Globalization and Employment: Imported Skill Biased Technological Change in Developing Countries

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Abstract

This paper discusses the impact of the international transfer of embodied technological change on the employment evolution of skills in a sample of low and middle income countries (LMICs). A large body of literature has already underlined the occurrence of widening wage and employment differentials between skilled and unskilled workers in high-income countries (HICs) (Katz and Autor, 1999). Such empirical evidence is consistent with both trade- and technology-based explanations while these competing theoretical frameworks predict opposite effects on within-country inequality in LMICs. Recent analytical advancements have found convergent elements between these two lines of research, especially in the prediction of the employment impact of technology transfer. However, a systematic lack of data in LMICs still hampers empirical research on the determinants of the witnessed increase in inequality in these economies.

This paper provides a direct measure of technology transfer from HICs, that is from those economies which have already experienced the occurrence of skill-biased technological change, to LMICs. GMM techniques are applied to an original panel dataset comprising 28 manufacturing sectors for 23 countries over a decade.

Econometric results provide direct robust evidence of the *absolute* skill-bias effect of technology import in LMICs which, therefore, represents an important determinant of the growing divide between skilled and unskilled workers in these countries.

Keywords: Skill Biased Technological Change, capital trade, GMM estimation, General Industrial Statistics, World Trade Analyzer.

JEL classification: F16, J23, J24, O30

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1 Introduction

Since the beginning of the 1980s, a growing divide in terms of wages and unemployment rates between skilled and unskilled workers has been documented in the US (Katz and Murphy, 1992; Murphy and Welch, 1992, 1993a and 1993b; Juhn *et al.,* 1993; Goldin and Katz, 1999; Chay and Lee, 2000), in the UK (Machin, 1996), in Japan (Katz and Revenga, 1990) and in other OECD countries (Freeman, 1988; Davis, 1992; Nickell and Bell, 1995 and 1996). The emergence of this common pattern across countries has attracted economic research since widening skill-based differentials in the labour market affect an overall measure of within-country inequality[1].

On one side, many scholars have applied the insights of the classical Stolper-Samuelson (S-S) theorem and consequently related the rising trend of inequality in high-income countries (HICs) to trade with low and middle income (LMICs) economies (Wood, 1995 and 1998; Leamer, 1994 and 1996; Borjas *et al.*, 1997). On the other side, technology-based explanations have emphasised the role of skill-biased technical change (SBTC) in shifting relative employment levels and, thus, rising the wage and employment gap between skilled and unskilled labour (Bound and Johnson, 1992; Berman *et al.,* 1994; Autor *et al.,* 1998). While a large economic literature has dealt with the determinants of rising inequality in OECD countries, applied research to LMICs still appears into a developing stage, mainly because of the novelty of the theoretical analysis in this field and the lack of appropriate data for its empirical verification. However, recent contributions have already provided a setting where - at odds with the predictions of the S-S theorem - the contemporaneous occurrence of economic integration and technology diffusion may determine a possible increase in inequality in LMICs (Feenstra and Hanson, 1996; Robbins, 1996; Berman and Machin, 2000). These theories seem consistent with available empirical evidence on LMICs which underlines the contemporaneous appearance of both trade openess and increased within-country inequality, at least in the short/medium run (Harrison and Hanson, 1999; O'Connor and Lunati, 1999; Arbache *et al.*, 2004; Vivarelli, 2004).

This paper discusses the occurrence of Skill-Enhancing Technology Import (SETI), namely the relationship between imports of embodied technology and the employment of skilled and unskilled labour in a sample of LMICs. This study is motivated by the identification of a gap in applied literature which specifically concerns the employment effect of the international transfer of SBTC in countries which rely solely on the imports of capital goods for their technological upgrading.

Three aspects make this paper different from other empirical studies in this field. First, while previous research has focused only on indirect proxies of technological change (TC) (Berman and Machin, 2004), this paper provides an original detailed measure of SETI (Section 3.2). Second, this study offers a unified multi-country analysis and, thus, it avoids the limitations which generally characterise country-specific research. In particular, the effect of SETI is investigated through a merging of different data sources which results in an (unbalanced) panel of 4934 observations for 28 manufacturing sectors of 23 LMICs in the period 1980-1991. Finally, the empirical analysis verifies the hypothesis of "capital-skill complementarity" and "skill-enhancing technology import" by looking separately at the employment equation for both "operative" and "non-operative" workers rather than in a single-equation framework (Bartel and Lichtenberg, 1987; Zhu, 2005). In turn, this allows to disentangle more effectively the determinants of relative skill upgrading in LMICs by looking at the effect of capital and technology on different categories of workers.

