Effects of North–South trade on wage inequality and on human-capital accumulation

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ABSTRACT

This paper develops an endogenous growth model with technological knowledge directed towards high- versus low-skilled labour, augmented with North–South international trade of intermediate goods and with human-capital accumulation, to analyse how trade affects wage inequality and the inter-country human-capital gap. Trade is a vehicle for inter-country technological-knowledge diffusion and human-capital accumulation interacts with the intra-country direction of technological knowledge arising from trade. In contrast with the market-size effect, stressed in the skill-biased technological change literature, the operation of the price channel following openness to trade predicts, in line with the recent trends in developed and developing countries, an increasing technological-knowledge bias towards high-skilled human capital. This, in turn, decreases inter-country gaps of technological knowledge and human capital and increases intra-country wage inequality. Also in line with recent empirical evidence, inter-country wage convergence is induced by the trade-opening level effect.

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1. Introduction

Empirical evidence detects two compelling trends since the early 1980s: (i) rise in wage inequality in favour of high-skilled labour and (ii) rise in the proportion of high-skilled labour, both occurring in developed (North) and developing (South, newly-industrialized) countries, in the context of strong technological-knowledge progress and enlarged intermediate goods trade flows (e.g., Acemoglu, 2003; Alesina and Savorides, 2006; Berman et al., 1998; Egger and Kreickemeier, 2008; Goldberg and Pavcnik, 2007; Machin and Van Reenen, 1998; Robertson, 2004; Zhu and Treffer, 2005). To account for the above empirical facts, we develop an endogenous directed technological-knowledge model with North–South trade and human-capital accumulation. In the model, trade of intermediate goods is a vehicle for inter-country technological-knowledge diffusion and human-capital accumulation interacts with the intra-country direction of technological knowledge arising from trade.

The two main approaches in the literature contradict at least one of the mentioned trends. The dominant trade approach (e.g., Leamer, 1998; Wood, 1995) relies on the labour-level channel through the Stolper–Samuelson theorem: i.e., a decline in the relative price of the imported good reduces the return of the factor that is used intensively in its production; however, applied to the South, it would predict a reduction of the high-skilled labour premium. The technological approach (e.g., Acemoglu, 1998, 2002; Acemoglu and Zilibotti, 2001) relies on the market-size channel; i.e., larger high-skilled labour creates a larger demand for R&D biased towards improvements in inputs used in goods produced by high-skilled labour, thus increasing relative high-skilled wages; however, applied to trade with the South (low-skilled abundant), it would predict a reduction of the high-skilled technological-knowledge bias and, thus, of the high-skilled premium in the North.

Thus, in these two approaches labour levels govern wage inequality, either in a Heckscher–Ohlidan way or through R&D intensity. However, with respect to the latter, and in addition to the described market-size channel, the direction of R&D is also influenced by the price of goods (price channel), since more expensive goods command higher profits for the producers of the respective inputs. For instance, the relative abundance of high-skilled labour increases the competitive price of goods produced by low-skilled labour and, thus, the demand for R&D directed towards improvements in goods produced by low-skilled labour.

Pursuing this argument, we merge the technological and the trade approaches, by shifting the focus to the price channel (instead of the market size) (e.g., Afonso, 2006, 2008) and by accounting for technological-knowledge diffusion (e.g., Barro and Sala-i-Martin, 1997; Grossman and Helpman, 1991), which we deem as non-dissociable from intermediate-good trade (e.g., Amiti and Konings, 2007; Goldberg et al., 2008). This framework then implies that when the high-skilled labour abundant North exports inputs incorporating its R&D results to a low-skilled abundant South, it benefits from the higher prices of...
goods produced by high-skilled labour in the South. The resulting profit
opportunities redirect R&D towards inputs that increase the marginal
productivity and thus wages of high-skilled labour in the North and,
under technological-knowledge diffusion, in the South.

Furthermore, instead of fixed labour levels, we consider endogenous
human-capital accumulation, through both schooling and on-the-job-
training (OJT), in line with Lucas (1993) and Mincer (1993). Indeed,
most of the empirical evidence points out the complementary nature
of schooling and OJT (e.g., Bartel and Lichtenberg, 1987; Brunello,
2004; OECD, 2001). In particular, high complementarity means that
schooling is far from providing all the needed skills, which supports
the claims in the growth-human-capital literature that the lack of an
empirically robust relationship between human capital and growth is
partially caused by the exclusion of OJT (e.g., Lucas, 1993). We assume
that, relative to low-skilled, high-skilled human capital is school
ensive and is more efficient in production.

