Globalization, Labor Mobility and the Wage Skill Gap

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Abstract

This paper analyzes the labor market effects of globalization, defined as the expansion in openness that follows an increase in the terms-of-trade, in the presence of a non-tradable sector and uncertainty. The results show an increase in the wage skill gap, a decline in the real wage and welfare of unskilled workers, and an expansion of inter-sectoral labor mobility and wage volatility. These results accord with stylized facts and, remarkably, are robust to the empirical evidence usually presented to dismiss the role of international trade. The model assumes that labor demand uncertainty arises from industry-specific productivity shocks, and that the costs of inter-sectoral mobility are lower for skilled workers.

Keywords: wage-skill gap, trade and wages, wage volatility, globalization.
JEL Classification: F16, D33
1 Introduction

The last two decades have been a distressful period for unskilled workers in industrialized countries; their real wages having declined, while the wage skill gap has grown. As to its causes, an emerging empirical consensus seems to play down the role of international trade: labor economists claim that the degree of openness to trade with developing countries is too small to produce the extent wage variation in the data; while international economists argue that evidence that the relative price of skill intensive goods has been falling and that similar wage trends can be found in developing countries is at odds with the Stolper-Samuelson theorem. (For a survey see Cline, 1997, ch. 2 or Slaughter and Swagel, 1997).

Meanwhile, other empirical trends in labor markets have surfaced, uncovering an increase in labor mobility and wage volatility. Gottschalk and Moffit (1994) and Gottschalk (1997) find a surge in the short-term volatility of wages, particularly for unskilled workers; Greenaway et al. (1998) and Magnani (1998) document an increase in inter-sectoral movements of workers, namely educated ones; and Farber (1997) and Idson and Valetta (1997) present evidence of higher job instability, particularly for skilled workers. Recently, Rodrik (1997) and Bhagwati (1998) have argued that globalization might have a role to play in explaining some of these trends.1

This paper shows that globalization, captured by the expansion of the tradable sector ensuing an improvement in the terms of trade, generates the trends in the level, dispersion and volatility of wages and the mobility of workers discussed above. Remarkably, our results are robust to the evidence usually presented to dismiss the role of globalization, (described in the first paragraph). On one hand, the wage effects obtained here are strongest when the degree of openness is not too large. On the other, they (a) are independent of the trends in the world price of skill intensive goods and (b) occur in both unskilled and skilled labor abundant countries, - indeed the model establishes that international trade increases the wage-skill gap and lowers the unskilled wage, not only when it is due to differences in the abundance of skilled labor (through the Stolper-Samuelson theorem), but in virtually all its variants (e.g. North-North trade).

We look at uncertainty and volatility arising from country- and industry-specific productivity shocks, in a small open economy. To the extent that they

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1Rodrik (1997) argues that increased exposure to terms of trade volatility has led to greater volatility in domestic income and consumption. Bhagwati (1998) addresses external risk as *kaleidoscopic comparative advantage*, whereby changes in the international environment continuously affect the competitive position of domestic firms, and argues that it helps explain the increase in worker displacement and job instability.
affect labor demand, industry-specific shocks imply (i) ex-ante, uncertainty on labor market conditions, and (ii) ex-post, the reallocation of workers across sectors. Two factors affect the implications of productivity shocks for labor markets.

On one hand, a worker’s ability to benefit from opportunities in expanding sectors is directly related to her ability to assess those opportunities and to change sector. Education is widely recognized as a factor enhancing the exibility of workers to perceived changes. First, from an informational perspective, education improves the ability to assess market conditions, and to track down opportunities. Second, education provides general human capital, transferrable across sectors, whereas the human capital of those with lower education is bound to be specific to the firm or industry\(^2\) (Grossman and Shapiro, 1982). Third, education facilitates geographical mobility (Pissarides and Wadsworth, 1989; Mauro and Spilimbergo, 1998). Hence, we assume that skilled workers have lower inter-sectoral mobility costs than unskilled workers.

On the other hand, an industry’s exposure to international competition plays a fundamental role in determining the induced uncertainty of labor demand. In tradable industries, the impact of the shock on the marginal product is fully passed through to labor demand, since the price of the good is set at its world level. By contrast, in non-tradable industries, the impact of the shock in domestic supply implies that the marginal product and the price of the good move in opposite directions. Hence, even if the statistical features of the productivity shock are similar across industries, international competition implies a higher volatility of labor demand in tradable industries than in non-tradables.

For unskilled workers, locked into an industry due to high mobility costs, labor demand volatility passes through to wages and consumption, and thus uncertainty is higher in the tradable sector; as implicit contracts and insurance markets break down, due to failures like moral-hazard, monitoring costs, or bankruptcy risk. For skilled workers, the higher volatility of labor demand in tradables means a stronger volatility of sectoral employment and higher inter-sectoral mobility, as they hedge wage risk through lower mobility costs.\(^3\) Hence, given risk-aversion, tradable industries are on average more

\(^2\)Carrington (1993) and Neal (1995) argue that an important part of the human capital accumulation is industry- and location-specific.

