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Abstract

In this paper we formulate a three-sector general equilibrium model where one sector produces a service or good used as an intermediate input in two other sectors. Intermediate input here resembles bureaucratic (in)efficiency/control, red-tapism etc. in light of these concerns we introduce informal sector where wage is determined through competitive mechanism. We show that informal wage must go up if bureaucratic efficiency increases in general or if informal sector becomes less prone to bureaucracy related menace. However, in the welfare front the eventual impact depends on whether labor reallocation effect can outweigh the tariff revenue effect.

Keywords: General equilibrium; Intermediation; Informal sector; Welfare.

JEL Classification: D5; D73; O17; D6.

1. Introduction

In tune with globalization though reform is taking place in every corner of the world, bureaucracy related obstacles are not yet removed form the economy in particular and society in general. Omnipresence of such menace tempted many researchers to strive for exploring various consequences of this phenomenon. Notable among them are Bandyopadhyay and Roy (2007), Bose (2004, 2010), Bose and Gangopadhyay (2009), Chaudhuri and Ghosh Dastidar (2011), Chaudhuri and Gupta (1996), Gupta and Chaudhuri (1997), Guriev (2004), Marjit and Shi (1998), Marjit et al (2003), Mauro (1995) etc. These papers mainly talk how and why corruption significantly influences trade protection and trade openness; different aspects, causes and types of bureaucratic corruption and the relevance of taking into account the issue of intermediation in the analysis of corruption; role of corruption related intermediation in credit market etc. However, none of the papers in existing lot have focus on informal wage and welfare. Here we will try to fill up this caveat.

In early literature, bureaucratic complications allied corruption was considered as "grease in the wheels of commerce and trade" [Leff (1964), Huntington (1968)]. The fundamental argument stresses corruption as signals for firms' competitive efficiency. But "grease theory" has lost much of its importance later and started being considered as "sand" than "grease". Afterward Kaufman & Wei (1999) tested the grease theory, empirically, but found no support in its favor.

Recently Marjit et al (2007) introduced informality and corruption in a partial equilibrium framework. In addition Marjit and Mandal (2012) also formulated a general equilibrium structure to assess the influence of trading cost/distribution cost on wage, rental, output and welfare. They have nicely started with arguing how trading cost and bureaucracy related intermediation cost can be used interchangeably. While doing that it has also explained the effects of symmetric and asymmetric change in trading cost and their reliance on factor intensity assumption of trading as a separate activity. This paper further emphasized welfare implication of such changes. But there was no informal sector. Here we have that. In line of Marjit and Mandal (2012) we also develop a general equilibrium structure with two final goods where both use another service or good in order to combat bureaucracy linked complications. So in a sense final goods are vertically integrated. One important merit of our paper over the existing papers is that here we endogenously determine the price of the service (call it intermediate input) required for goods' production. Beside, we successfully decide on informal wage, unlike other papers and can evaluate welfare implications.

Corruption related service and hence the required cost in our framework redirects some labor and capital from productive sector. This is in line with Bhagwati (1982) and Shleifer & Vishny (1993). Corruption is viewed in Bhagwati (1982) as DUP activity as many people engaged in corruption essentially avail of the arbitrage opportunities [Wei (1997)], acting as middlemen and intermediaries. Such diversion of resources is really costly for the society and thus is related to the ideas of Shleifer and Vishny (1993). This argument is drawn from our day-to day experience that economic agents often have to comply with the undesired forces of bureaucratic regulation, intervention, rent-seeking etc. Such activities lead to surfacing of a sector which produces good/service to be used as an intermediate input in final good production. The service might be used for negotiation for political / bureaucratic special favors, to jump the "queue" and engage in many other intermediations. The transaction costs due to such corruption are essentially spending to sustain this non-traded intermediate input sector.

The basic results that we derive in this paper are:

(1) Bureaucratic reform may lead to an increase in both informal wage and informal output under certain factor intensity condition(s);
(2) If bureaucratic control is reduced in informal sector, informal wage goes up but the effect on informal output is uncertain; and
(3) Welfare crucially hinges on two opposing effects – one due to labor reallocation and other due to change in tariff revenue.

The rest of the paper is schematized as follows. In the next section we formulate the model and try to solve it intuitively. Section 3 describes the mathematical expositions along with economic explanations for changes in E (overall bureaucratic efficiency) and a_{G1} (bureaucracy in informal sector). Subsequent section focuses on welfare implications of the changes mentioned here. This is succeeded by some concluding remarks in the last section. However, the relevant mathematical details are relegated to the Appendix.

2. The Basic Model and Solution

With this backdrop let us consider a small open economy producing final goods 1 and 2 and one intermediate input or service G. Good 1 is produced in the informal counterpart of the economy whereas 2 and G belong to formal segment. All production functions follow neo-classical framework. G is used in both 1 and 2 as input. This is what we define as the service of negotiating with undesired bureaucratic control or regulation and the price is denoted by P_G. Sectors 1 and 2 share L and K as factors of production. Labor employed in 2 gets wage W^* which is higher than W the wage rate that they could get in 1. This assumption is quite sensible in that people first try to get a job in the formal sector as the wage rate is higher there. If they don't find one, move to informal sector where wage rate is determined through competitive labor demand and supply functions. This should never be higher than W^* . W^* is pre-fixed by labor unions. And labor union normally does not accept any wage equal to or less than W. Existence of informal sector therefore guarantees full employment of labor. The way we introduce informal sector in a standard general equilibrium model follows Beladi and Chao (1993), Agenor and Montiel (1997), Beladi and Yabuchchi (2001), Marjit (2003), Amaral and Quintin (2006) etc. Nevertheless, it is to be noted that the effective price of intermediate input crucially depends on bureaucratic efficiency. This is measured by E. An efficient bureaucracy implies less per unit price of G and hence lower expenditure on L and K employed in such operations. We further assume that good 2 is subject to tariff protection. Tariff is imposed at the rate t.