[1] Indeed, there has been an increase in within-country inequality in the last 25 years while, at the same time, population-weighted measures of between-country inequality have shown a decreasing trend (Sala-i-Martin, 2002). Inequality is a very heterogeneous multi-dimensional concept. Given the research topic of this paper, the concept of "inequality" adopted throughout this study will refer only to its "within-country" dimension and, specifically, to the increasing wage or employment ratio between skilled and unskilled workers - unless otherwise stated.

The remainder of the paper is organized as follows: the discussion about the theoretical framework on which this work is based (Section 2) is followed by the description of the data (Section 3) and the econometric methodology (Section 4) adopted in the empirical analysis. Subsequently, the empirical results obtained from the descriptive analysis (Section 5) and the econometric estimates (Section 6) are discussed. Section 7 concludes this paper by summarising the main findings obtained.

2 Interpretative Background

Two main streams of literature - rooted in international and labour economics - have provided competing theoretical frameworks for assessing the employment evolution of different skills over time (Baldwin and Cain, 2000; Moore and Ranjan, 2005). On one side, some scholars have focused on the effect of trade and foreign direct investment (FDI) by stressing specific features and role of recipient economies in the international division of labour. On the other side, technology-based explanations have pointed at the intrinsic characteristics of TC - such as its factor bias and its cumulative pattern over time - by neglecting the role of international trade and\or a country's relative endowments. The core of the disagreement between these two approaches refers to the degree and nature of the endogeneity between TC and trade and, therefore, on which factor has to be ultimately declared responsible for the increase in within-country inequality worldwide. Although starting from different perspectives, these two lines of research have found convergent spots over time, especially in the assessment of the labour market outcome of international technology transfer. This section provides a comparative survey of these topics.

2.1 The Employment Effect of Economic Integration

Economic research has interpreted the rapid expansion of international trade occurred since the 1980s as one of the main determinants of changes in the employment structure and increased inequality in HICs (Burtless, 1995; Freeman, 1995; Wood, 2000)[2]. While the classical Heckscher-Ohlin (H-O) trade theory - and the related Stolper-Samuelson (S-S) theorem - provide a theoretical framework consistent with the employment evolution of skills in HICs, available empirical evidence of increased inequality in LMICs is at odds with the predicted egalitarian effect of increasing trade in these economies (Revenga, 1997; Reuveny and Li, 2003; Taylor, 2004; Zhu, 2004 and 2005)[3]. In this setting, differences in relative availability of skills represent the unique explanatory factor of trade between HICs and LMICs so that increased integration will only affect the relative wage and employment divide between skilled and unskilled workers[4].

[2] Although feedback effects may arise in countries already exposed to international trade (p. 217), Wood (1994, p. 269) advocates the exogenous nature of the expansion of trade with LMICs and its effect on widening skill-based wage differentials in HICs.

[3] In fact, H-O\S-S theory suggests that trade specialisation and FDI inflows favour sectors which intensively use a country's abundant production factor. In LMICs, this means an increase in the international demand for unskilled labour which - coupled to the contemporaneous decrease of the real rate of return to skilled labour (the relatively scarce production factor) - will lead to an overall decrease in wage dispersion and inequality.

[4] The implicit assumption is that capital is perfectly mobile across countries which, in turn, means that international trade between HICs and LMICs does not affect the share of real wages/profits (Wood, 1994, p. 59). Different reasons - such as increasing returns to scale and product differentiation - explain trade between HICs (Wood, 1994, p. 275).

The basic dychotomic framework depicted by the S-S theorem has been extended in several directions (Slaughter, 1998) through the analysis of multiple skill-related categories of workers (Wood, 1994), country groups (Davis, 1996 and 1998) and traded goods (Dornbusch, 1980; Feenstra and Hanson, 1996). The general implication of these theoretical extensions is the invalidation of the global predictions of the S-S theorem in favour of an approach which takes into account relative directions, characteristics and weights of a country's trade flows.