\(^3\)Gourrinchas (1998) shows that the volatility of employment levels is higher in tradables sectors than in non-tradables. Greenaway et al. (1998) and Magnani (1998) present evidence of higher inter-sectoral mobility for educated workers, while Fallick (1993) finds that education increases the probability that a displaced worker moves to a different industry. Finally, Gottschalk and Moffit (1994) present evidence that the transitory variance of
intensive in skilled labor than non-tradable industries.

Looking at the implications of an increase in the terms of trade, i.e. globalization, on the level of real wages and welfare, the main results are as follows. It improves the skilled wage, due to the income effect from the improvement in the terms of trade. However, under certain conditions, it brings down the unskilled wage and the welfare of unskilled workers, due to the volatility effect. The latter captures how the expansion of the (skilled labor intensive) tradable sector results in a decline in the intensity in skilled labor across all industries, in order to preserve full-employment. Through its impact on the marginal product of unskilled labor, the volatility effect, which dominates the income effect, when the economy is not very open, reduces the unskilled wage.

In addition, globalization leads to an increase in cross-sectional wage dispersion: rst, the volatility effect expands the wage skill gap; second, the expansion of the tradable sector, where labor demand is more volatile, increases the dispersion of unskilled wages. The latter implies also an expansion of the time-series volatility of individual wages. Finally, there is an expansion in the inter-industry mobility, as a larger share of skilled workers are now employed in the tradable sector, where labor mobility is higher. These results are in accordance with the stylized facts described in the rst two paragraphs.

The next section introduces the model and describes the features of the equilibrium. Section three analyzes the implications of globalization. Section four concludes.

2 The model

Take a small open economy composed of three sectors: the non-tradable \( (n) \), the importable \( (m) \) and the exportable \( (x) \). Each sector contains a continuum of measure one of goods (or industries). Only non-tradables and importables are consumed domestically; and only non-tradables and exportables are earnings is considerably higher for low educated workers.

4Rodrik (1997) argues that, by increasing the elasticity of the labor demand schedule, international competition brings down wages and expands wage volatility and employment movements resulting from labor supply shocks. See Pangaryia (1998) for a critique of Rodrik’s argument.

5Looking at globalization as the integration of international nancial markets, Rodrik (1997) argues that it leads to a decline in the public sector, due to difficulty to tax increasingly mobile capital. Given the public sector’s higher propensity to consume non-tradable goods, such downsizing of the public sector generates similar effects on wages and volatility, by expanding the tradable sector.
produced domestically, using labor as the only factor of production. To set notation, henceforth, the subscript \( n_j \) denotes industry (good) \( j \) in the non-tradable sector \((j \in n)\), the subscript \( m_j \) denotes good \( j \) in the importable sector \((j \in m)\), and the subscript \( x_j \) denotes industry \( j \) in the exportable sector \((j \in x)\).

The economy is composed of workers of two types: skilled \((h)\) and unskilled \((l)\). Technologies are identical for all goods, whether in the exportable or non-tradable sector. Letting \( h_j \) and \( l_j \) denote, respectively, the skilled and unskilled labor employed in industry \( j \) \((j \in n \cup x)\), the output of good \( j \) \((z_j)\) is given by:

\[
z_j = A_j h_j^\alpha l_j^{1-\alpha} \quad j \in n \cup x
\]  

(1)

The stochastic foundations of the model lie on the productivity parameter: \( A_j \) is a log-normally distributed random variable, independent across goods, with the mean of log \( A_j \) equal to \(-\gamma\) and the variance of log \( A_j \) given by \(2\gamma\), with \(\gamma > 0\), yielding that the \(k^{th}\) moment of the distribution of \( A_j \) is given by:

\[
E(A_j^k) = \exp(k(k-1)\gamma)
\]  

(2)

Hence we obtain that \( E(A_j) = 1 \). The coefficient of variation of \( A_j \) is given by \( \sigma_A = E(A_j^2)/E(A_j)^2 = e^{2\gamma} \), yielding that \( \gamma \) captures the exogenous uncertainty in the model.\(^7\)

The supply of labor of either type is exogenous. There are a continuum of skilled workers and a continuum of unskilled workers, both of measure one. Each worker is endowed with one unit of labor. Hence the supplies of skilled and unskilled labor are normalized at one.

A crucial assumption in this paper is the timing at which skilled and unskilled workers commit their labor to a given industry. The events in the model take place in the following stages: First, each unskilled worker chooses the industry she will work for. Second, the shock occurs. Third, skilled workers offer their services to any industry, and labor markets clear, with wages determined by the marginal product. The market for skilled workers is integrated across the economy. For unskilled workers, labor markets are industry specific. Hence we capture the notion that educated workers have lower costs of inter-sectoral mobility. Finally, fourth, production, sales and consumption take place in competitive markets.

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\(^6\)For the properties of the log-normal distribution, see Newberry and Stiglitz (1981).