The symbols and basic equations are in consistence with Jones (1965). To build the system of equations, we use following notations:

P_i = Price of i[th] good, *i = 1, 2, G* ; W^* = Return to labor in the formal sector; W = Return to labor in the informal sector; *r* = Return to capital, *K*; a_{ij}= Technological co-efficient; K = Total supply of capital; L= Total supply of labor;

Competitive price condition entails the following

$$Wa_{L1} + ra_{K1} + P_G a_{G1} = P_1 \tag{1}$$

$$W^* a_{L2} + ra_{K2} + P_G a_{G2} = P_2(1 + t) \tag{2}$$

$$W^* a_{LG} + ra_{KG} = EP_G \tag{3}$$

Full employment of factors makes sure that the following equations are satisfied

$$a_{L1}X_1 + a_{L2}X_2 + a_{LG}X_G = L \tag{4}$$

$$a_{K1}X_1 + a_{K2}X_2 + a_{KG}X_G = K \tag{5}$$

$$a_{G1}X_1 + a_{G2}X_2 = X_G \tag{6}$$

Essentially the model has six unknown variables $W, r, P_G, X_1, X_2\ and\ X_G$ to solve from equation (1) through (6). So in brief the model is solvable. Assumption of a small open economy reduces the model to one with given P_1 and P_2. Let us first start with some E and t . Thus P_G and r are determined from (2) and (3). Here it is worth mentioning that W^* is given. One can plug P_G and r in (1) to get the equilibrium value of W. Since all factor prices are determined, a_{ij} s are calculated from CRS assumption. Thus X_1, X_2 and X_G are solved from (4), (5) and (6).

It is also to be noted that substituting from (6) in (4) and (5) we respectively obtain

$$(a_{L1} + a_{G1}a_{LG})X_1 + (a_{L2} + a_{G2}a_{LG})X_2 = L \quad \text{(4A)}$$

$$(a_{K1} + a_{G1}a_{KG})X_1 + (a_{K2} + a_{G2}a_{KG})X_2 = K \quad \text{(5A)}$$

A careful investigation of (4A) and (5A) reveal that the structure is essentially demonstrating the feature of using an intermediate good/service to produce the final good or to make the goods marketable. Both 1 and 2 are vertically integrating sectors where both use G as input. Therefore, one interesting feature of the structure is that both 1 and 2 use only L and K either directly or indirectly (in form of G which is also produced by L and K).

Social welfare of the economy is measured by the following strictly quasi-concave social welfare function.

$$U = U(D_1, D_2) \quad \text{(7)}$$

Where D_i is the aggregate demand for the i th commodity with $i = 1,2$.

National income at domestic prices is given by

$$Y = P_1X_1 + P_2X_2 = WL + (W - W^*)(L - a_{L1}X_1) + rK + tP_2(D_2 - X_2) \quad \text{(8)}$$

We would be using both (7) and (8) to assess welfare implication of any policy in the framework that we developed here.

3.1. Effects of Different Reformatory Policies

In this section we attempt to look at how reform can put its mark on the endogenous variables that we have defined before. We have two instruments that can be used as policy variables: E, bureaucratic efficiency; and a_{G1}, bureaucratic control in informal sector. With an increase in bureaucratic efficiency (bureaucratic reform) E takes a higher value and thus the Right Hand Side (RHS) goes up. On the other hand, if there is a decline in the requirement of G in negotiating bureaucrats related with 1, a_{G1} must fall[1].

We first chalk out the general mathematical channels encompassing all effects[2]. Then we attempt to separate out the effects one by one. Our focus is on the informal wage and formal outputs in tandem. In doing so we shall use a "hat" (following Jones '65 and '71) over a variable to represent proportionate change.

Through simple mathematical manipulation one gets

$$\hat{r} = (-)\frac{1}{|\theta|}\left(\theta_{G2}\hat{E}\right) \tag{9}$$

$$\hat{P}_G = \frac{1}{|\theta|}\left(\theta_{K2}\hat{E}\right) \tag{10}$$

$$\widehat{W} = \frac{\hat{E}}{|\theta|\theta_{L1}}\left(\theta_{K1}\,\theta_{G2} - \theta_{G1}\theta_{K2}\right) - \frac{\theta_{G1}}{\theta_{L1}}\hat{a}_{G1} \tag{11}$$

Note that θs bear usual meaning, the value share of factors or services, e.g. $\theta_{KG} = \frac{a_{KG.r}}{EP_G}$, $\theta_{K2} = \frac{a_{K2.r}}{P_{2(1+t)}}$, $\theta_{G2} = \frac{a_{G2.P_G}}{P_{2(1+t)}}$, $\theta_{L1} = \frac{a_{L1.W}}{P_1}$, $\theta_{G1} = \frac{a_{G1.P_G}}{P_1}$ etc. and define $|\theta| = (-)(\theta_{K2} + \theta_{G2}\theta_{KG}) < 0$.

