



# Skilled–unskilled wage inequality and offshore outsourcing with asymmetric adjustment costs

Avik Chakrabarti <sup>a,\*</sup>, Rajarshi Mitra <sup>b</sup>

<sup>a</sup> Department of Economics, 816 Bolton Hall, College of Letters and Science, University of Wisconsin-Milwaukee, P.O. Box 413, Wisconsin 53201, United States

<sup>b</sup> Department of Economics, College of Letters and Science, University of Wisconsin-Milwaukee, P.O. Box 413, Wisconsin 53201, United States

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## ABSTRACT

We present a model that can capture the effects of offshore outsourcing on the wedge between the wages of skilled and unskilled workers when costs of adjustment are asymmetric. We identify conditions under which offshore outsourcing activities widen the skilled–unskilled wage inequality in the presence of asymmetric adjustment costs. We show how a higher cost of adjustment in the import-competing sector can magnify the offshore outsourcing induced gap between the wages of the skilled and unskilled workers. We also demonstrate the sensitivity of the effects of offshore outsourcing, on the skilled–unskilled wage gap, to asymmetries in the costs of adjustment.

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## 1. Introduction

The role of adjustment costs in the structure of the general equilibrium models is well known.<sup>1</sup> While a number of econometric studies have provided estimates of adjustment costs<sup>2</sup>, there is convincing evidence reflecting significant variations in these costs of adjustment<sup>3</sup>. In this paper, we look at the effects of offshore outsourcing on the wedge between the wages of skilled and unskilled workers when costs of adjustment vary across sectors.

\* Corresponding author. Tel.: +1 414 229 4680; fax: +1 414 229 3860.

E-mail addresses: [chakra@uwm.edu](mailto:chakra@uwm.edu) (A. Chakrabarti), [rmitra@uwm.edu](mailto:rmitra@uwm.edu) (R. Mitra).

<sup>1</sup> For an early treatment of adjustment costs of investment see Lucas (1967) where he suggested that this cost behavior can be thought of as a sum of purchase costs (with perfect or imperfect factor markets) and installation costs.

<sup>2</sup> See Cooper and Haltiwanger (2006), Thomas (2002), Barnett and Sakellaris (1999), Kolstad and Lee (1993), Wolfson (1993), Zanas (1991), Bernstein (1988), Lichtenberg (1988), Mohnen, Nadiri and Prucha (1986), and Pindyck and Rotemberg (1983) for representative estimates of adjustment costs.

<sup>3</sup> Benoit and Serena (1992) reported significant differences in the speed and the costs of adjustment in Canadian industries. Chakrabarti (2009), for a panel of annual observations on 534 firms from the U.S. economy over the period 1989–1993, concludes that the cost of adjustment is significantly higher in the capital-intensive sectors than it is in the labor-intensive sectors.

Recent research lends increasing support for a greater role that trade has played in raising the relative reward for skilled labor than was suggested by the relevant literature that had accumulated before the 1990s. Claims that trade *can* explain the observed increase in wage inequality appear<sup>4</sup> to be consistent with the predictions of the Heckscher–Ohlin–Samuelson (H–O–S) theory:

- a. Free and frictionless trade induces each country to specialize in the production of goods that use intensively her relatively abundant factors: a developed country specializes in the production of goods that are intensive in skilled labor and a developing country in goods that are intensive in unskilled labor.
- b. International competition leads to an increase in the relative wage of high-skilled labor in a developed country *if* there is an increase in the relative price of the goods she specializes in.

Notwithstanding the relatively vast literature documenting and attempting to explain the rise in wage inequality in the developed world, the wage-wedge is now well known as a global phenomenon as the gap continues to widen in the developing countries as well. The outreach of the skilled–unskilled wage inequality to the developing world does not fit well with the H–O–S theory which would predict that a trade-induced increase in the price of unskilled intensive products leads to an increase in the wages of unskilled workers and the decrease in the price of skilled labor intensive products leads to a decline in wages of skilled workers in the developing world.