\(^7\)We use the coefficient of variation as a measure of dispersion (volatility, uncertainty), because it is invariant to a multiplicative transformation of the random variable. For example, given (1), the volatility of output, measured by the coefficient of variation, is independent of the amount of labor employed.
All workers are risk averse and have identical preferences, with $U$ denoting the utility index:

$$U \equiv \left[ \left( \exp \int \ln z_{nj} \right)^{\frac{\varepsilon-1}{\varepsilon}} + \left( \exp \int \ln z_{mj} \right)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{1}{\varepsilon(1-\rho)}} \quad \varepsilon > 1$$

(3)

where $z_{nj}$ denotes good $j$ in the non-tradable sector, $z_{mj}$ represents a good in the importable sector, $\rho$ is the Arrow-Pratt coefficient of relative risk aversion and $\varepsilon$ is the elasticity of substitution between the two sectors. 8

Below, we address the equilibrium of the model. We start by looking at the equilibrium in product markets. Then we address the outcomes in the skilled and unskilled labor markets.

2.1 Product markets

We start by looking at the equilibrium prices in product markets, contingent on the output in the different industries. Assuming a small open economy, the relative prices among tradable goods are given from abroad. For simplicity, we assume that they are not random. Moreover, without loss of generality, we assume that (a) the relative price between any two importables is unitary, (b) the relative price between any two exportables is also unitary, and (c) the relative price between an exportable and an importable is given by $\tau$, which we address as the terms of trade. Later, we simulate an increase in $\tau$ to capture the implications of globalization.

Taking nominal domestic expenditure as the numeraire, we use $p_x$ to denote the price of each and every exportable good, while $\tau^{-1}p_x$ denotes the price of each and every importable good. In non-tradables, the lack of foreign substitutes implies that prices vary between different industries, depending on the conditions of domestic supply, - hence we use $p_{nj}$ to denote the price of non-tradable good $j$ in terms of the numeraire.

We assume that workers have no access to insurance markets for income risk, and that there are no intertemporal securities, i.e. savings. Hence the income of each individual worker consists only of her wage, and equals her expenditure, yielding that the current account is balanced.

The consumption problem of a worker $i$ (skilled or unskilled) consists in the maximization of (3), subject to a budget constraint given by: $\int p_{nj}z_{nj} + \tau^{-1}p_x \int z_{mj} \leq w_i$, where $w_i$ is the wage. The solution yields that the demand

8In the utility index, the elasticity of substitution (EOS) between two goods within the same sector is unitary, while the EOS between the two sectors is $\varepsilon$. Taking a unitary EOS for goods in the same sector simplifies greatly the model, and is without loss of generality, relative to a more general CES formulation of preferences.
for non-tradable good \( j \) is: 
\[
z_{nj}(i) = s_n w_i / p_{nj},
\]
and for importable good \( j \) is: 
\[
z_{mj}(i) = \tau w_i (1 - s_n) / p_x,
\]
with \( s_n \), denoting the share of non-tradables in expenditure (which does not depend on \( w_i \), due to homotheticity), given by:
\[
s_n = \left( \frac{\pi_n}{\pi} \right)^{1-\epsilon} \tag{4}
\]
where \( \pi \) is the consumer price index (CPI) and \( \pi_n \) is the price index for non-tradables, given respectively by:
\[
\pi \equiv \left( \pi_n^{1-\epsilon} + \tau^{1-\epsilon} p_x^{1-\epsilon} \right)^{\frac{1}{1-\epsilon}} \tag{5}
\]
\[
\pi_n \equiv \exp \int \ln p_{nj}
\]
Substituting \( z_{nj}(i) \) and \( z_{mj}(i) \) in (3), we obtain that the indirect utility index can be written in terms of the real wage \( (w_i/\pi) \), as shown below:
\[
U = \left( \frac{w_i}{\pi} \right)^{1-\rho} \tag{6}
\]
Moreover, since income equals expenditure for all workers and domestic expenditure is the numeraire, \( s_n \) becomes the aggregate expenditure in the non-tradable sector, with the aggregate demands for a good in the non-tradable and tradable sectors given, respectively, by
\[
z_{nj}^d = \frac{s_n}{p_{nj}} \quad \quad z_{mj}^d = \frac{(1 - s_n)}{\tau^{-1} p_x} \tag{7}
\]
Letting \( z_{nj} \) denote the output of non-tradable good \( j \), the equilibrium in the market for each non-tradable good implies that \( z_{nj}^d = z_{nj} \), which given (7) yields
\[
p_{nj} = \frac{s_n}{z_{nj}} \tag{8}
\]
\[
\pi_n = \frac{s_n}{\exp \int \ln z_{nj}}
\]
In the tradable sector, the equilibrium is obtained when the current account is balanced. Letting \( z_{xj} \) denote the output of an exportable good, the aggregate export revenue is given by \( p_x \int z_{xj} \), while from (7), the aggregate expenditure in importables is \( 1 - s_n \). Hence we obtain:
\[
p_x = \frac{(1 - s_n)}{\int z_{xj}} \tag{9}
\]
Finally, from (4), we obtain the aggregate expenditure in non-tradables:

\[
  s_n = \frac{(\exp \int \ln z_{nj})^{\frac{1}{\tau}}}{(\tau \int z_{xj})^{\frac{1}{\tau}} + (\exp \int \ln z_{nj})^{\frac{1}{\tau}}}
\]

Equations (8) and (9) show the effect of a supply shock (e.g. a productivity shock) on the price of the good. As is standard in general equilibrium models, a shock in the supply of good \( j \) affects the price of the good through two mechanisms.