Analogously, from full employment conditions of factors we can derive the values of $\hat{X}_1$ and $\hat{X}_2$ in terms of $\hat{E}, \hat{t}$ *and* $\hat{a}_{G1}$ (we assume that factor endowments are constants but factor substitution is possible)

$$\hat{X}_1 = \frac{1}{|\lambda|}\left\{\hat{E}\left(A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2}\right) - \hat{a}_{G1}\left(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2}\right)\right\} \tag{12}$$

$$\hat{X}_2 = \frac{1}{|\lambda|}\left\{-\hat{E}\left(A_1\bar{\lambda}_{K1} + B_1\bar{\lambda}_{L1}\right) + \hat{a}_{G1}\left(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1}\right)\right\} \tag{13}$$

λs represent factors' employment share e.g. $\lambda_{L1} = \frac{a_{L1}X_1}{L}$, $\lambda_{G1} = \frac{a_{G1}X_1}{X_G}$, $\lambda_{G2} = \frac{a_{G2}X_2}{X_G}$ etc. Further define $S_{LL}^1 = \frac{\partial a_{L1}}{\partial W}\frac{W}{a_{L1}}$, $S_{LK}^1 = \frac{\partial a_{L1}}{\partial r}\frac{r}{a_{L1}}$, $S_{KK}^1 = \frac{\partial a_{K1}}{\partial r}\frac{r}{a_{K1}}$ and so on. We also know that $(S_{LL}^1 + S_{LK}^1) = 0 = (S_{KK}^1 + S_{KL}^1)$.

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[1] This idea can easily be replicated as one where "middlemen" in agricultural marketing are replaced by one or a few buyers leading to less bureaucratic obstacles and/or intermediators. So one may think of extending the current essay to encompass the effects of issues like FDI in retail marketing, monopsonistic agricultural goods market etc.

[2] For detailed calculation please refer to Appendix A.1.

$A_1 = \frac{1}{|\theta|}\left[\lambda_{L1}S_{LK}^1\left(\frac{\theta_{L1}\,\theta_{G2}+\theta_{K1}\,\theta_{G2}-\theta_{G1}\,\theta_{K2}}{\theta_{L1}}\right) + \lambda_{L2}S_{LK}^2\,\theta_{G2} + \lambda_{LG}S_{LK}^G\,\theta_{G2}\right]$

$A_1 < 0$, iff $(\theta_{L1}\,\theta_{G2} + \theta_{K1}\,\theta_{G2}) \geq \theta_{G1}\,\theta_{K2}$

A closer inspection of the above inequality asserts that if $\theta_{G2} \geq \theta_{G1}$ the above inequality would be automatically satisfied.

$B_1 = \frac{1}{|\theta|}\left[\lambda_{K1}S_{KL}^1\left(\frac{\theta_{L1}\,\theta_{G2}+\theta_{K1}\,\theta_{G2}-\theta_{G1}\,\theta_{K2}}{\theta_{L1}}\right) + \lambda_{K2}S_{KL}^2\,\theta_{G2} + \lambda_{KG}S_{KL}^G\,\theta_{G2}\right]$

$B_1 < 0$, iff $(\theta_{L1}\,\theta_{G2} + \theta_{K1}\,\theta_{G2}) \geq \theta_{G1}\,\theta_{K2}$. Same reasoning like A_1 also applies here.

$A_2 = \left(\lambda_{LG}\lambda_{G1} + \lambda_{L1}S_{LK}^1\,\frac{\theta_{G1}}{\theta_{L1}}\right) > 0$

$B_2 = \left(\lambda_{K1}S_{KL}^1\,\frac{\theta_{G1}}{\theta_{L1}} - \lambda_{KG}\lambda_{G1}\right) = \frac{1}{\theta_{L1}}(\lambda_{K1}S_{KL}^1\,\theta_{G1} - \lambda_{KG}\lambda_{G1}\,\theta_{L1})$

The value of B_2 significantly depends on the value of the variables within the parenthesis.

$B_2 \gtrless 0$ if $\frac{\lambda_{K1}}{\lambda_{KG}}\frac{S_{KL}^1}{\lambda_{G1}} \gtrless \frac{\theta_{L1}}{\theta_{G1}}$

Now let us define,
$$\left.\begin{aligned}\bar{\lambda}_{L1} &= (\lambda_{L1} + \lambda_{LG}\lambda_{G1}) > 0\\ \bar{\lambda}_{L2} &= (\lambda_{L2} + \lambda_{LG}\lambda_{G2}) > 0\\ \bar{\lambda}_{K1} &= (\lambda_{K1} + \lambda_{KG}\lambda_{G1}) > 0\\ \bar{\lambda}_{K2} &= (\lambda_{K2} + \lambda_{KG}\lambda_{G2}) > 0\end{aligned}\right\}$$

A careful investigation of the RHS of the first condition reveals that λ_{L1} implies direct requirement of L in producing 1 whereas $\lambda_{LG}\lambda_{G1}$ represents indirect requirement of L in producing 1 via G. Same reasoning also applies for $\bar{\lambda}_{L2}$, $\bar{\lambda}_{K1}$ and $\bar{\lambda}_{K2}$. This argument follows straight from the vertically integrating nature of 1 and 2.

Following our previous explanations we argue that $|\lambda|\{= \left(\bar{\lambda}_{L1}\bar{\lambda}_{K2} - \bar{\lambda}_{K1}\bar{\lambda}_{L2}\right)$ (say)}>0 if total labor requirement in 1 higher than 2 in comparison with capital. In other words vertically integrating 1 is labor-intensive than vertically integrating 2.

