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Authors	Subhayu Bandyopadhyay, Sugata Marjit, and Vivekananda Mukherjee
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Incidence of an Outsourcing Tax on Intermediate Inputs

Subhayu Bandyopadhyay
Federal Reserve Bank of St. Louis, USA

Sugata Marjit
Centre for Studies in Social Sciences, Calcutta, India

Vivekananda Mukherjee
Department of Economics, Jadavpur University, Calcutta, India

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Abstract

The paper uses a Hecksher-Ohlin-Samuelson type general equilibrium framework to consider the incidence of an outsourcing tax on an economy in which the production of a specific intermediate input has been fragmented and outsourced. If the outsourced sector provides a non-traded input, the outsourcing tax can have adverse impact on labor even if it is the *most capital-intensive* sector of the economy. Thus contrary to expectations, a tax on a capital-intensive sector actually hurts labor. In the case where the intermediate input is traded, the outsourcing tax closes down either the intermediate input producing sector, or the final good producing sector which uses the intermediate input.

Keywords: Fragmentation, Outsourcing, Factor intensity, Tax incidence.

JEL Classification: F11, F16, D33

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1. Introduction

Economic recession in the U.S. and continuing job losses prompted the new president to suggest policies that would make outsourcing a relatively expensive activity. Firms, which will rely on outsourced activities, will find it harder to get “tax-breaks”. Similarly, procedure or formalities for H-1B visa (a type of visa required by foreign nationals to work temporarily in USA) are also being made stringent. The tax on outsourcing activities is expected to reverse the trend in fragmentation of production and to provide a boost to the demand for local labor.

Some papers have attempted to analyze the general equilibrium incidence of an outsourcing tax[1] in a relatively capital abundant country like the U.S., where firms outsource their relatively labor intensive production fragments. Arndt (1997), Markusen and Venables (2005), among others, assume full employment of factors and a small open economy, to show that if the outsourcing sector is labor (capital) intensive, the tax hurts (benefits) labor. A limitation of most of these papers is that they consider only the final good sectors. Outsourcing, however, is a reality even in sectors, which produce intermediate inputs[2]. For example, if airline services are conceived as inputs to business activities; then call centers outside the U.S. serving the airlines are contributing towards the provision of an intermediate input. Although in the example above the input is non-traded, outsourcing can also take place in a traded input (as it lowers the cost of production in the outsourced fragment). This paper stands out from its predecessors on

[1] The tax is generally interpreted as escalation of cost on offshore outsourcing. Other than the policy hurdles and transport cost it may also include the monitoring and coordinating cost of offshore workers as considered in Grossman and Rossi-Hansberg (2008).

[2] See Head, Mayer and Ries (2009) for an overview of the data on recent growth in service and manufacturing sector outsourcing, the composition of different services in the service sector outsourcing and country specific flows. It shows that the cost of outsourcing of services is falling over time.

two counts: first, it considers the implications of an outsourcing tax on the input side of an intermediate input-producing sector[3]; second, it shows, in studying the incidence in such a situation, the factor intensity ranking of the input-producing sector vis-à-vis the final good producing sectors matters. It uses a variant of the standard two final goods, two primary inputs, Hecksher-Ohlin-Samuelson framework, where an intermediate input is also used. We find that if the outsourced sector provides a non-traded input, an outsourcing tax can have adverse impact on labor even if it is the *most capital-intensive* sector of the economy. This is interesting, because it is apparently counterintuitive that a tax on a capital-intensive sector hurts labor[4]. The finding is also related to Leamer's (1996) result that it is the sector bias rather than the factor bias that determines how a factor's reward may change due to globalization (or technological change). In our paper, the relative factor intensity of the relevant sector is most critical in determining the direction of change of the wage rate.[5] In addition, we find that when the intermediate input is traded, the outsourcing tax closes down either the intermediate input sector or the final good sector, which uses it specifically in its production.

The next section presents the model. In the subsections we discuss the results for the cases where the intermediate input is non-traded and traded, respectively. The last section concludes.

[3] Markusen and Venables (2005) also considers an intermediate input producing sector but does not discuss a tax which is exclusive on input side of the intermediate good producing sector, as we do in this paper.
[4] The result assumes no reversal of factor intensity rankings of the commodities consequent on outsourcing of the labor intensive fragmented part of the production.
[5] We thank the editor Eric Bond for drawing this similarity to our attention.

