Taxation of labour, product varieties and skilled-unskilled wage inequality: Short-run versus long-run

Abstract

In a three-sector general equilibrium model we examine the impact of a partial tax on labour on skilled-unskilled wage inequality. We find that a tax on labour in industrial sector increases skilled-unskilled wage inequality in the short-run, and can have the opposite effect in the long-run. A tax on labour in the services sector reduces skilled-unskilled wage inequality in both the short-run and long-run. Furthermore, introduction of a tax on labour in agricultural sector has no effect on the skilled wage, but reduces the unskilled wage. Accordingly, such a tax increases skilled-unskilled wage inequality in both the short-run and long-run.

Keywords: Skilled-unskilled wage inequality; partial tax on labour; product varieties; monopolistic competition; short-run; long-run

JEL Classification: J31; H24; D00

1. Introduction

Economic restructuring, technological progress and an increase in the pace of globalisation has resulted in economic growth in a number of economies, notably Brazil, China and India. While there is a general improvement in the standard of living, not all groups within each country have equally benefitted. Rising wage inequality has been identified as a major concern (e.g., see Juhn, Murphy, and Pierce, 1993).

A number of studies have attempted to identify the determinants of skilled-unskilled wage inequality.[1] Early studies focused on the role of skill-biased technological progress and trade liberalisation. It has been argued that technological progress and worker skills are complementary and hence improvement in technology has resulted in a relatively large increase in the skilled wage, thereby increasing skilled-unskilled wage inequality (Acemoglu, 2002; Epifani and Gancia, 2008). Within the context of perfectly competitive market structure, trade liberalisation can also contribute to wage inequality when, for example, at least one factor of production is sector specific or workers are heterogeneous (Kumar and Mishra, 2008). Other studies, such as Chaudhuri and Yabuuchi (2007), argue that labour market imperfections can also explain the rise in skilled-unskilled wage inequality. Beladi, Chaudhuri and Yabuuchi (2008), among others, focus on the role of international factor mobility.

This paper aims to extend the existing literature on the determinants of skilled-unskilled wage inequality in a novel way. Specifically, we examine the impact of a tax on labour in different sectors on skilled-unskilled wage inequality. Recent studies, such as OECD (2012), suggest that too much attention has been paid to absolute wage inequality and factors like taxation and employment status (part time versus full time) have not received adequate attention.

[1] Wage inequality, wage gap and skill premium are three terminologies that are used interchangeably in the existing literature.

While some studies in the area of public finance (for example McLure, 1971) have highlighted the role of sector specific factors, none of the available studies has considered the link between a partial tax on labour and skilled-unskilled wage inequality. Using a three-sector general equilibrium model involving an industrial good, an agricultural good and a large number of varieties of producer services, this paper shows that a tax on labour in the industrial sector can increase skilled-unskilled wage inequality. However, a tax on labour in producer services sector reduces skilled-unskilled wage inequality. This paper also distinguishes between short-run and long-run effect of a partial tax on labour on skilled-unskilled wage inequality.

The rest of this paper is organised as follows. A brief of review of related literature is provided in section 2. Following the existing literature, a three-sector general equilibrium model involving monopolistic competition is specified in section 3. The model is used to consider the impact of the introduction of a tax on labour on skilled-unskilled wage inequality in the short-run and the long-run in section 4. The last section offers some concluding remarks.

2. Review of the related literature

A large number of studies have examined various aspects of skilled-unskilled wage inequality. These studies can be divided into three broad categories: (i) studies that highlight the role of skill-biased technological progress, (ii) studies that focus on the role of trade liberalisation and factor mobility, and (iii) studies that focus on the role of institutional quality and other factors. The rest of this section contains a brief review of some recent studies that belong to each of these three strands of existing literature on skilled-unskilled wage inequality.[2]

2.1 Technological progress and wage inequality

[2] A review of recent studies concerning the impact of skill-biased technological progress and factor mobility on skilled-unskilled wage inequality can be found in Zhang (2015).