Now let us move to the issue of separating out the effects of change in E and a_{G1}.

3. 2. Change in *E*

We first focus on change in E. given t if bureaucracy becomes more efficient, E goes up leading to a fall in the price or cost that producers need to pay to combat bureaucracy related menace. This, in turn, may indicate an increase in the return to capital. These are evident from (9) and (10) . Then comes the issue of informal wage, W.

$$\widehat{W} = \frac{\hat{E}}{|\theta|\theta_{L1}} \left(\theta_{K1}\, \theta_{G2} - \theta_{G1}\theta_{K2} \right)$$

Here $|\theta| < 0$ and $\hat{E} > 0$. This implies $\widehat{W} > 0$ if $\theta_{K1}\, \theta_{G2} < \theta_{G1}\theta_{K2}$.

Using equation (12)

$$\hat{X}_1 = \frac{1}{|\lambda|}\{\hat{E}\, (A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2})\}$$

We know that $\hat{E}, |\lambda|,\ \bar{\lambda}_{K2},\ \bar{\lambda}_{L2} > 0$. And the condition for A_1 and B_1 to be zero are most likely to hold. Thus an increase in X_1 is ensured. Following this we have the proposition:

PROPOSITION I: *An increase in bureaucracy efficiency leads to*

(a) *An increase in informal wage if* $\frac{\theta_{K2}}{\theta_{G2}} > \frac{\theta_{K1}}{\theta_{G1}}$;

(b) *A contraction of informal sector if* $\theta_{G2} \geq \theta_{G1}$.

The economic intuition runs as follows. An efficient bureaucracy implies that lower cost has to be paid for bureaucracy related intermediation activities. In what follows other factors' return must change. As sector 2 is capital-intensive, r goes up leading to opening up the possibility of factor substitution. Since formal wage is constant and capital endowment is held fixed, sector 2 must expand (this is also evident from (13). Capital can easily be relocated between 1 and 2 as the return is identical. 2 draws up both capital and labor from 1. Therefore 1 must contract. On the other hand labor moves out of informal sector implying a supply crunch. This pushes up the informal wage. To put in a different way, as 1 uses relatively less capital the value of increase in the cost of capital must be less than that of in 2. Even if we assume $P_G a_{G1}$ and $P_G a_{G2}$ as identical, W has to increase to compensate for lower enhancement in capital cost.

QED

3. 3. A fall in a_{G1}

Any effort to formalize the informal unit surely reduces bureaucracy related complications. This is reflected in a reduction in the requirement of G in 1. In other words we can also think of a reduction in cost of agricultural marketing or trading. It is apparent from the system[3] that there would be no change in r and P_G. Therefore the only effect would be on W.

$\widehat{W} = (-)\frac{\theta_{G1}}{\theta_{L1}}\hat{a}_{G1} > 0$ as $\hat{a}_{G1} < 0$

Equation (12) asserts that $\hat{X}_1 = (-)\frac{1}{|\lambda|}\{\hat{a}_{G1}(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2})\}$

The value of $\hat{X}_1$ is ambiguous.

$$\hat{X}_1 > 0 \text{ if } \frac{\lambda_{K1}}{\lambda_{KG}}\frac{S_{KL}^1}{\lambda_{G1}} > \frac{\theta_{L1}}{\theta_{G1}} \qquad (14)$$

However, $\hat{X}_1$ may take any value if $\frac{\lambda_{K1}}{\lambda_{KG}}\frac{S_{KL}^1}{\lambda_{G1}} < \frac{\theta_{L1}}{\theta_{G1}}$. Under this condition $\hat{X}_1 \gtreqless 0$ if

$$\left\{\lambda_{G1}(\lambda_{LG}\bar{\lambda}_{K2} + \lambda_{KG}\bar{\lambda}_{L2}) + \frac{\theta_{G1}}{\theta_{L1}}\lambda_{L1}S_{LK}^1\bar{\lambda}_{K2}\right\} \gtreqless \frac{\theta_{G1}}{\theta_{L1}}\lambda_{K1}S_{KL}^1\bar{\lambda}_{L2} \qquad (15)$$

Thus the following proposition is immediate

PROPOSITION II: *Due to reduction in bureaucratic control in the informal sector*

(a) Informal wage unambiguously goes up;

(b) Informal output may expand under two reasonable conditions.

A fall in a_{G1} indicates, in turn, a savings in cost of production/marketing as expenditure for "unproductive" activity, per se, falls. Beside as there is no change in r and P_G, the saved amount would be spent on labor. This, essentially, guarantees the result of Proposition III (a). However, the ambiguity in output effect emanates from elasticity of substitution and as formal labor may not find it lucrative to go out of 2 as long as $W < W^*$. An increase in W can (should) no way guarantee the reversal of this inequality. This argument is also supported by the uncertainty of capital relocation as the return is identical everywhere.

QED

[3] Interested readers may check it from Equation (A.1.9) and (A.1.10) of Appendix A.1.

4. Welfare Implication

In this section we focus on the welfare effects of such changes that are explained in the foregoing section. First we describe the mathematical formulation[4] and then, in brief, we explain the economic arguments.