The tripartite skill-based distinction of the workforce proposed by Wood (1994, p. 213) does not change the predictions of S-S theory, but it requires a closer look at a country's specific terms of trade[5].

A representation of countries along a skill supply-based continuum, rather than in a North-South framework, implies that the final within-country distributional consequences of a world-wide economic integration for a LMIC will depend on its specific trade patterns, especially the relative weights and directions of its trade flows. In particular, economic integration with trading partners which are relatively skilled-labour abundant will produce opposite effects compared to the ones obtained by trade with countries relatively unskilled-labour abundant. In this framework, the predictions of the S-S theorem are better identified in relation to the so-called "cones of diversification", that is groups of countries characterised by similar endowment proportions, the same production functions and supplies of the same range of goods (Davis *et al.*, 1996; Davis, 1998), rather than to the world economy on the whole.

Finally, the introduction of technological (skill-related) heterogeneity of traded goods represents an important departure from the basic S-S theorem which assumes, on the contrary, the same production function among countries and the absence of scale economies. The extension of this framework to TC opens the way to the possible counter-effects of economic integration on within-country inequality in LMICs (Section 2.3) as well as to the complementary and overlapping effects between a country's economic integration and its technological upgrading (Francois and Nelson, 1998)[6]. However, rather than by technology-based explanations, trade economists have generally explained rising inequality through the employment impact of trade-based adverse competitive factors in LMICs, namely a causality relationship which goes from (exogenous) changes in trade patterns to (possible) defensive endogenous innovation (Leamer, 1994 and 1996), and the occurrence of a "market stealing" effect and "crowding out" of domestic production due to both imports and inward FDI (Aitken and Harrison, 1999; Markusen and Venables, 1999).

[5] In particular, LMICs with a comparative advantage in manufacturing experience a general decrease in inequality since the expansion of labour-intensive manufactured exports increases the demand for relatively-abundant basic-educated workers. On the contrary, "*in countries with high proportions of no-educated workers and/or abundant natural resources, liberalisation of trade policies could cause manufacturing to contract, and primary exports to expand, with uncertain effects on the distribution of income*" (Wood, 1994, p. 246).

[6] For instance, it has been recognised that the Heckscher-Ohlin theory represents a suitable theoretical framework only for long-run dynamics whereas competing factors - such as technology - affect labour markets in the short-run (Krugman, 1995). However, the long–run in this setting implies only perfectly elastic labor demand curves since *"infinitely elastic supply would undermine the central premise that differences in the availability of skills are the main basis of North-South trade"* (Wood, 1994, p. 53).

2.2 The Employment Effect of TC

The foundation of economic research on the employment effect of TC goes back to the contributions of Hicks (1932) and Harrod (1939) and to the assessment of a possible factor-biased TC in the context of growth equations. Economic scholars have looked at the interaction between employment and TC mainly focusing on both the effectiveness of compensation mechanisms in the labour market (Myers, 1929; Vivarelli, 1995; Vivarelli and Pianta, 2000) and a mismatch technology-based explanation of unemployment[7]. Research has then moved to the analysis of the effect of factor-biased TC on the employment of different skills by providing a significant amount of evidence which underlines the occurrence of SBTC among OECD countries (Machin and Van Reenen, 1998)[8]. The SBTC hypothesis is based on the idea that the exogenous adoption of a new technology would determines a *relative* employment shift from unskilled to skilled workers thus rising both relative wages and employment levels (Berman *et al.*, 1998)[9].

While trade and SBTC predict a similar effect on relative employment in HICs[10], available empirical evidence in LMICs underlines a rising wage inequality which is at odds with the S-S theorem while consistent with the occurrence of SBTC (Cragg and Epelbaum, 1996; Feenstra and Hanson 1996a, 1996b, 1997; Berman *et al.,* 1998; Beyer *et al.*, 1999; Hanson and Harrison, 1999; Feliciano, 2001; Kang and Hong, 2002; Pavcnik, 2003).