2. The Model and Results

The economy has three sectors X, M and Y. X and Y are final goods, while M is an intermediate input. X uses labor and capital, Y uses labor and the intermediate input M, and M uses labor, capital and an outsourced input produced by foreign labor. The foreign wage cannot be affected by domestic policies. Production functions are standard, exhibiting CRS and diminishing marginal productivities. Resources are fully employed and markets are competitive. X and Y are traded. The traded good prices are frozen by the "small" economy assumption.

2.1 *M is non-traded*

Following equations provide a formal description of the model. Symbols have usual natural interpretations. Competitive price conditions imply:

$$wa_{LX} + ra_{KX} = p_{X.} \tag{1}$$

$$wa_{LM} + w^*(1 + t)a_{LM}{}^* + ra_{KM} = p_M \,. \tag{2}$$

$$wa_{LY} + p_M\, a_{MY} = p_Y \,, \tag{3}$$

where t is the tax on outsourced input. Full employment conditions give us:

$$a_{LX}X + a_{LM}\, M + a_{LY}Y = L \,. \tag{4}$$

$$a_{KX}X + a_{KM}\, M = K \,. \tag{5}$$

For market clearance the demand for M must match its supply:

$$a_{MY}Y = M. \tag{6}$$

Given (p_X, p_Y, w^*, t, K, L) we can determine (w, r, p_M, X, Y, M) from equations (1) to (6). Also note that by CRS when factor prices are determined the factor intensities are also determined. Simple manipulation of the equations (2) and (3) yield:

$$w(a_{LY} + a_{LM}a_{MY}) + ra_{KM}\, a_{MY} = p_Y - w^*(1 + t)a_{LM}{}^*\, a_{MY} \,. \tag{7}$$

Consider equations (1) and (7) and work out the effect of change in t on w. Using '$\wedge$' over a variable to denote proportional change one can get:

$$\theta_{LX}\ \hat{w} + \theta_{KX}\ \hat{r} = 0. \tag{8}$$

$$\theta_{LY}\ \hat{w} + \theta_{KY}\ \hat{r} = -\ \theta_{LY} * \hat{T} \tag{9}$$

where $T = 1 + t$.

Note θ_{ij} s are factor income shares in unit cost. From equation (8) and (9):

$$\hat{w} = \frac{\hat{T}\theta_{KX}\theta_{LY} *}{\theta_{LX}\theta_{KY} - \theta_{KX}\theta_{LY}}. \tag{10}$$

Equation (10) yields the following proposition:

Proposition 1: *The necessary and sufficient conditions for a fall in w following a rise in t are given by* $\frac{\tilde{\theta}_{LY}}{\theta_{KM}\theta_{MY}} > \frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LM}}{\theta_{KM}}$ *and* $\frac{\theta_{LM}}{\theta_{KM}} > \frac{\theta_{LX}}{\theta_{KX}}$ *respectively where* $\tilde{\theta}_{LY} = \frac{wa_{LY}}{p_Y}$.

Proof: As $\hat{t} > 0$ equation (10) implies $\hat{w} < 0$ iff $\theta_{LX}\ \theta_{KY}\ -\ \theta_{KX}\ \theta_{LY}\ < 0$.

Suppose we violate the necessary condition such that

$$\frac{\tilde{\theta}_{LY}}{\theta_{KM}\theta_{MY}} < \frac{\theta_{LX}}{\theta_{KX}} - \frac{\theta_{LM}}{\theta_{KM}}. \tag{11}$$

Now since $\theta_{KY} = \theta_{KM}\ \theta_{MY}$ and $\theta_{LY} = \tilde{\theta}_{LY} + \theta_{LM}\theta_{MY}$ from inequality (11) we obtain:

$$\frac{\theta_{LY}}{\theta_{KY}} < \frac{\theta_{LX}}{\theta_{KX}}.$$

So, w cannot fall following a rise in t. On the other hand, suppose we satisfy the sufficient condition $\frac{\theta_{LM}}{\theta_{KM}} > \frac{\theta_{LX}}{\theta_{KX}}$. If the sufficient condition holds it must be true that:

$$\frac{\tilde{\theta}_{LY} + \theta_{LM}\theta_{MY}}{\theta_{KM}\theta_{MY}} > \frac{\theta_{LX}}{\theta_{KX}}.$$