From the social welfare function the change in welfare is defined as

$$dU \Big/ \frac{\partial U}{\partial D_1} = dD_1 + P_2^* dD_2 \quad \text{(assume } P_1 = 1 \text{ and } P_2^* = P_2(1+t)\text{)}$$

The trade balance equation is given by (at domestic prices) $(X_1 - D_1) = P_2(D_2 - X_2)$. At international prices, $D_1 + P_2^* D_2 = X_1 + P_2^* X_2 + tP_2 M$ (where $M = D_2 - X_2$ and $D_2 = D_2(P_2^*, Y)$; Y signifies national income at domestic prices.)

Taking clue from small economy assumption we derive

$$dU \Big/ \frac{\partial U}{\partial D_1} = dD_1 + P_2^* dD_2 = dX_1 + P_2^* dX_2 + tP_2 dM$$

Form import demand function we get

$$dM = V\left[-\frac{\partial D_2}{\partial Y}(W^* - W)dL_1 - dX_2\right]$$

Where, $V = \frac{(1+t)}{\{1+t(1-m)\}} > 0$ and $m = P_2^* \frac{\partial D_2}{\partial Y}$ marginal propensity to consume good 2 such that $0 < m < 1$.

Hence, eventually, $dU \Big/ \frac{\partial U}{\partial D_1} = V[-(W^* - W)dL_1 + tP_2(-dX_2)]$

Define $\frac{\partial U}{\partial D_1} = U_1$. Manipulating the above equation we arrive at the solutions for $\frac{dU}{dE} \Big/ U_1$ and $\frac{dU}{da_{G1}} \Big/ U_1$ as

$$\frac{dU}{dE} \Big/ U_1 = (-)V\Big[(W^* - W)\frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}\{|\theta|\theta_{L1}(A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2}) - S_{LK}^1|\lambda|(\theta_{L1}\,\theta_{G2} + \theta_{K1}\,\theta_{G2} - \theta_{G1}\,\theta_{K2})\} - tP_2\frac{X_2}{E}\frac{1}{|\lambda|}(A_1\bar{\lambda}_{K1} + B_1\bar{\lambda}_{L1})\Big] \quad (16)$$

[4] Detailed derivations are provided in Appendix A.2.

$$\frac{dU}{da_{G1}}\Big/U_1 = (-)V\left[(W^*-W)\frac{L_1}{a_{G1}}\frac{1}{|\lambda|\theta_{L1}}\left\{|\lambda|\,\theta_{G1}S_{LK}^1 - \theta_{L1}\left(A_2\bar{\lambda}_{K2}+B_2\bar{\lambda}_{L2}\right)\right\} + tP_2\frac{X_2}{a_{G1}}\frac{1}{|\lambda|}\left(A_2\bar{\lambda}_{K1}+B_2\bar{\lambda}_{L1}\right)\right] \tag{17}$$

Welfare is barely defined here by the change in real income or total disposable income of the consumers. Since we are not indulging into any tax whatsoever, the entire factor income and income generated from tariff revenue constitute total disposable income. Factor income is again comprised of wage income and total rent paid to the capital. Throughout the analysis r remains unchanged and so is the capital income. But there is a possibility that labor moves from informal sector to formal sector and can earn higher wage. This indicates an increase in wage income. However, factor substitution between labor and capital may affect welfare differently. On the other hand tariff revenue depends on the import demand and hence on the production of the tariff protected formal good, 2. Tariff revenue goes up (falls) as 2 falls (goes up). It is also to be noted that, by assumption entire tariff revenue is redistributed among nationals for consumption purpose. Marginal propensity to import also comes into the analysis.

In addition if we do not allow factor substitutability one negative effect (i.e S_{LK}^1 becomes zero) would be vanished from the result as producer would be able to substitute costly labor by relatively cheap capital implying a greater chance of increasing welfare due to reform. Thus subsequently welfare effect can be disaggregated into labor reallocation effect and tariff revenue effect. And again labor reallocation effect can be of two types: one when technology is constant and other when we consider variable co-efficient technology. Hence a counter intuitive outcome of welfare reduction is a possibility.

Hence we propose that:

PROPOSITION III: *The welfare will increase*

(i) Following an increase in E

(a) If $(W^*-W)\frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}\left\{|\theta|\theta_{L1}\left(A_1\bar{\lambda}_{K2}+B_1\bar{\lambda}_{L2}\right)\right\} > tP_2\frac{X_2}{E}\frac{1}{|\lambda|}\left(A_1\bar{\lambda}_{K1}+B_1\bar{\lambda}_{L1}\right)$, *when technology is fixed;*

(b) If

$(W^*-W)\frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}\left\{|\theta|\theta_{L1}\left(A_1\bar{\lambda}_{K2}+B_1\bar{\lambda}_{L2}\right)\right\} > \left\{(W^*-W)\frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}S_{LK}^1|\lambda|(\theta_{L1}\,\theta_{G2}+\theta_{K1}\,\theta_{G2}-\theta_{G1}\,\theta_{K2}) + tP_2\frac{X_2}{E}\frac{1}{|\lambda|}\left(A_1\bar{\lambda}_{K1}+B_1\bar{\lambda}_{L1}\right)\right\}$, *when technology is variable;*

(ii) Following a fall in a_{G1}

(a) If $\left\{(W^* - W)\frac{L_1}{a_{G1}}\frac{1}{|\lambda|\theta_{L1}}\,\theta_{L1}\left(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2}\right)\right\} > tP_2\frac{X_2}{a_{G1}}\frac{1}{|\lambda|}\left(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1}\right)$ *, when technology is fixed;*

(b)If $\left\{\theta_{L1}\left(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2}\right)\right\} > \left[tP_2\frac{X_2}{a_{G1}}\frac{1}{|\lambda|}\left(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1}\right) + (W^* - W)\frac{L_1}{a_{G1}}\frac{1}{|\lambda|\theta_{L1}}|\lambda|\,\theta_{G1}S_{LK}^1\right]$ *, when technology is variable;*

Proof: See discussion above.