A number of theoretical and empirical studies have examined the link between technological improvement and skilled-unskilled wage inequality. A large body of this literature is summarised by Card and DiNardo (2002). They suggest that an increase in the use of microcomputers from the late 1980s led to increase in worker productivity in the US. As skilled workers make a greater use of computers, there was a relatively larger increase in skilled wages. A number of empirical studies reviewed by Card and DiNardo highlight different aspects of the link between technology and wage inequality in US and other countries. Lemieux (2006) finds that an increase in worker education and experience can account for rising wage inequality in the US. The empirical work of Ábrahám (2008), based on data from the US, appears to suggests that the observed increase in skilled-unskilled wage inequality could be attributed to a relatively slow increase in the supply of educated workers. Using a calibrated vintage capital model with heterogeneous labour, Marquis, Trehan and Tantivong (2014) suggest that skill-biased technological progress explains only a small proportion of the increase in skilled-unskilled wage inequality in US. They argue that a shift in the distribution of human capital across skilled and unskilled workers can account for a large proportion of observed increase in skilled-unskilled wage inequality in US.

2.2 Trade liberalisation and wage inequality

In a recent review of trade and wage inequality literature, Kurokawa (2014) suggests that an increase in international trade has contributed to increase in skilled-unskilled wage inequality in the US and Mexico. Kurokawa argues that trade based explanations of wage inequality are not entirely satisfactory. For example, trade based theories fail to explain the observed decrease in the price of goods produced by skilled workers, which is inconsistent with a relatively large

increase in the skilled wage rate. This has resulted in an examination of the role of some related factors. For example, the theoretical work of Oladi, Gilbert and Beladi (2011) shows that foreign direct investment can increase the skilled-unskilled wage inequality[3]. Empirical studies that consider the impact of foreign investment on wage inequality include Taylor and Driffield (2005), Chen, Ge, and Lai (2011) and Anwar and Sun (2012). Using firm level data, Taylor and Driffield (2005) argue that foreign direct investment can account for approximately 11% of wage inequality in the UK. Anwar and Sun (2012), using firm level panel data from China's manufacturing sector, find that trade liberalisation and foreign investment can affect skilled-unskilled wage inequality. Chen, Ge and Lai (2011) argue that foreign investment in China has contributed to a decline in wages paid by some domestic firms but, generally speaking, foreign-invested firms pay higher wages and hence foreign investment has contributed to a rise in wage inequality in China.

Using a theoretical model, where job creation is endogenous, Ranjan (2012) suggests that the impact of trade on wage inequality cannot be unambiguously determined. While taking firm heterogeneity and task outsourcing into account, Bakhtiari (2012) shows that, under certain conditions, trade can affect the skilled-unskilled wage inequality. Using a sector specific model, Barua and Pant (2014) consider the impact of trade liberalisation on wage inequality in developing countries. Their analysis based on a sector specific model with full employment suggest that, as compared to free trade, labour productivity makes a relatively strong contribution to skilled-unskilled wage inequality. Barua and Pant further argue that, when labour is not fully employed in the production of a sector specific non-traded intermediate good, trade can contribute to skilled-unskilled wage inequality. While summarising the exiting literature,

[3] In addition to foreign direct investment, migration of labour is also found to affect the skilled-unskilled wage inequality, for example Kar and Beladi (2004) and Marjit and Kar (2005).

Akerman et al. (2013) suggest that the impact of trade liberalisation on productivity of all firms is not uniform, which gives rise to wage inequality as export oriented firms can pay higher wages. In a recent empirical study, Cali (2014) finds that, contrary to the predictions of the Heckscher-Ohlin theory, an increase in international trade contributed to a decrease in skilled-unskilled wage inequality in Uganda.[4] However, expansion of domestic trade has accounted for a rise in skilled-unskilled wage inequality in districts of Uganda.

2.3 Institutional and other factors

As indicted earlier, while previous studies on the determinants of skilled-unskilled wage inequality focus on the role of skilled-biased technological progress and trade, recent studies highlight other factors. For example, Anwar (2009) and Beladi and Chao (2010) focus on the link between downsizing and skilled-unskilled wage inequality. Mandal and Marjit (2010) investigate the role of corruption. Pi and Zhou (2013) consider the role of institutional quality, whereas Anwar (2008), Dutta and Gupta (2012) and Pi and Zhou (2014) show that provision of public infrastructure can affect skilled-unskilled wage inequality. Akerman et al. (2013) suggest that labour market frictions and firm heterogeneity can also explain the increase in skilled-unskilled wage inequality. The theoretical work of Anwar (2013) suggests a relationship between outsourcing and skilled-unskilled wage inequality. The empirical work of Chongvilaivan and Thangavelu (2012) focuses on the link between outsourcing and wage inequality in Thailand. Li and Zhou (2013) suggest that remittances of unskilled workers can contribute to skilled-unskilled