Using the definitions of θ_{KY} and θ_{LY} we obtain:

$$\frac{\theta_{LY}}{\theta_{KY}} > \frac{\theta_{LX}}{\theta_{KX}}$$

which in turn implies $\theta_{LX}\ \theta_{KY}$ - $\theta_{KX}\ \theta_{LY}$ < 0. Hence from equation (10) it follows that $\hat{w}$ < 0. □

Proposition 1 implies that if *M* is labor intensive relative to *X*, a tax on outsourcing must lower *w*. However, following a tax on outsourcing, *w* may fall even if *M* is capital intensive, provided it is not too capital intensive relative to *X*. Let us explain why these results are important.

If *M* is labor intensive, taxing it will raise *r* and reduce *w* by the Stolper-Samuelson result. Note that this has to happen notwithstanding the substitution effects, even if *M* uses more local labor and capital relative to foreign labor. From (3), as *w* goes down, p_M must rise in equilibrium. Therefore, this is a clear case where *M* becomes more costly. In this case, effectively *Y* is labor intensive relative to *X*, once we take the indirect requirement of capital and labor in this sector through the use of *M*.

When *M* is capital intensive, *Y* can still be labor intensive. The necessary condition derived in proposition 1 tells us that as long as $\tilde{\theta}_{LY}$ (θ_{MY}) is very high (low), *w* will still go down. Even if θ_{KM} is high, a low θ_{MY} can induce a fall in *w* because the effective capital intensity of Y can be pretty low.

By the same logic as above, the conditions under the outsourcing tax can raise *w* are also clear. For this to happen, such a tax must adversely affect the cost of production of the capital-intensive final good. Thus, if M is labor intensive, but it helps the capital-intensive segment, an outsourcing tax may raise the local wage. On the other hand, if the outsourcing helps a capital-intensive intermediate good or service but the users of such facilities are labor intensive, then an outsourcing tax will ultimately hurt the typical worker.

Finally, note that in our model if the outsourcing tax increases the wage rate, it must reduce p_M. This is a peculiar but very interesting outcome. In this case, as Y decreases, demand for M drops considerably leading to a decline in p_M. This is apparently paradoxical, because the tax makes foreign labor more costly for M, but that cannot (in equilibrium) translate to a rise in its price.

2.2 *M is traded*

When M is traded, its price is frozen by the "small" economy assumption. Therefore, the market clearing equation for M (equation-6) no longer applies here. X, Y and M are produced using the same technology as above. The full employment conditions of the primary factors of production also remain unchanged. We are left with equations (1) through (5) to determine the equilibrium of this economy.

There are two possible equilibria and patterns of trade that can arise after the imposition of the outsourcing tax. To understand this first consider the case where there is no outsourcing tax (i.e., $t = 0$). Assume that the economy produces all three goods X, Y and M, with labor and capital as primary inputs. Initial w and r must be such that equations (1) through (3) must hold as equalities. Now consider the imposition of a small outsourcing tax (i.e., $t > 0$). At the initial (w, r) equations (1) and (3) are satisfied, but the left hand side of (2) must exceed the right hand side. This means that the cost of domestic production of M must exceed the given international price p_M at the initial factor price combination. One possibility is that this leads to a closure of domestic production of M , with all the M being imported for use in Y at the given international price p_M. Notice that full employment of factors will require that all the labor and capital that was previously employed by M is fully absorbed by X or Y. Given that Y does not use capital, all of it needs to be absorbed by X. At initial (w, r), X's factor intensity is given, thus X must expand to absorb the extra capital. If X is more capital intensive than M, it can absorb all the capital and part of the labor that M releases. The labor that is left over after absorption in X, can be used up through an expansion of Y, which can import a corresponding amount of M to keep its factor intensity constant. Thus the pattern of trade must involve greater imports of M and countervailing adjustments in X and Y to keep trade balanced. Note, however, that there is another type of equilibrium that is possible when X is relatively labor intensive compared to M. Consider the case that we discuss above where M shuts down. To absorb all the capital that is released at unchanged factor prices, X will need more labor than what M can provide. This labor has to come from Y. Thus Y must shrink. If it releases enough labor to fully employ the capital in sector X, full employment is achieved at the original factor prices. However, if the amount of labor used by Y at the initial equilibrium is sufficiently small, it will not be able to release enough labor to employ all the additional capital in X at unchanged factor prices, even if Y shuts down. The resulting excess demand for labor can be resolved if w rises. If w rises then from equation (1) we know that r falls. This fall in r can allow equation (2) to be satisfied and thus allow M to stay in business. However, since Y does not use capital, its unit cost has to rise faced with a constant p_M and a higher w. In this case, Y shuts down and consequently all the M that is domestically produced must be exported. In this second case, the effect of a change in t on w is obtained from equations (1) and (2):