5. Conclusion

In this paper we have attempted to structure a three-sector model where goods and services are produced following neo-classical assumptions. Out of these three two use an intermediate service or good produced in the third sector. It has been proved in this set up that due to an increase in bureaucratic efficiency informal wage would go up if informal good is intermediate service intensive than formal good in comparison with capital. Whereas, informal sector would contract if the value share of intermediate service is higher in formal good than informal one. On the other hand informal wage would unambiguously increase if bureaucratic control is reduced in informal sector. However, on the welfare front if the labor reallocation effect dominates over the tariff revenue effect, welfare goes up consequent upon reform.

If informal sector does not encompass any dangerously harmful activities as such for the society, this paper has some intriguing policy implications primarily because of two conflicting reasons. From any developing economy's perspective removal of informality is not a feasible option owing to huge population pressure. In that case government may go for initiating policies to ensure increasing bureaucratic efficiency, reducing bureaucratic bottleneck in some sectors. This may boost up informal workers standard of living through increased income. Nevertheless one should keep in mind that reduction of bureaucratic control in informal sector may imply semi-formalization or formalization of informal segment which in turn may have some further revenue inference through tax. These policies may also help the economy to reduce the size of the informal counterpart substantially in tandem if carefully engineered. However, on the other hand if informal sector expands and it really does employ significant number of people, welfare of the economy as a whole must be saddened. Therefore it would be a tough call for both policy makers and politicians to choose the right trajectory. Thus the paper may shed some light on the issue as to what extent bureaucratic reform is desired given the nature of input requirement and value share of intermediate service.

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Appendix

A.1. General Mathematical Derivations

Differentiating fully (2), (3) and (1) can be redefined as follows

$$\hat{r}\theta_{K2} + \hat{P}_G\theta_{G2} = 0 \quad (A.1.1)$$

$$\hat{r}\theta_{KG} - \hat{P}_G = \hat{E} \quad (A.1.2)$$

$$\widehat{W}\theta_{L1} + \hat{r}\theta_{K1} + \hat{P}_G\theta_{G1} = -\theta_{G1}\hat{a}_{G1} \quad (A.1.3)$$

Also note that θs bear usual meaning, the value share of factor or service in final commodity, e.g. $\theta_{KG} = \frac{a_{KG.r}}{EP_G}$, $\theta_{K2} = \frac{a_{K2.}r}{P_{2(1+t)}}$, $\theta_{G2} = \frac{a_{G2.}P_G}{P_{2(1+t)}}$, $\theta_{L1} = \frac{a_{L1.}W}{P_1}$, $\theta_{G1} = \frac{a_{G1.}P_G}{P_1}$ etc.

Using Cramer's rule we can solve for the values of $\hat{r}$ and $\hat{P}_G$ from (A.1.1) and (A.1.2).

$$\hat{r} = (-)\frac{1}{|\theta|}\left(\theta_{G2}\hat{E}\right) \quad (A.1.4)$$

$$\hat{P}_G = \frac{1}{|\theta|}\left(\theta_{K2}\hat{E}\right) \quad (A.1.5)$$

Define $|\theta| = (-)(\theta_{K2} + \theta_{G2}\theta_{KG})$

If we substitute the values of $\hat{r}$ and $\hat{P}_G$ form (A.1.4) and (A.1.5) into (A.1.3)

$$\widehat{W} = \frac{\hat{E}}{|\theta|\theta_{L1}}\left(\theta_{K1}\,\theta_{G2} - \theta_{G1}\theta_{K2}\right) - \frac{\theta_{G1}}{\theta_{L1}}\hat{a}_{G1} \quad (A.1.6)$$

Analogously, from full employment conditions of factors we derive (we assume that factor endowments are constants but factor substitution is possible)

$$\hat{X}_1\lambda_{L1} + \hat{X}_2\lambda_{L2} + \hat{X}_G\lambda_{LG} = (-)\lambda_{L1}\left(S_{LL}^1\widehat{W} + S_{LK}^1\hat{r}\right) - \lambda_{L2}S_{LK}^2\hat{r} - \lambda_{LG}S_{LK}^G\hat{r} \quad (A.1.7)$$

$$\hat{X}_1\lambda_{K1} + \hat{X}_2\lambda_{K2} + \hat{X}_G\lambda_{KG} = (-)\lambda_{K1}\left(S_{KL}^1\widehat{W} + S_{KK}^1\hat{r}\right) - \lambda_{K2}S_{KK}^2\hat{r} - \lambda_{KG}S_{KK}^G\hat{r} \quad (A.1.8)$$

$$\hat{X}_1\lambda_{G1} + \hat{X}_2\lambda_{G2} - \hat{X}_G = (-)\lambda_{G1}\,\hat{a}_{G1} \quad (A.1.9)$$

Incorporating (A.1.9) into (A.1.8) and (A.1.7)