[4] The empirical work of Mehta and Hassan (2012) suggests that trade liberalisation has contributed to an increase in wage inequality in India.

wage inequality in developing countries. Pan and Zhou (2013) consider the role of environmental pollution, whereas Zhang (2015) highlights the role of elasticity of substitution in production.[5]

3. **A three sector model**

Consider a small open economy that produces an exportable industrial good (*Y*) and an importable agricultural good (*Z*). Skilled labour, capital and varieties of producer services (x_i) enter into the production of the industrial good. Varieties of producer services are produced by means of skilled labour and capital, whereas the importable agricultural good is produced by unskilled labour and capital. Furthermore, varieties of producer services are internationally traded. It is well known that the pattern of intra-industry trade is indeterminate, but a country will be either a net-exporter or net-importer of varieties of producer services.[6] The production function for the exportable good is as follows:

$$Y = \Theta L_{ys}^{(1-\alpha)(1-\beta)} K_y^{\beta(1-\alpha)} \left(\sum_{i=1}^{n} x_i^{\delta} \right)^{\frac{\alpha}{\delta}}$$

where L_{ys} and K_y respectively are skilled labour and capital used in the production of the industrial good; x_i is the *i*th variety of producer services used in the production of the good; n is the number of varieties produced; α, β, and δ are positive but less than 1; and

$$\Theta = \frac{1}{(1-\alpha)^{(1-\alpha)} (1-\beta)^{(1-\alpha)(1-\beta)} \alpha^{\alpha} \beta^{\beta(1-\alpha)}} > 0 .$$

[5] Other related studies include Beladi, Chakrabarti and Marjit, S. (2010), Blum (2008) and Breau and Rigby (2010).

[6] See Helpman and Krugman (1985).

The services sector produces a large number of varieties. The cost function for the *i*th variety of producer services is as follows:[7]

$$c^{x_i}\left(w_s, r, x_i; \lambda, \mu, t_x\right) = [\mu + \lambda x_i]\left(w_s\left(1+t_x\right)\right)^{1-\gamma} r^{\gamma}$$

where w_s and r respectively are the skilled wage and the reward for capital; t_x is the tax on skilled labour in the services sector and γ is positive but less than 1.[8]

The production function for good Z, which uses unskilled labour and capital, is as follows:

$$Z = \Psi L_{zu}^{(1-\theta)} K_z^{\theta}$$

where L_{zu} and K_z respectively are the unskilled labour and capital used in the production of Z; θ is positive but less than 1; and $\Psi = \dfrac{1}{\theta^{\theta} + (1-\theta)^{1-\theta}} > 0$.

Following the existing literature, for example Anwar (2010), Zhang (2012 & 2013) and Gupta and Dutta (2012), this paper focuses on a symmetric equilibrium where all varieties of producer services are equally priced. As the production of each variety is subject to internal economies of scale, and producer services varieties enter as input into the production of the industrial good Y, the production of Y is subject to external economies of scale. This implies that an increase in the number of varieties reduces the effective price of each variety. The zero profit condition that determines the equilibrium output of Y under perfect competition is as follows:

$$1 = \left(w_s\left(1+t_y\right)\right)^{(1-\alpha)(1-\beta)} r^{\beta(1-\alpha)} \left[\frac{p^{\alpha}}{n^{\frac{\alpha(1-\delta)}{\delta}}}\right] \qquad (1)$$

[7] A similar cost function has been used by, among others, Anwar (2013) and Zhang (2012 & 2013).
[8] The industrial good Y is the numéraire.

where p is the relative price of producer services varieties and t_y is the tax on labour in the industrial good sector.

The right-hand side of equation (1) is the marginal cost, whereas the left-hand side is the price of Y, which has been normalised to equal unity. Due to the presence of international economies, each variety of producer services is produced under conditions of monopolistic competition. Equation (2) determines the equilibrium output of each variety as follows:

$$\delta p = \lambda \left(w_s \left(1 + t_x\right)\right)^{1-\gamma} r^{\gamma} \tag{2}$$

The right-hand side of equation (2) is the marginal cost of production, whereas the left hand-side is marginal revenue. The final good Z is produced under perfectly competitive conditions and its equilibrium output is determined by equation (3) as follows:

$$q = \left(\left(1 + t_z\right) w_u\right)^{1-\theta} r^{\theta} \tag{3}$$

where t_z is the tax on unskilled wage; w_u and q respectively are the unskilled wage and the relative price of Z.