First, there is an indirect effect on the income/expenditure of consumers, \( s_n \) (equation 10), which has an impact on demand. In our framework, where each good is an element in a continuum, the impact of the shock on the income of consumers, and thus on demand, is negligible.

Second, the shock affects the price of the good directly, due to changes in the quantity supplied. The actual effect depends on the sector, due to the role played by international competition. Equation (8) shows that for a non-tradable good, a supply shock affects the price of the good negatively. However, given the small size of the industry, relative to the continuum of non-tradable goods, the shock has only a negligible effect on the price index for non-tradables (\( \pi_n \)).

By contrast, for tradable goods, foreign competition keeps relative prices constant. The price index for tradables (\( p_x \)) is only affected by a supply shock that is large enough to create an imbalance in the current account. However, since each exportable industry is part of a continuum of tradable industries, an industry's supply shock has only a negligible effect on \( p_x \), as can be seen in (9). In sum, in a non-tradable industry, the price of the good reacts negatively to a supply shock in the industry, while in a tradable sector the price is unaffected by a supply shock.

### 2.2 Labor Markets

Now, we assess the equilibrium in labor markets. For both skilled and unskilled workers, labor demand is given by the value of the marginal product, whether in the tradable or the non-tradable sectors. Hence, the impact of a productivity shock in labor demand depends on the relative force of two effects. First, given the multiplicative nature of the interaction between labor and the productivity parameter in (1), the productivity shock affects the marginal product of labor of either type (measured in units of the good).

Second, the productivity shock affects the value of the marginal product through its effect on the price of the good. As we established before, the extent of international competition plays an important role. In tradable
industries, the price is unaffected by changes in the supply of the good. By contrast, in the non-tradable sector, the productivity shock has an effect on the price, due to changes in the quantity supplied.

The effect of the productivity shock on the price, in non-tradables, conflicts with the effect on the marginal product (e.g. a positive productivity shock expands the marginal product, but reduces the price of the good), thus smoothing the impact on labor demand. Hence the volatility of labor demand in the non-tradable sector is smaller than in the tradable sector.

We start by analyzing the implications on the market for skilled workers, taking as given the allocation of unskilled workers across industries. The latter is addressed subsequently. We restrict our analysis to the case where the ex-ante allocation of unskilled labor among industries in the same sector (exportable or non-tradable) is symmetric, i.e. where \( l_{nj} = l_n \) and \( l_{xj} = l_x \).

Hence \( l_n \) and \( l_x \) denote the employment of unskilled labor on each non-tradable and exportable industry, respectively. Moreover, since there are a continuum of measure one of industries in each sector, \( l_n \) and \( l_x \) denote also the total unskilled labor employed in the non-tradable and exportable sector, respectively, which, given the supply of unskilled labor, yields: \( l_x = 1 - l_n \).

### 2.2.1 Skilled Labor Markets

The skilled labor market is competitive and integrated across the economy; firms hire skilled labor until the marginal return equals the economy-wide equilibrium wage \( w_h \), thus yielding the skilled-labor demand:

\[
\begin{align*}
    h_j &= \frac{\alpha}{w_h} p_j z_j \\
    &\forall j \in n \cup x
\end{align*}
\]  

(11)

Given that the supply of skilled labor is normalized at one, we obtain:

**Proposition 1** The skilled-wage \( w_h \) is given by \( w_h = \alpha \).

**Proof.** In a non-tradable industry, (8) and (11) imply that skilled labor demand becomes: \( h_{nj} = \alpha s_n / w_h \). In a tradable industry, (9) and (11) yield: \( h_{xj} = \frac{\alpha}{w_h} z_{xj} \). Hence, the equilibrium in the skilled labor market, given by \( \int h_{nj} + \int h_{xj} = 1 \), yields \( w_h = \alpha \). ■

Since the skilled wage is constant, the employment of skilled workers in each industry depends on the industry’s skilled labor demand. Thus, the volatility of the employment of skilled workers in tradable industries is higher than in non-tradable ones, as international competition renders the demand for skilled labor more volatile in the tradable sector. Substituting (8) for \( p_j \)
in (11), and taking \( w_h = \alpha \), we obtain that the employment of skilled labor in a non-tradable industry \( j \) is given by:

\[
h_{nj} = h_n = s_n
\]

For the tradable sector, substituting (9) for \( p_j \) in (11), and using \( w_h = \alpha \), we obtain:

\[
h_{xj}^{1-\alpha} = (1 - s_n) A_{xj} / \int A_{xj} h_{xj}^{\alpha}.
\]