Several findings support the SBTC hypothesis against competing explanations of increased inequality (Baldwin, 1995). First, the predominance of the within-industry component of the overall employment shift of different skills over the between-industry reallocation component is more consistent with the hypothesis of SBTC rather than with changes in product demand, trade patterns or Hicks-neutral sector-biased TC which, instead, shift employment towards skill-intensive sectors (Bound and Johnson, 1992; Katz and Murphy, 1992; Berman *et al.*, 1994). Second, the pervasiveness of skill-biased technologies across industries and countries is consistent with available evidence of both increased relative wages and within-industry employment shifts towards skilled labour (Berman and Machin, 2000 and 2004). Indeed, the more pervasive the technology (Bresnahan and Tratjenberg, 1995), the higher its capacity to affect relative wages (Krugman, 1995)[11]. Finally, some authors support SBTC by providing evidence of within-industry correlations between measures of TC and rising relative employment of skilled labour (Berndt and Morrison, 1995; Autor *et al.*, 1998; Machin, 1996b; Berman and Machin, 2004)[12].

[7] Mainstream economic theory has generally downsized the aggregate employment effect of TC (Layard *et al.,* 1991; Nickell and Bell, 1995; Manacorda and Manning, 1999; Card and DiNardo, 2002) by likening its occurrence to fluctuating productivity shocks without, however, providing detailed evidence on the sources of these shocks (Lilien, 1982; Mankiw, 1989; Nickell, 1990).

[8] Support to the hypothesis of SBTC in the US is offered by Krueger (1993), Berman *et al.* (1994), Levy and Murnane (1996); Doms *et al.* (1997); Autor *et al.* (1998), Siegel (1999) and Baltagi and Rich (2005); in Canada by Betts (1997); in the UK by Machin (1996a and 1996b); Haskel and Heden (1999) and Borghans and Well (2003); in France by Greenan *et al.* (2001); in Italy by Piva and Vivarelli (2002 and 2004).

[9] This definition does not require, therefore, an absolute decline in the demand for unskilled workers or an absolute increase in the demand for skilled workers. In the context of a production function with three inputs - capital, skilled labour and unskilled labour - the extent of factor-bias is measured by the rate of change of output elasticity to any input factor (Berman, 2000).

[10] Wood (1994, p. 287) suggests that in HICs trade and trade-induced TC tend to affect negatively the lower half of the skill distribution whereas autonomous TC mainly shifts upwards the demand of skilled workers.

[11] The pervasive nature of SBTC and changes in trade patterns on one side, and the persistent and pervasive widening of skill differentials on the other side, tend to marginalise competing explanations of rising inequality based on country-specific shifts in domestic labour supply\demand (Wood, 1994 p. 171) or institutional variables - such as the decline in trade unions membership, the real value of the minimum wage and the extent of pay-setting norms (DiNardo *et al.,* 1996).

[12] At the same time, weak within-industry correlations between relatively skilled employment and aggregate imports

2.3 Technology Transfer

The relaxation of the H-O/S-S hypothesis of technological homogeneity among countries opens the way to the assessment of the within-country effects of technology transfer in LMICs (Reddy and Zhao, 1990; Piva, 2003)[13].

Since the level of aggregate R&D investment in these economies is negligible[14], international technology transfer represents a crucial determinant of technological upgrading in LMICs (Krugman, 1979a and 1979b; De Long and Summers, 1993; Mayer, 2001). Moreover, economic literature has provided substantial insights into the relationship between the adoption of foreign technologies and a country's economic growth (Rosenberg, 1963 and 1970; Grossman and Helpman, 1990)[15].

International technology transfer, mainly through imports of capital equipment and intermediate goods from HICs (Acemoglu, 1998; Bin and Jianmao, 1999; Arbache, 2002), implies that LMICs experience the main features of imported technologies such as their labour-saving and\or factor-biased components (Berman, 2000). In turn, this implies that technology transfer affects employment and inequality in LMICs (Lall, 1999; Cornia 2003 and 2004) where the extent of its final effect will depend on the skill intensity of the imported technologies and some specific "absorptive capacity" features of the recipient economy (Cohen and Levinthal, 1989; Lumenga-Neso *et al.,* 2005), such as the skill intensity of its labour force (Schiff and Wang, 2004a and 2004b)[16].