The market clearing level of the skilled wage is determined by the interaction of demand and supply as follows:

$$\frac{\left(1-\alpha\right)\left(1-\beta\right)Y}{\left(1+t_y\right)w_s} + \frac{\delta\left(1-\gamma\right)\left(\mu+\lambda x\right)np}{\lambda\left(1+t_x\right)w_s} = \bar{L}_s \tag{4}$$

where $\bar{L}_s$ is the supply of skilled labour, which is fixed.[9]

[9] Equilibrium conditions (1) to (3) have been used to derive simplified versions of all market clearing conditions, i.e., equations (4) to (6).

Equation (4) shows that skilled labour is used only in the production of Y and varieties of producer services. The first term on the left hand side of equation (4) is demand for labour in the industrial good sector and the second term is demand for labour in producer services sector.

Unskilled labour is used only in the production of Z and the market clearing condition is as follows:

$$\frac{(1-\theta)qZ}{w_u(1+t_z)} = \bar{L}_u \tag{5}$$

where $\bar{L}_u$ is the supply of unskilled labour, which is fixed.

Capital is used in all sectors and the relevant market clearing condition is as follows:

$$\frac{\beta(1-\alpha)Y}{r} + \frac{n(\mu+\lambda x)\gamma\delta p}{\lambda r} + \frac{\theta qZ}{r} = \bar{K} \tag{6}$$

where $\bar{K}$ is the supply of capital, which is fixed.

Equation (6) determines the equilibrium reward for capital. The first and the second terms on the left hand side of equation (6) are demand for labour in the exportable good and producer services sectors, whereas the third term is demand for labour in the agricultural sector.

Short-run equilibrium involves a situation where the number of varieties produced (i.e., the number of firms in the producer services sector) is exogenous and the equilibrium price is determined in the international market. Accordingly, the equilibrium is characterised by equations (1) to (6). There are six equations with six endogenous variables: x, r, w_s, w_u, Z and Y. Equations (1) to (6) can be used to investigate the impact of a partial tax on labour on skilled-unskilled wage inequality.

The long-run equilibrium is characterised by free entry and exit of firms, which implies that each firm within the producer services sector produces a single variety and earns zero economic profit. The following condition ensures zero economic profit.

$$(1-\delta)\, px = \mu\left((1+t_x)\, w_s\right)^{1-\gamma} r^{\gamma} \tag{7}$$

Equation (7) also determines the optimal number of varieties produced (i.e., n). Because the economy under consideration is small and varieties of producer services are internationally traded, the equilibrium price p is determined in the international market. Accordingly the long-run equilibrium where producer services are internationally traded involves seven equations in seven endogenous variables: n, x, r, w_s, w_u, Z and Y. Equations (1) to (7) can be used to investigate the impact of a partial tax on labour on skilled-unskilled wage inequality in the long-run.

4. The impact of a partial tax on labour and skilled-unskilled wage inequality

The main purpose of this section is to investigate the impact of a partial tax on labour on skilled-unskilled wage inequality. This task is accomplished by making use of the models that are presented in section 3. Specifically, we consider the link between $\left[\frac{w_s}{w_u}\right]$ and the tax rates $\left(\text{i.e., } t_y, t_x \text{ and } t_z\right)$.

4.1 Impact of a tax on labour on skilled-unskilled wage inequality in the long-run

Given that p is exogenous, equations (2) and (3) can be used to derive the following relationship.

$$\left[\hat{w}_s - \hat{w}_u\right] = \left[\left(\frac{\theta}{1-\theta}\right) - \left(\frac{\gamma}{1-\gamma}\right)\right]\hat{r} + \tau_z \hat{t}_z - \tau_x \hat{t}_x \tag{8}$$

$$\tau_z = \frac{t_z}{1+t_z}, \tau_x = \frac{t_x}{1+t_x}$$

where a caret "^" on top of a variable represents percentage change as follows:

$$\hat{w}_s = \left[\frac{dw_s}{w_s}\right],\ \hat{w}_u = \left[\frac{dw_u}{w_u}\right],\ \hat{t}_z = \left[\frac{dt_z}{t_z}\right],\ \hat{t}_x = \left[\frac{d\hat{t}_x}{t_x}\right], \text{ etc.}$$

Equation (8) shows that introduction of a tax on labour in the industrial sector affects the skilled-unskilled wage through its impact on the price of capital. However, introduction of a tax on the producer services sector and the agricultural sector affects skilled-unskilled wage inequality directly as well as indirectly through its effect on the price of capital.