Final-goods production uses low (or high)-skilled human capital
together with low (or high)-specific quality-adjusted intermediate
goods (e.g., Acemoglu and Zilibotti, 2001). Innovative Northern R&D
improves the quality of intermediate goods (e.g., Acemoglu and Zilibotti,
2001). Innovative Northern R&D
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partially caused by the exclusion of OJT (e.g., Lucas, 1993 and Mincer,
1993). We assume
empirically robust relationship between human capital and growth is
enhanced and/or the absolute advantage of high-skilled human
capital is increased. We define the productive setup, which, excluding some parameter
values and some elements of R&D activities, is common to both
countries.

Each economy is populated by infinitely-lived individuals and popula-
ation growth is zero. Individuals choose between consumption and
savings on income allocation and between production and human-
capital accumulation on time allocation.

Competitive final goods use low (or high)-skilled human capital
together with low (or high)-specific quality-adjusted intermediate
goods. Quality-adjusted intermediate goods are produced under
monopolistic competition by combining units of aggregate output
and designs (e.g., Aghion and Howitt, 1992). Designs are obtained
through R&D – Northern innovative and Southern imitative – which
affect technological knowledge, economic growth and wages.

2. Economic structure

By expanding the closed-economy endogenous R&D-growth model with fixed labour levels proposed by Afonso and Gil (2006, 2008),
we define the productive setup, which, excluding some parameter
goods use low (or high)-skilled human capital
together with low (or high)-specific quality-adjusted intermediate
goods. Quality-adjusted intermediate goods are produced under
monopolistic competition by combining units of aggregate output
and designs (e.g., Aghion and Howitt, 1992). Designs are obtained
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2.1. Households

A time-invariant number of heterogeneous individuals decide the
allocation of income and time. Income is partly spent on consump-
tion and partly lent in return for future interest. Time, t, is divided between human-capital accumulation,
and working to earn a share of Y proportional to the individual’s human
capital.

Heterogeneity is present in two connected individuals’ features: the
ability level, a, uniformly distributed over a range [0, 1], and
the human-capital type. We consider a threshold ability A, such that
high ability individuals, a > A, accumulate high-skilled human
capital, H, and low ability individuals, a ≤ A, are only able to accumu-
late low-skilled human capital, L. Individuals have identical preferences
described by a stable relative risk aversion utility function
\[ u_T(t) = \frac{1}{1 - \theta} \exp(-\theta p dt) \]
where \( c_a(t) \) is the level of consumption of Y of individual a at t, p > 0 is the subjective discount rate and \( \theta > 0 \) is the relative risk aversion.
Savings are the accumulation of financial assets, K, which have return (the interest rate) r.\(^1\) The budget constraint of a at t equals savings
to income earned minus consumption: \( K_a(t) = r(t)(K_a(t) + [1 - u_{F,S}(t) - u_{F,T}(t)] w_m(t) m_a(t) - c_a(t), \)
where: m indexes the human capital type;\(^2\) \( w_m(t) \) is the wage per unit of m-type human capital at t; and \( u_{F,S}(t) \) and \( u_{F,T}(t) \) are the fractions of t that a spends at school and on-the-job-training (OJT),\(^3\) respectively; due to arbitri-
tage in the domestic assets markets, r depends neither on a nor m, only on t.

Individuals accumulate either H or L, restricted by the ability level,
using schooling and OJT. The productivity of the time spent increases

\(^1\) That is, lending takes the form of ownership of profitable firms, which are the ones
that produce quality-adjusted intermediate goods. The value of these firms, in turn, is
the value of patents in use.

\(^2\) That is, \( m_a = L_a (m_a = H_a) \), if a ≤ A (a ≥ A), and L − \( \int_a^1 a \rho dt \) (H − \( \int_a^1 a H_a \rho dt \)).

\(^3\) Following Mincer (1993), we consider that OJT is costly, in the sense that it requires
time away from work.
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