While we take as our theoretical point of reference<sup>5</sup> the general equilibrium framework of the H–O–S model, our analysis departs from the traditional rendering of the H–O–S structure to the extent that we look at the links between offshore outsourcing and wage inequality without assuming perfect inter-sectoral mobility of capital. In the next section we present our model and discuss some propositions that follow. The final section summarizes our conclusion.

## 2. Model and propositions

Our model builds on Chakrabarti (2004)<sup>6</sup> and Marjit, Beladi and Chakrabarti (2004)<sup>7</sup>. Consider, à la Chakrabarti (2004), capital to be a quasi-fixed input in the sense that adding new capital, removing existing capital and/or moving capital from one sector to another entails an adjustment cost. Moving capital from one sector to another is viewed as a two-step process: 1) Removal: capital is removed from one sector the cost of which is borne exclusively by that sector and 2) Addition: the released capital is transformed and installed in the other sector the cost of which is borne exclusively by the recipient sector.

Suppose a competitive sector (*A*) exclusively provides a non-tradable service transforming capital (new or released) to fit its use in production:  $K_j^A$  represents the amount of capital used by *A* exclusively for adjustment in the output of sector *j*;  $P_{Aj}$  is the unit cost of adjustment for sector *j* (i.e. the price paid by sector *j* to *A* in transforming capital to support a unit change in the output of sector *j*). To focus on the asymmetry in adjustment costs *between* sectors, we assume away any difference in adjustment cost a) between addition of capital to a sector and removal of capital from the same sector and b) between addition of new capital to a sector and addition of capital to the same sector released by the other. For simplicity, we also assume that capital is the only resource used up in the installation and implementation of capital. The adjustment technology is specified as:

$$K_j^A = \alpha_j dj$$

where  $\alpha_j = \begin{cases} +\alpha^j & \text{for } dj \geq 0 \\ -\alpha^j & \text{for } dj \leq 0 \end{cases}$  and  $\alpha^j \geq 0$  are constants.

Visualize now, à la Marjit et al. (2004), an economy that produces four goods<sup>8</sup>: a skilled export good (*X*), an unskilled export good (*Z*), an importable good (*Y*), and an intermediate good (*M*), which is a non-traded intermediate input used in the skilled export good sector. There are four factors of production: skilled labor (*S*), unskilled labor (*L*), land (*T*) and capital (*K*). This pattern of production and trade reflects that our model economy can export both skilled, as well as, unskilled products. Sector *M* uses skilled labor and capital, *X* uses skilled labor and the intermediate input, *Y* uses unskilled labor and capital and *Z* uses land and unskilled labor.

But for any asymmetry in adjustment costs, our model would permit reallocation of resources between industries without affecting factor prices as long as the factor use envelope contains the factor endowment envelope with the factor use matrix having

<sup>4</sup> A convincing argument questioning the importance of trade as an explanation for the rise in inequality in the US can be made based on the observation the relative price of skill-intensive goods has not increased to the extent that would explain the rise in inequality. See Acemogulu (2003).

<sup>5</sup> The traditional theories of trade and their refinements have had much to offer in terms of explaining the phenomenon and consequences of offshore outsourcing Jones (2000), Jones et al. (2005) and Kierzkowski (2005).

<sup>6</sup> Chakrabarti (2004) showed that the introduction of asymmetric adjustment costs in a simple general equilibrium framework establishes a meaningful link between factor price determination and output determination, breaking the analytically convenient dichotomy of the Heckscher–Ohlin–Samuelson (H–O–S) model. Sarker and Oladi (2008) demonstrated that the introduction of asymmetric adjustment costs makes the rate of urban employment respond to an exogenous shock in the aggregate capital endowment, raising the possibility of several counter-intuitive immiserizing growth scenarios.

<sup>7</sup> Marjit et al. (2004) offer a theoretical analysis of the possible impact of trade and fragmentation on the skilled–unskilled wage gap in a small developing economy.

<sup>8</sup> Similar production structures have been discussed in Jones and Marjit (2001), Marjit et al. (2004), Chaudhuri and Yabuuchi (2007), and Beladi, Chakrabarti and Marjit (in press).

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