Raising the expression to \( \alpha / (1 - \alpha) \), multiplying by \( A_j \), and taking the integral over all \( xj \), we get:

\[
\int A_{xj} h_{xj}^{\alpha} = (1 - s_n)^\alpha \left( \int A_{xj}^{1/(1-\alpha)} \right)^{1-\alpha}
\]

which, substituted in the previous expression, yields the employment of skilled labor in tradable industry \( j \):

\[
h_{xj} = (1 - s_n) \frac{A_{xj}^{1-\alpha}}{\int A_{xj}^{1-\alpha}}
\]

Hence we obtain:

**Proposition 2**

(a) The expenditure in the non-tradable sector, \( s_n \), is non-stochastic. (b) All non-tradable industries employ a non-stochastic, identical amount of skilled labor.\(^9\) (c) The employment of skilled labor in a tradable industry is stochastic, i.e. depends (positively) on the productivity shock. (d) \( s_n \) captures the employment of skilled labor in the non-tradable sector, and \( 1 - s_n \) the employment of skilled labor in the tradable sector.

**Proof.** Use (12) to substitute for \( h_{nj} \) and (13) to substitute for \( h_{xj} \) in (10). Applying the law of large numbers (Judd, 1985) and (2) to obtain:

\[
\int A_{xj}^{1/(1-\alpha)} = e^{\alpha \gamma / (1-\alpha)^2} \quad \text{and} \quad \int \ln A_{nj} = -\gamma,
\]

we get:

\[
(s_n^{-1} - 1)^{\alpha / (\alpha - 1)} = \tau e^{\gamma / (1-\alpha)(t_n^{-1} - 1)^{1-\alpha}},
\]

which establishes (a). Consequently, (12) and (13) establish points (b) and (c). For (d), note that \( \int h_{nj} = \int h_n = h_n = s_n \) and use \( \int h_{xj} = 1 - \int h_{nj} \).

### 2.2.2 Labor Markets for Unskilled Workers

Now, we look at the labor markets for unskilled workers. First, we address the industry-specific ex-post wages, and then obtain their ex-ante allocation to the different industries.

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\(^9\)The employment of skilled workers in non-tradable industries is non-stochastic because the demand for labor in these industries does not depend on the productivity shock. The reason is that the impact of the productivity shock on the marginal product and on the price off-set each other. This, in turn, is due to unitary elasticity of demand arising from the structure of preferences in (6). Under alternative preferences, the demand for labor in non-tradables, and thus the employment of skilled labor in these industries, could be stochastic. However, the volatility would always be lower in the non-tradable than in the tradable sector.
The industry-specific markets for unskilled workers are competitive, and workers are paid the marginal product of their labor. Letting \( w_{lj} \) denote the unskilled wage in industry \( j \), we have from (1) that it is given by:

\[
 w_{lj} = (1 - \alpha) \frac{p_j z_j}{l_j} \quad j \in n \cup x
\]  

(14)

For unskilled workers, the volatility of labor demand leads to a stochastic wage. Moreover, since the volatility labor demand depends on the extent of foreign competition, we obtain that, although all industries have the same technology and are subject to identically distributed shocks, the volatility of the unskilled wage is higher in tradable industries.

For the wage in a non-tradable industry, substitute (8) for \( p_j \) in (14), to obtain

\[
 w_{lnj} = (1 - \alpha) \frac{s_n}{l_n}
\]  

(15)

For the wage in a tradable industry, substitute (1), (9) and (13) into (14), to get:

\[
 w_{lxj} = (1 - \alpha) \frac{1 - s_n A_{xj}^{1/(1-\alpha)}}{1 - l_n A_{xj}^{1/(1-\alpha)}}
\]  

(16)

Moreover, given the large number of industries with idiosyncratic shocks, the CPI is non-stochastic, and the volatility of the real wage of unskilled workers is determined only by the volatility of the nominal wages in (15) and (16). Hence, using the coefficient of variation, we can address the volatility of the real wage of unskilled workers:

**Proposition 3**  
(a) The consumer price index is non-stochastic. (b) The coefficient of variation of the unskilled wage is lower in non-tradable industries than in tradable ones. Consequently, coefficient of variation of the real wage of unskilled workers is lower in non-tradable industries. (c) In non-tradable industries, the unskilled wage is non-stochastic\(^{10}\).

