000	0.649	221	0.97	0.000	0.647	194	0.99
15	0.000	0.649	221	0.97	0.000	0.647	192	0.99
16	0.000	0.649	221	0.97	0.000	0.647	190	0.99
17	0.000	0.649	221	0.97	0.000	0.647	187	0.99
18	0.000	0.649	221	0.97	0.000	0.647	185	1.00
19	0.000	0.649	221	0.97	0.000	0.647	182	1.00
20	0.000	0.649	221	0.97	0.000	0.647	180	1.00
Period Average[1]		0.004	0.015	-0.002		0.004	0.004	0.000

Source: Model computations.

Note: 1. Average percentage change.

Figure 4.6 shows a more dramatic decline in the level of traded goods output as time passes in this simulation.

The reasons for the superiority of the Washington Consensus over this more populist approach are now evident. The increase in the wage rate causes the marginal cost to rise and since now the marginal benefit of monitoring is concave in the region of $x = 0.6$, a reduction is called for. This implies a *both a lower market share* and *lower* output as the firm climbs the demand curve and loses patronage as explained above. Phelps and Winter consumer dynamics would ameliorate these results somewhat, but shape of the Hamiltonian would still require a reduction in monitoring in the more complex environment.[20]

[20] Why do we not simply introduce two controls and have the Phelps and Winter effect present simultaneously? This is possible, but makes the model very difficult to interpret. Perhaps in future research this problem could be addressed.

Figure 4.6: Traded good output with a 3% increase in female nominal wages and $x_0 = 0.6$

The increase in the nominal wage does result in an increase in real wages and there is a corresponding decrease in employment (not shown). The result is *not* of course the product of factor substitution, since there is none built into the model. It is rather the product of the interaction of the micro and macroeconomic features of the model. Monitoring, by assumption, causes labor productivity to increase and this implies a lower demand for labor as the model evolves through time.

5. Conclusions

The effect of monitoring is similar to efficiency wages but has a nonlinear relationship to market share. At low levels, policy is not as effective as when the market share is higher. This suggests that monitoring may not suitable as an "infant industry" policy recommendation. Having said this, it is true that the effect of monitoring can be large if there is a substantial core of conscious customers. This is a big "if" of course, but when firms can identify a responsive clientele, the impact can be more significant than ordinary fiscal and monetary measures. The estimates of this paper are probably too high, however, given that the data base to which the model was calibrated implied a very high elasticity of demand.

Monitoring labor conditions in not a panacea. It is necessarilya temporary strategy and will not last into the steady state (although arguably monitoring would even be *necessary* once the economy passes the Lewis turning point.) It is also to be noted that every favorable simulation in this paper involves a substantial contraction at the near end of the horizon, with corresponding low levels of employment. This may be exaggerated by the model, but it is still the case that some pain must be endured before the gains of improved labor conditions can be spread to the rest of the economy. The loss in output and employment may be difficult to accept, especially if duration of monitoring is always limited. Moreover, policymakers may well be reluctant to promote monitoring in industries with monopolistic competition, that is where firms maximize their profits by producing *less* and charging a higher price.

The limitations of the model are significant and have been pointed out along the way. Not enough sensitivity analysis has been done and it remains an elaborate numerical example rather than a proof of a general proposition. But the data of the model is realistic and the dynamic behavior of the model is as well and it shows that macroeconomic constraints can be effective in a reasonable, if not perfect, model of microeconomic behavior.

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6. Appendix

Social accounting matrix
GAMS program listing

SAM for Korea			Consumption				Investment				Comp	
1990	Traded	Nontraded	Female	Male	Capitalists	Govt	Private	Public	Stocks	Exports	Imports	GVP
Traded	63.5	28.9	6.4	10.4	7.4	0.0	16.9	0.4	-0.5	45.7	-12.5	166.7
Nontraded	32.4	86.9	14.8	28.9	23.0	5.4	37.3	8.6	0.8	6.3	-7.0	237.4
Women	6.1	14.9				4.7						25.7
Men	18.7	40.0				8.6						67.3
Capitalists	12.9	51.1				0.8						64.9
Savings	8.8	-4.7	2.7	23.5	29.9	7.2					2.1	69.5
Indirect taxes	2.6	10.8										13.4
Direct tax	0.0	0.0	1.3	3.4	3.2							7.9
Import duties	2.9	1.2	0.1	0.1	0.2		0.8	0.0	0.0			5.4
Noncom Impts	18.7	8.3	0.5	0.9	1.1		5.1	0.1	-0.1			34.7
GVP	166.7	237.4	25.7	67.3	64.9	26.7	60.1	9.1	0.3	52.0	34.7	
KRW x 10^{12}												