$\hat{X}_1(\lambda_{L1} + \lambda_{LG}\lambda_{G1}) + \hat{X}_2(\lambda_{L2} + \lambda_{LG}\lambda_{G2}) = (-)\lambda_{LG}\lambda_{G1}\hat{a}_{G1} + \lambda_{L1}S_{LL}^1\widehat{W} - \big(\lambda_{L1}S_{LK}^1 + \lambda_{L2}S_{LK}^2 + \lambda_{LG}S_{LK}^G\big)\hat{r}$ (A.1.10)

$\hat{X}_1(\lambda_{K1} + \lambda_{KG}\lambda_{G1}) + \hat{X}_2(\lambda_{K2} + \lambda_{KG}\lambda_{G2}) = (-)\lambda_{KG}\lambda_{G1}\hat{a}_{G1} - \lambda_{K1}S_{KL}^1\widehat{W} + \big(\lambda_{K1}S_{KL}^1 + \lambda_{K2}S_{KL}^2 + \lambda_{KG}S_{KL}^G\big)\hat{r}$ (A.1.11)

λs represent factors' employment share e.g. $\lambda_{L1} = \frac{a_{L1}X_1}{L}$, $\lambda_{G1} = \frac{a_{G1}X_1}{X_G}$, $\lambda_{G2} = \frac{a_{G2}X_2}{X_G}$ etc. Further define $S_{LL}^1 = \frac{\partial a_{L1}}{\partial W}\frac{W}{a_{L1}}$, $S_{LK}^1 = \frac{\partial a_{L1}}{\partial r}\frac{r}{a_{L1}}$, $S_{KK}^1 = \frac{\partial a_{K1}}{\partial r}\frac{r}{a_{K1}}$ and so on. We also know that $(S_{LL}^1 + S_{LK}^1) = 0 = (S_{KK}^1 + S_{KL}^1)$.

$\bar{\lambda}_{L1}, \bar{\lambda}_{L2}, \bar{\lambda}_{K1}\ and\ \bar{\lambda}_{K2}$ are already defined in the main body of the paper

A careful investigation of the RHS of the first condition reveals that λ_{L1} implies direct requirement of L in producing 1 whereas $\lambda_{LG}\lambda_{G1}$ represents indirect requirement of L in producing 1 via G. Same reasoning also applies for $\bar{\lambda}_{L2}$, $\bar{\lambda}_{K1}$ and $\bar{\lambda}_{K2}$. This argument follows straight from the vertically integrating nature of 1 and 2.

Substituting $\widehat{W}$ and $\hat{r}$ in (A.1.10) and (A.1.11)

$\hat{X}_1\bar{\lambda}_{L1} + \hat{X}_2\bar{\lambda}_{L2} = \hat{E}\ A_1 - \hat{a}_{G1}A_2$ (A.1.12)

$\hat{X}_1\bar{\lambda}_{K1} + \hat{X}_2\bar{\lambda}_{K2} = -\hat{E}\ B_1 + \hat{a}_{G1}A_2$ (A.1.13)

Interpretations of A_1, B_1, A_2, B_2 are already provided in the main text.

Here, using Cramer's rule we can easily solve for $\hat{X}_1$ and $\hat{X}_2$ in terms of $\hat{E}\ and\ \hat{a}_{G1}$ from (A.1.12) and (A.1.13).

$\hat{X}_1 = \frac{1}{|\lambda|}\{\hat{E}\ (A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2}) - \hat{a}_{G1}(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2})\}$ (A.1.14)

$\hat{X}_2 = \frac{1}{|\lambda|}\{-\hat{E}\ (A_1\bar{\lambda}_{K1} + B_1\bar{\lambda}_{L1}) + \hat{a}_{G1}(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1})\}$ (A.1.15)

A.2. Welafre Derivation

From the social welfare function the change in welfare is defined as

$$dU = \frac{\partial U}{\partial D_1}dD_1 + \frac{\partial U}{\partial D_2}dD_2$$

$$dU \Big/ \frac{\partial U}{\partial D_1} = dD_1 + P_2^* dD_2$$ (assume $P_1 = 1$ and $P_2^* = P_2(1+t)$)

While calculating the welfare it needs to be taken into account that D_1 and D_2 themselves contain all consumption of G.

The trade balance equation is given by (at domestic prices)

$(X_1 - D_1) = P_2(D_2 - X_2)$

Or, $D_1 + P_2D_2 = X_1 + P_2X_2$

At international prices

$D_1 + P_2^*D_2 = X_1 + P_2^*X_2 + tP_2M$ (where $M = D_2 - X_2$ and $D_2 = D_2(P_2^*, Y)$; Y signifies national income at domestic prices.)

$Y = X_1 + P_2^*X_2 + tP_2M$

Taking clue from the small economy assumption we derive

$dU \Big/ \frac{\partial U}{\partial D_1} = dD_1 + P_2^*dD_2 = dX_1 + P_2^*dX_2 + tP_2dM$ and

$dY = dX_1 + P_2^*dX_2 + tP_2dM$

Or, $dY = (F_L^1 dL_1 + F_K^1 dK_1 + P_G a_{G1} dX_1) + (P_2^* F_L^2 dL_2 + P_2^* F_K^2 dK_2 + P_G a_{G2} dX_2) + tP_2dM$

Where, $F_L^1 = MP_L^1$, $F_L^2 = MP_L^2, F_K^1 = MP_K^1$, $F_K^2 = MP_K^2$ and so on. Substituting marginal productivity equals to money return to factors

$dY = WdL_1 + rdK_1 + W^*dL_2 + rdK_2 + P_G(a_{G1}dX_1 + a_{G2}dX_2) + P_2(tdM)$

In terms of factor return and tariff revenue the above equation can be reduced to

$dY = WdL_1 + W^*(dL_2 + dL_G) + r\ (dK_1 + dK_2 + dK_G) + P_2(tdM)$

We know that

$X_G = a_{G1}X_1 + a_{G2}X_2$

Or, $dX_G = a_{G1}dX_1 + a_{G2}dX_2$

Again $X_G = f(L_G, K_G\ )$ where L_G and K_G represent labor and capital requirement in G, respectively.