**Proof.** (a) Manipulate (5), (8) and (9) to obtain:

\[
\pi^{1-\epsilon} = \left[ e^{-\gamma} s_n^{\alpha-1} l_n^{1-\alpha} \right]^{\epsilon-1} + [\tau e^{\alpha \gamma/(1-\alpha)} (1 - s_n) A_{xj}^{1/(1-\alpha)}]^{\epsilon-1},
\]

which, given proposition 2, establishes the result. (b and c) Given proposition 2, from (15), the coefficient of variation of the unskilled wage in the non-tradable sector is \( \sigma_{ln} = 1 \), while from (16), the coefficient of variation of the unskilled wage in the tradable sector is \( \sigma_{lx} = e^{2\gamma/(1-\alpha)^2} \). \( \blacksquare \)

\(^{10}\) The wage in the non-tradable sector is non-stochastic, because labor demand in the sector does not depend on the productivity shock. This is due to the unitary elasticity of demand. See footnote 9.
Finally, we address the ex-ante allocation of unskilled workers. Since all unskilled workers are identical, the ex-ante equilibrium implies that their expected utility in any industry \( U_{lj} \) is the same:

\[
U_{lj} = U_{lj}^0, j, j' \in n \cup x.
\]

Carrying on with the hypothesis of symmetric equilibria, the equilibrium condition requires that the representative unskilled worker in each sector has the same expected utility\(^{11}\)

\[
U_{lx} = U_{ln} \tag{17}
\]

which yields

**Proposition 4** Letting \( \Lambda_n \equiv e^{-\gamma}, \Lambda_x \equiv e^{(1-\alpha)\gamma}, \) and \( \theta \equiv e^{-\rho(1-\alpha)^{-2}\gamma} < 1 \) the equilibrium employment of unskilled workers in the non-tradable sector is given by

\[
l_n = \frac{\Lambda_n^{\varepsilon-1}}{\tau^{\varepsilon-1} \Lambda_n^{\varepsilon-1} \theta + \Lambda_n^{\varepsilon-1}}
\]

while the total expenditure in that sector, which captures the employment of skilled workers in the non-tradable sector, yields:

\[
s_n = h_n = \frac{\Lambda_n^{\varepsilon-1}}{\Lambda_n^{\varepsilon-1} + \tau^{\varepsilon-1} \Lambda_x^{\varepsilon-1}}
\]

**Proof.** From (6), we obtain that (17) can be written as: \( E(w_{lj}/\pi)^{1-\rho} = E(w_{lx}/\pi)^{1-\rho} \). Since \( \pi \) is non-stochastic, taking (15) and (16) and using (2), we obtain: \( s_n/l_n = \theta(1 - s_n)/(1 - l_n) \). Together with the expression for \( s_n \) obtained in proposition 2, we obtain the result. Equation (12) establishes that \( h_n = s_n \).

Finally, despite the fact that all industries are technologically identical, the lower costs of inter-sectoral mobility of skilled workers have implications for the skill-intensity of production. The higher volatility of the unskilled wage in the tradable sector makes these industries more unattractive for risk-averse unskilled workers than those in the non-tradable sector. By contrast, skilled workers face similar (zero) uncertainty in both sectors, as they hedge risk through inter-industry mobility. Hence the tradable industries are relatively more attractive for skilled workers than for unskilled workers, and we obtain that:

**Proposition 5** On average, the industries in the tradable sector are more intensive in skilled-labor than those in the non-tradable sector. The average skill intensity in a non-tradable industry is given by \( h_n/l_n = \phi \), and in an exportable industry is given by \( \int h_{xj}/l_x = \theta^{-1} \phi \), where

\(^{11}\)Note that since all industries in the same sector (exportable or non-tradable) have the same wage distribution (see equations 15 and 16), the symmetric allocation constitutes an equilibrium.
\[
\phi \equiv \frac{\tau^{\xi-1} \Lambda_n^{\xi-1} \theta + \Lambda_n^{\xi-1}}{\Lambda_n^{\xi-1} + \tau^{\xi-1} \Lambda_x^{\xi-1}} < 1
\]

**Proof.** From \(l_n\) and \(s_n\) in proposition 4 we obtain \(\phi\). On the other hand, (13) and proposition 4 yield \(\int h_{2j}/l_x = \theta^{-1} h_n/l_n\). \(\blacksquare\)

### 2.2.3 Real Wages and Welfare

Finally, we obtain the expressions for the expected wage (\(\bar{w}\)) of unskilled and skilled workers. Note that, given the law of large numbers, the expected wage corresponds, ex-post, to the average wage of the respective group. First, we solve for the CPI:

**Lemma 6** The CPI is given by \(\pi = \phi^{1-\alpha} (\Lambda_n^{\xi-1} + \tau^{\xi-1} \Lambda_x^{\xi-1})^{\frac{1}{1-\alpha}}\).