The impact of the introduction of a tax on labour in the industrial sector on skilled-unskilled wage inequality can be examined by means of equation (9) as follows:

$$\left[\frac{\hat{w}_s - \hat{w}_u}{\hat{t}_y}\right] = \tau_y \left[\frac{\gamma(1-\theta)-\theta(1-\gamma)}{\Delta}\right]\left[\left[\frac{\alpha(1-\delta)}{\delta}\right]K_y L_y - (1-\alpha)(1-\beta)\left(L_x K_y - K_x L_y\right)n\right] \quad (9)$$

where
$$\Delta = -\left[\frac{\alpha(1-\delta)}{\delta}\right]\left[\theta(1-\gamma)K_z + (1-\theta)\left[\gamma K_y + (1-\gamma)\bar{K}\right]\right]L_y$$
$$-(1-\theta)\left[\beta(1-\alpha)(1-\gamma) - \gamma(1-\alpha)(1-\beta)\right]\left[L_x K_y - K_x L_y\right]n < 0 \quad .$$

The results presented in this paper depend on relative factor intensities. In the rest of this paper, we assume that that the industrial good is capital intensive relative to producer services and producer services are capital intensive relative to the agricultural good. In other words, we assume that

$$\frac{K_y}{L_y} > \frac{K_x}{L_x} > \frac{K_z}{L_z} \quad (10)$$

Using the properties of cost functions, it can be confirmed that

$$\beta(1-\alpha)(1-\gamma) > \gamma(1-\alpha)(1-\beta) \Leftrightarrow L_x L_y \left[\frac{K_y}{L_y} > \frac{K_x}{L_x}\right]$$

$$\theta(1-\gamma) > \gamma(1-\theta) \Leftrightarrow L_x L_z \left[\frac{K_x}{L_x} > \frac{K_z}{L_z}\right]$$

The above relationships imply that Δ is negative, which in turn implies that the impact of the introduction of a tax on labour in the industrial sector on skilled-unskilled wage inequality, as shown by equation (9) cannot be unambiguously determined. However, if the size of external economies in the industrial sector $\left(\text{i.e., } \frac{\alpha(1-\delta)}{\delta}\right)$ is sufficiently large then the introduction of a tax on labour can decrease skilled-unskilled wage inequality. But, if the impact of external economies arising from the use of producer services in the industrial sector is sufficiently small then the introduction of a tax on labour in the industrial sector increases skilled-unskilled wage inequality. In other words, given the assumptions regarding relative capital intensities, as $\frac{\alpha(1-\delta)}{\delta} \to 0$, the introduction of a tax on skilled labour in the industrial sector increases skilled-unskilled wage inequality. Introduction of a tax on labour in the industrial sector, as shown in equation (11), increases the number of varieties of producer services, which enhances the productivity of skilled labour as well as capital in the industrial sector. The introduction of a tax on labour in the industrial sector encourages substitution of capital for skilled labour which contributes to an increase in both the skilled and the unskilled wage rates. However, there is a larger increase in the skilled wage rate.

$$\begin{bmatrix}\hat{n} \\ \hat{t}_y\end{bmatrix} = \begin{bmatrix}\frac{-\tau_y K_y}{\Delta_{tl}}\end{bmatrix} \begin{bmatrix}(1-\alpha)(1-\beta)\left[(1-\gamma)\left\{\theta K_z + (1-\theta)\bar{K}\right\} + \gamma(1-\theta)\right]K_y \bar{L}_s \\ +(1-\theta)\left[\beta(1-\alpha)(1-\gamma) - (1-\alpha)(1-\beta)\gamma\right]L_y\end{bmatrix} > 0 \qquad (11)$$

The above discussion yields the following proposition.

Proposition 1: Introduction of a tax on labour in the industrial sector can decrease skilled-unskilled wage inequality in the long-run, if the size of external economies in the industrial sector is sufficiently large.