Therefore, $dX_G = F_L^G dL_G + F_K^G dK_G = a_{G1}dX_1 + a_{G2}dX_2$

Note that capital always gets identical return, r. Labor can, however, get a higher return if moves out of 1. Hence, $dY = (WdL_1 - W^*dL_2) + P_2(tdM)$ (as $L_1 + L_2 + L_G = \bar{L}\ or\ (-)dL_1 = dL_2 + dL_G$)

Form import demand function we get

$dM = \frac{\partial D_2}{\partial P_2^*}dP_2^* + \frac{\partial D_2}{\partial Y}P_2tdM - \frac{\partial D_2}{\partial Y}(W^* - W)dL_1 - dX_2$

$dM = V\left[-\frac{\partial D_2}{\partial Y}(W^* - W)dL_1 - dX_2\right]$

Substituting the value of dM in welfare calculation eventually we get

$dU \Big/ \frac{\partial U}{\partial D_1} = (-)(W^* - W)dL_1 + VP_2t\left[-\frac{\partial D_2}{\partial Y}(W^* - W)dL_1 - dX_2\right]$

Where, $m = P_2^* \frac{\partial D_2}{\partial Y}$ marginal propensity to consume good 2. $0 < m < 1$; and $V = \frac{(1+t)}{\{1+t(1-m)\}} > 0$.

Or, $dU \Big/ \frac{\partial U}{\partial D_1} = V[-(W^* - W)dL_1 + tP_2(-dX_2)]$

Therefore, $\frac{dU}{dE} \Big/ U_1 = (-)V\left[(W^* - W)\frac{dL_1}{dE} + tP_2 \frac{dX_2}{dE}\right]$ (Define $\frac{\partial U}{\partial D_1} = U_1$) (A.2.1)

$$\frac{dU}{da_{G1}} \Big/ U_1 = (-)V\left[(W^* - W)\frac{dL_1}{da_{G1}} + tP_2 \frac{dX_2}{da_{G1}}\right] \quad \text{(A.2.2)}$$

We already know the values of $\frac{dX_2}{dE}$ and $\frac{dX_2}{da_{G1}}$ from output effects. Thus to pinpoint the welfare implications we need to derive the values of $\frac{dL_1}{dE}$ and $\frac{dL_1}{da_{G1}}$. Reiterating the output effects

$\frac{dX_2}{dE} = (-)\frac{X_2}{E}\frac{1}{|\lambda|}\left(A_1\bar{\lambda}_{K1} + B_1\bar{\lambda}_{L1}\right) > 0$; $\frac{dX_2}{da_{G1}} = \frac{X_2}{a_{G1}}\frac{1}{|\lambda|}\left(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1}\right) > 0$.

From labor requirement equation simultaneously we have

$$\frac{dL_1}{dE} = \frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}\left[|\theta|\theta_{L1}\left(A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2}\right) - S_{LK}^1|\lambda|(\theta_{L1}\,\theta_{G2} + \theta_{K1}\,\theta_{G2} - \theta_{G1}\,\theta_{K2})\right]$$

$$\frac{dL_1}{da_{G1}} = \frac{L_1}{a_{G1}}\frac{1}{|\lambda|\theta_{L1}}\left[|\lambda|\,\theta_{G1}S_{LK}^1 - \theta_{L1}\left(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2}\right)\right]$$

Manipulating the above equation we arrive at the solutions for $\frac{dU}{dE} \Big/ U_1$ *and* $\frac{dU}{da_{G1}} \Big/ U_1$ as

$$\frac{dU}{dE} \Big/ U_1 = (-)V\Big[(W^* - W)\frac{L_1}{E}\frac{1}{|\lambda||\theta|\theta_{L1}}\left\{|\theta|\theta_{L1}\left(A_1\bar{\lambda}_{K2} + B_1\bar{\lambda}_{L2}\right) - S_{LK}^1|\lambda|(\theta_{L1}\,\theta_{G2} + \theta_{K1}\,\theta_{G2} - \theta_{G1}\,\theta_{K2})\right\} - tP_2\frac{X_2}{E}\frac{1}{|\lambda|}\left(A_1\bar{\lambda}_{K1} + B_1\bar{\lambda}_{L1}\right)\Big] \quad \text{(A.2.3)}$$

$$\frac{dU}{da_{G1}} \Big/ U_1 = (-)V\Big[(W^* - W)\frac{L_1}{a_{G1}}\frac{1}{|\lambda|\theta_{L1}}\left\{|\lambda|\,\theta_{G1}S_{LK}^1 - \theta_{L1}\left(A_2\bar{\lambda}_{K2} + B_2\bar{\lambda}_{L2}\right)\right\} + tP_2\frac{X_2}{a_{G1}}\frac{1}{|\lambda|}\left(A_2\bar{\lambda}_{K1} + B_2\bar{\lambda}_{L1}\right)\Big] \quad \text{(A.2.4)}$$