**Proof.** Substitute \(l_n\) and \(s_n\), from proposition 4, in the expression for \(\pi\) in proposition 3, and take into account that: \(e^{\alpha \gamma/(1-\alpha)} = \Lambda_x/\theta^{1-\alpha}\). \(\blacksquare\)

To obtain the expected real skilled-wage, we have from proposition 1:

\[
\frac{\bar{w}_s}{\pi} = \alpha \phi^{\alpha-1} \left( \Lambda_n^{\xi-1} + \tau^{\xi-1} \Lambda_x^{\xi-1} \right)^{\frac{1}{1-\alpha}}
\]

(18)

As to the real unskilled wage, we distinguish between the tradable and the non-tradable sectors. In the latter, the expected real unskilled wage (\(\bar{w}_{ln}/\pi \equiv \pi^{-1} \int w_{ln}/\pi\)) is obtained from proposition 4 and (15) to yield:

\[
\frac{\bar{w}_{ln}}{\pi} = (1 - \alpha) \phi^\alpha \left( \Lambda_n^{\xi-1} + \tau^{\xi-1} \Lambda_x^{\xi-1} \right)^{\frac{1}{1-\alpha}}
\]

(19)

Meanwhile, in tradable industries, from proposition 4 and (16), the expected real wage (\(\bar{w}_{lx}/\pi \equiv \pi^{-1} \int w_{lx}/\pi\)) can be written:

\[
\frac{\bar{w}_{lx}}{\pi} = (1 - \alpha) \theta^{-1} \phi^\alpha \left( \Lambda_n^{\xi-1} + \tau^{\xi-1} \Lambda_x^{\xi-1} \right)^{\frac{1}{1-\alpha}}
\]

(20)

The expected utility of skilled and unskilled workers, corresponding to their average welfare ex-post, is affected by the expected level of wages as well as by uncertainty. For skilled workers, the wage is non-stochastic, and thus (18) is a sufficient statistic for welfare. For unskilled workers, given the equilibrium condition in (17), the non-stochastic wage in non-tradables, given in (19), represents the certainty equivalents to the wage in the tradable sector, and thus is also an appropriate measure for welfare.
To conclude, we can summarize the implications of the model for the cross-sectional wage-dispersion and wage volatility. Looking at the cross-sectional wage distribution, there are three important factors contributing for wage dispersion, i.e. for difference in wages across workers. First, skilled and unskilled workers in each sector have different wages. The wage-skill gap reflects not only the differences in productivity, but also the lower mobility costs of skilled workers. Second, within unskilled workers, there is a wage differential among tradables and non-tradables. As can be seen from (19) and (20), the expected wage of an unskilled worker is higher in the tradable sector, to compensate workers in that sector for the higher wage-volatility. Finally, third, unskilled workers within the tradable sector have different wages, depending on the realization of the productivity shock. The latter can be addressed as the transitory dispersion of wages, and will result also in time series volatility in the wage of an unskilled worker. Note that this volatility does not exist for skilled workers, since the latter compensate for productivity shocks by moving across sectors. (Gottschalk and Moffit, 1994).

3 Globalization

Let’s then look at the impact of globalization on wages and welfare, and on mobility and volatility. We capture the notion of globalization through an expansion in the terms of trade ($\tau$). Higher terms of trade may arise from a decline in transport costs or from a decline in trade barriers in trading partners. We address the impact of an increase in $\tau$ as globalization because, as the proposition below shows, it yields an expansion of the tradable sector.

**Proposition 7** An increase in $\tau$ increases the share of skilled and unskilled workers allocated to the tradable sector.

**Proof.** From proposition 4, it is immediate that $h_n$ and $l_n$ fall, as $\tau$ increases. ■

Moreover, looking at the impact of globalization on the skill-intensity in the different industries, we have:

\[ \text{Bernard and Jensen (1995, p. 71) nd that, after controlling for other variables known to be correlated with higher wages, the export wage premium at [the plant level] is still significant and between 7 and 11 percent, although industry variation accounts for much of the premium. Moreover, they nd a high transition rate into and out of exporting at the plant level; 18 percent of exporting plants leave the export market and 9 percent of nonexporters begin foreign shipments in an average year. Hence suggesting an important amount of volatility in export activity.} \]
Proposition 8 An increase in $\tau$ causes a decline in the average intensity in skilled labor in all industries in the economy.

**Proof.** From proposition 5, $\phi$ falls, as $\tau$ increases. □

The decline in the average intensity in human capital across the sectors of the economy is addressed as the volatility effect. The volatility effect, the driving force in the analysis of distributional consequences that will follow, arises because *globalization* implies an expansion of the tradable sector, which being more skilled labor intensive, implies that the average intensity in skilled labor in each sector has to fall, in order to preserve full employment.

Now, we address the implications for real wages. The increase in the terms-of-trade has a positive income effect, as it expands the value of domestic production, which works to increase the wages of skilled and unskilled workers. In addition, there is the impact of the volatility effect on wages, as the decline in average skill-intensity (see proposition 8) works to increase the marginal product of skilled workers, while reducing that of unskilled labor.

Hence, for skilled workers, the income and the volatility effects affect wages in the same direction, yielding that:

**Proposition 9** An increase in $\tau$ raises the skilled real wage and the welfare of skilled workers.

**Proof.** see (18). □

For unskilled workers, the volatility effect has a negative impact on wages and welfare. And, as we show below, it may outweigh the (positive) income effect.

**Proposition 10** Let $\xi \equiv \alpha(\varepsilon - 1)(\theta^{-1} - 1) - \theta^{-1}$, an increase in $\tau$ reduces the unskilled wage across industries and reduces the welfare of unskilled workers, when $\tau^{\varepsilon - 1} \Lambda_x^{\varepsilon - 1} \leq \Lambda_n^{\varepsilon - 1} \xi$.