The impact of a tax on labour in the producer services sector on skilled-unskilled wage inequality can be examined by means of equation (12) as follows:

$$\left[\frac{\hat{w}_s-\hat{w}_u}{\hat{t}_x}\right]=\left[\frac{(1-\gamma)\tau_x}{\Delta}\right]\begin{bmatrix}\left[\frac{\alpha(1-\delta)}{\delta}\right]\left\{\left\{\theta K_z+(1-\theta)\bar{K}\right\}L_y+K_y\bar{L}_s\right\}\\+\left\{\beta(1-\alpha)(1-\theta)-\theta(1-\alpha)(1-\beta)\right\}\left\{K_yL_x-K_xL_y\right\}n\end{bmatrix} \quad (12)$$

Equation (12) shows that introduction of a tax on labour in the producer services sector leads to an unambiguous decrease in skilled-unskilled wage inequality. However, its effect on the number of varieties of producer services produced as shown by equation (13) is not unambiguous.

$$\left[\frac{\hat{n}}{\hat{t}_x}\right]=\left[\frac{\tau_x}{\Delta}\right]\begin{bmatrix}(1-\gamma)\left[(1-\alpha)(1-\beta)\left\{\theta K_z+(1-\theta)\bar{K}\right\}L_y+\beta(1-\alpha)(1-\theta)K_y\bar{L}_s\right]\\-(1-\theta)\left[\beta(1-\alpha)(1-\gamma)-(1-\alpha)(1-\beta)\gamma\right]nL_xK_y\end{bmatrix} \quad (13)$$

Introduction of a tax on labour in the services sector leads to substitution of capital for skilled labour. As the services sector is relatively skilled labour intensive, a large number of workers are released, which tends to reduce the skilled wage rate. On the other hand, there is upwards pressure on the price of capital, which leads to an outflow of capital from the agricultural sector. This out flow of capital from the agricultural sector puts upward pressure on the unskilled wage rate thereby decreasing the skilled unskilled-wage inequality. The theoretical result presented in equation (12) can be summarised by a proposition as follows:

Proposition 2: Given the assumptions concerning relative factor intensities, irrespective of the size of external economies in the industrial sector, a tax on labour in producer services sector decreases skilled-unskilled wage inequality in the long-run.

So far we have considered the impact of a tax on labour in the industrial and the producer services sectors on skilled-unskilled wage inequality in the long-run. Introduction of a tax on agricultural sector has no effect on the skilled wage rate but it reduces the unskilled wage rate thereby increasing skilled unskilled wage inequality. This yields proposition 3 as follows.

Proposition 3: Irrespective of the size of external economies in industrial sector, a tax on labour in the agricultural sector increases skilled-unskilled wage inequality in the long-run.

Proposition 3 follows from the fact that unskilled labour is specific to the agricultural sector, whereas the skilled labour is mobile across producer services and industrial sectors. The impact of a partial tax on labour on skilled-unskilled inequality in the short-run is discussed in section 3.2.

3.2 Impact of a tax on labour on skilled-unskilled wage inequality in the short-run

The short-run impact of a partial tax on labour on skilled-unskilled wage inequality can be investigated by differentiating equilibrium conditions (1) to (6) with respect to the relevant tax rates. As a first step, given that both p and n are exogenous, using equations (1) to (3), the following relationship can be derived.

$$\left[\hat{w}_s - \hat{w}_u\right] = \left[\left(\frac{\theta}{1-\theta}\right) - \left(\frac{\beta(1-\alpha)}{(1-\alpha)(1-\beta)}\right)\right]\hat{r} + \tau_z\hat{t}_z - \tau_y\hat{t}_y = \left[\left(\frac{\theta}{1-\theta}\right) - \left(\frac{\gamma}{1-\gamma}\right)\right]\hat{r} + \tau_z\hat{t}_z - \tau_x\hat{t}_x \qquad (14)$$

Equation (14) shows that, in the short-run, introduction of a partial tax on labour affects skilled-unskilled wage inequality both directly as well as indirectly (through its effect on the price of capital). The impact of a tax on skilled labour in the industrial sector on wage inequality in the short-run can be examined by means of equation (15) as follows:

$$\left[\frac{\hat{w}_s - \hat{w}_u}{\hat{t}_y}\right] = \left[\frac{(1-\alpha)(1-\beta)\{\gamma(1-\theta)-\theta(1-\gamma)\}\tau_y}{(1-\theta)\{\beta(1-\alpha)(1-\gamma)-(1-\alpha)(1-\beta)\gamma\}}\right] > 0 \qquad (15)$$

Introduction of a tax on labour in industrial sector leads to an increase in both skilled and unskilled wage rate. The unskilled wage increases due to outflow of capital from agricultural sector. However, increase in the skilled wage is larger than the increase in unskilled wage, which yields proposition 4 as follows.