$$\theta_{LX}\ \hat{w} + \theta_{KX}\ \hat{r} = 0. \tag{12}$$

$$\theta_{LM}\ \hat{w} + \theta_{KM}\ \hat{r} = -\ \theta_{LM} * \hat{T}\ . \tag{13}$$

where θ_{ij} s are factor income share in unit cost. From equation (12) and (13):

$$\hat{w} = \frac{\hat{T}\theta_{KX}\theta_{LM} *}{\theta_{LX}\theta_{KM} - \theta_{KX}\theta_{LM}}\ . \tag{14}$$

Proposition 2:

(i) *If M is labor intensive compared to X, a rise in t starting from zero leads to closure of M. Sectors X and Y expand and factor prices are unaffected.*

(ii) If M is capital intensive compared to X, the rise in t must shrink sector Y. If Y's initial labor employment is sufficiently high, the factor prices are unchanged, X expands, Y shrinks, and M shuts down. If Y's initial labor employment is not sufficiently high, the wage rate must rise, the rental rate must fall and Y must shut down, while X and M can absorb all the labor that is released by Y.

Proof:

The first part of the proposition follows from the discussion above and an inspection of equations (1) through (3). On the other hand, when M is capital intensive relative to X, it must be $\theta_{LX}\ \theta_{KM}\ -\ \theta_{KX}\ \theta_{LM}\ > 0$. Therefore, from equation (14) it follows that as t rises, w rises. Since p_M and p_Y are fixed internationally, the rise in w suggests that the domestic unit production cost of Y exceeds its price. In turn, this implies that sector Y has to shut down. □

Proposition 2 has interesting policy implications. A government that is committed to keeping the M or the Y sector in operation while it imposes an outsourcing tax may have to support it through additional policy instruments like an import tariff. Effectively, to balance conflicting policy objectives, more distortions may need to be introduced. While we do not model this issue here, in reality the government's preference for survival of M or Y may stem from lobbying done by factors specific to these sectors, whose welfare is inextricably linked with production in that sector.

3. Conclusions

The paper shows that there are critically important differences between the effects of outsourcing that is related to the intermediate input sector, compared to outsourcing that caters to final good production. Also, it is important to identity whether the intermediate input is traded or non-traded. If it is non-traded, labor is hurt even if the intermediate input producing sector (suffering from the outsourcing tax) is the most capital-intensive in the economy. This finding is apparently paradoxical. On the other hand, if the input is traded, the domestic production of either the intermediate good or the final good using the input becomes non-viable. Therefore, if the government wants to sustain either of these sectors when it imposes an outsourcing tax, it has to consider further policy intervention (for example, a protective tariff), which may further distort the economy.

References

Arndt, S. (1997): Globalization and the Open Economy, *North American Journal of Economics and Finance* 8(1), 71 – 79.

Head, K., T. Mayer and J. Ries (2009): How Remote is the Outsourcing Threat? *European Economic Review*, 429 – 444.

Grossman, G. and E. Rossi-Hansberg (2008): Trading Tasks: A Simple Theory of Offshoring, *American Economic Review* 98(5), 1978 – 1997.

Leamer, Edward E., (1996): Wage Inequality from International Competition and Technological Change: Theory and Country Experience, *American Economic Review*, May 1996, 86(2), 309-14.

Markusen, J. and A. Venables (2005): A Multi-country Approach to Factors Proportion Trade and Trade Costs, Working Paper No. 11051, NBER.