**Proof.** Take the derivative of (19) with respect to $\tau$, to see that it is negative when the expression above holds. □

The conditions in proposition 10 establish an upper bound in the terms-of-trade, so that the volatility effect dominates the income effect. Then, an increase in the terms of trade brings down the industry wages and the welfare of unskilled workers. Since economies with lower terms-of-trade are, ceteris-paribus, less open, i.e. have a smaller share of labor allocated to tradables, these results suggest that *globalization*, brought about by an improvement in the terms of trade, is more likely worsen the absolute position of unskilled workers, when the economy is relatively less open to start with. The intuition is clear: in the limit, if all workers are in the tradable sector, the volatility
effect disappears, since no further expansion of the tradable sector is possible, following an increase in the terms of trade.

In terms of the wage-skill gap, the income effect disappears, since it affects skilled and unskilled wages alike, and thus the volatility effect yields:

**Proposition 11** An increase in $\tau$ expands the wage-skill gap across industries.

**Proof.** From (18), (19) and (20), we obtain that in a non-tradable industry, the expected wage skill gap is given by $\bar{w}_h/\bar{w}_n = \alpha/(1 - \alpha)\phi$, while in a tradable industry it is: $\bar{w}_h/\bar{w}_n = \alpha/(1 - \alpha)\phi\theta$. Proposition 8 shows that $\phi$ falls when $\tau$ increases. ■

The results in propositions 10 and 11 shed new light on the debate over the role of trade on the decline of real wages for unskilled workers over the last two decades. First, the ubiquitous argument that the industrialized economies are too closed for imports to play a significant role (Cline, 1997), means here that they are closed enough for the volatility effect to dominate.

Second, since our results are independent of the relative skill intensity of imports and exports, the decline in the world price of skill-intensive goods (surveyed in Slaughter and Swagel, 1997) and the increase in the wage-skill gap in developing countries (Robbins, 1996), which undermine the explanatory power of the Stolper-Samuelson effect, does not contradict our proposition that globalization has brought down the wages of unskilled workers through the volatility effect.

Looking now at the implications of globalization for the cross-sectional wage distribution, the increase in $\tau$ expands wage dispersion for two reasons. On one hand, there is an increase in the wage skill gap across industries (see proposition 11). On the other, there is an expansion in the dispersion of the wages of unskilled workers, due to the increase of the share of unskilled labor in tradables, where the coefficient of variation of wages is higher. The latter implies also an increase in the average time-series volatility of individual unskilled wages (Gottschalk and Moffit, 1994).

To conclude, we address the implications of globalization for labor mobility. Given that, as shown in proposition 2, employment volatility of skilled workers is higher in the tradable industries, globalization implies an increase in job instability for skilled workers (Farber, 1997; Idson and Valetta, 1997; Bhagwati, 1998). Moreover, interpreting variations in employment as a movement of workers across industries, the increase in volatility implies an increase in the inter-industry mobility of skilled workers (Magnani, 1998; Greenaway et al. 1998).
4 Conclusion

In this paper we have analyzed the relationship between international competition and volatility in labor markets, and the implications that arise when we assume that the inter-sectoral mobility of workers is positively correlated with their educational level. We have established that tradables cause more volatility in labor markets than non-tradable industries, because international competition increases the volatility of labor demand. Hence, the employment of skilled workers and the wages of unskilled workers are more volatile in tradables than in non-tradables.

In an era characterized by globalization, international competition plays an ever expanding role in determining labor market outcomes. Defining globalization as an expansion of the tradable sector, arising from an increase in the terms of trade (or a decline in transport costs), we obtained that it expands the inter-sectoral mobility of workers, the sectoral volatility of employment and the volatility of earnings.

On the other hand, we have obtained that, under certain conditions, globalization brings down the wage of unskilled workers, while increasing that of skilled workers, thus expanding the wage-skill gap. The effects of globalization on volatility, mobility and wage-levels obtained in the context of our model, are in accordance with empirical evidence on labor market trends of the last quarter century, and are robust to the evidence usually presented to dismiss the role of international trade on recent labor market trends in industrialized countries.

Finally, if, as suggested in this paper, globalization is responsible for the current distress of unskilled workers, through its effect on volatility, the policy challenge is to minimize such distress without jeopardizing the gains from trade. First-best responses include measures to promote the mobility of workers (e.g. retraining and information systems) and to reduce the volatility of their income (e.g. private insurance, institutional support to displaced workers). Meanwhile, contingent protection also helps to reduce the volatility of labor demand in tradable sectors, and can act as a second-best (Eaton and Grossman, 1995). However, as Dixit (1987, 1989a and 1989b) argues, the same market failures that bring down insurance markets, can undermine the case for these policies, and an appropriate analysis should model explicitly the reason for the break down of insurance markets (e.g. moral hazard, adverse selection). A rigorous analysis of the policy implications along these lines is a challenge for future research.
5 References