Proposition 4: Given the assumptions concerning relative factor intensities, a tax on labour in the industrial sector increases skilled-unskilled wage inequality in the short-run.

Equation (16) shows the short-run impact of a tax on labour in the producer services sector on skilled-unskilled wage inequality.

$$\left[\frac{\hat{w}_s - \hat{w}_u}{\hat{t}_x}\right] = \left[\frac{(1-\gamma)\{(1-\alpha)(1-\beta)\theta-\beta(1-\alpha)(1-\theta)\}\tau_x}{(1-\theta)\{\beta(1-\alpha)(1-\gamma)-(1-\alpha)(1-\beta)\gamma\}}\right] < 0 \qquad (16)$$

The result presented in equation (16) can be summarised by a proposition as follows.

Proposition 5: Given the assumptions concerning relative factor intensities, a tax on labour in the producer services sector decreases skilled-unskilled wage inequality in the short-run.

Proposition (5) follows from the fact that the introduction of such a tax decreases both the skilled and the unskilled wage rates. However, as the services sector is relatively labour intensive, the introduction of a tax on labour in this sector leads to a relatively larger decrease in the skilled wage rate thereby decreasing the skilled-unskilled wage inequality.

Proposition 6: A tax on labour in the agricultural increases skilled-unskilled wage inequality in the short-run.

Finally the introduction of a tax on labour in agricultural sector increases the skilled-unskilled wage inequality because it has no effect on skilled wage but unskilled wage decreases.[10]

5. Conclusion

A number of existing theoretical studies have attempted to identify the determinants of skilled-unskilled wage inequality. Early studies highlight the role of skill-biased technological progress and trade liberalisation. Recent studies consider the role of, among other things, corruption, international outsourcing and provision of public infrastructure. This paper focuses on the role of a partial tax on labour, which has not been considered by any of the available studies. Using a three sector general equilibrium model with monopolistic competition, this paper shows that introduction of a tax on labour in each of the three sectors can have a different effect on skilled-unskilled wage inequality. The three sectors considered in this paper are: an industrial sector, an agricultural sector and a services sector. The industrial sector utilises skilled labour, capital and a large number of varieties of producer services. Varieties of producer

[10] By making use of equations (1) to (6), it can be easily confirmed that if labour is uniformly taxed across all sectors then there will be no impact on skilled-unskilled wage inequality.

services are produced by means of skilled labour and capital. Due to the presence of internal economies of scale, monopolistic competition prevails in the services sector, which gives rise to external economies in the industrial sector. The agricultural sector utilises unskilled labour and capital. All goods are traded and the industrial sector is more capital intensive relative to the services sector, which in turn is more capital intensive relative to the agricultural sector. The theoretical set-up used in this paper also allows one to distinguish between the long-run and short-run effects.

The theoretical analysis presented in this paper suggests that, in the short-run, introduction of a tax on labour in the industrial sector increases skilled-unskilled wage inequality. On the other hand, introduction of a tax on labour in the services sector reduces skilled-unskilled wage inequality. In the long-run, the presence of external economies in the industrial sector plays a crucial role. Specifically, if the size of external economies arising from internal economies in the services sector is sufficiently large, introduction of a tax on labour in the industrial sector can decrease skilled-unskilled wage inequality. On the other hand, irrespective of the size of external economies in the industrial sector, introduction of a tax on labour in the services sector decreases skilled-unskilled wage inequality. Finally, the introduction of a tax on labour in the agricultural sector does not affect the skilled wage but its effect on the unskilled wage is negative, which contributes to increase in skilled-unskilled wage inequality in both the short and long-run.

The results presented in this paper are based on the assumption that all goods are internationally traded. It will be interesting to examine the impact of a partial tax on labour in the presence of non-traded goods. We plan to address this issue in our future research.[11]

Acknowledgements

[11] For example see Anwar and Sun (2015) where the framework includes a non-traded intermediate good.

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