An important difference characterises the autonomous effect of increased economic integration and technology on within-country inequality. Indeed, the former generates a one-off increase in relatively skilled employment while the latter implies that a LMIC's labour market is exposed to a continuous imports of SBTC. An example of the former is the model provided by Feenstra and Hanson (1996 and 1997). By dealing specifically with FDI and neutral TC in a context of technological heterogeneity among countries, they provide a setting where skill-intensive commodities are initially produced in HICs while unskilled-intensive goods in LMICs. FDI results in a shift of production from HICs to LMICs which follows the skill intensity of the outsourced commodities. Since these goods are unskilled-intensive from the HICs point of view while skilled-intensive for the recipient labour market of LMICs, FDI flows lead to an increase in relatively skilled employment in both country groups[17].

Such inequality-enhancing effects may be reinforced over time by both trade-based adverse competitive effects and the direct impact of SBTC. Indeed, integration among markets increases international competitive pressures and the need for firms in LMICs to modernize. On one side, this may stimulate investments in human capital and, therefore, the occurrence of *defensive skill-bias* (Thoenig and Verdier, 2003). On the other side, firms in LMICs may invest more in the imports of capital goods from HICs. Trade liberalization, therefore, shows a skill-enhancing effect in

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in HICs stand against the trade-based explanation (Berman *et al.,* 1994). Moreover, the insufficient growth rate of both within-industry capital-output ratios (Berman and Machin, 2000) and the investment share over GDP (Wood, 1994, p. 275) has been interpreted against the hypothesis of capital-skills complementarity (Griliches, 1969).

[13] The main channels of international technology diffusion are FDI (Vernon, 1966; Findlay, 1978; Blomstrom and Wang, 1992) and trade; in particular, trade of capital-embodied technology (Eaton and Kortum, 2001). Technology transfer may also occur through licensing, scientific journals, internet, and other sources of cross-borders communication (Schiff *et al.,* 2002).

[14] In the 1990s, 96% of the world R&D expenditure took place in industrialised countries (Coe *et al.*, 1997).

[15] Indeed, trade, imports and imitations of capital goods has entered both endogenous-growth (Grossman and Helpman, 1991; Lee, 1995; Hendricks, 2000) and evolutionary "catching-up" models (Fagerberg, 1995).

[16] Other factors may complement the inequality-enhancing effect of TC such as labour market institutions (Acemoglu, 2003) and organizational changes (Van Reenen, 1997, Aghion *et al.*, 1999; Aguirregabiria and Alonso-Borrego, 2001; Caroli and Van Reenen, 2001; Caroli *et al.,* 2001; Piva *et al.*, 2005).

[17] Zhu and Trefler (2001) discuss a similar setting where the relocation of least skill-intensive productions from HICs to LMICs determines technological catch-up and higher inequality in the latter.

LMICs (Robbins, 1996 and 2003) since it induces both capital deepening, which increases relatively skilled employment because of capital-skill complementarities (Griliches, 1969), and SBTC diffusion (Berman and Machin, 2004).

3 Dataset and Indicators

The empirical analysis in this paper is based on an original time-series cross-country dataset at the sector level. This is obtained by the merging of different data sources and it is characterised by an unbalanced structure comprising 4934 observations representative of 28 three-digit ISIC Rev. 2 manufacturing sectors (Major Division 3) of 23 LMICs over the period 1980 - 1991. The main original data source is the United Nations General Industrial Statistics Vol.1 (GIS) which provides annual sector data on employment and wage by worker categories, value added and capital formation. These variables are merged with the SETI indicator (Section 3.2) which is computed on data obtained by the World Trade Analyzer. This dataset is provided by Statistics Canada and allows to track the economic value of bilateral trade flows worldwide since 1980 at the four-digit level of SITC Rev. 2 classification. Finally, purchasing power parity and GDP deflator are taken from Penn World Tables 6.1 and The World Bank Development Indicators 2004 respectively.

Table 1 provides a list of the variables employed in the empirical analysis and their definitions. Appendix A describes these indicators in more details whereas Appendix B provides a full account of the procedure followed to create the dataset used for the empirical analysis.

Table 1. List of Variables and Definitions

BC	Number of employees engaged in production activities (or "blue collar")
WC	Number of employees engaged in non-production activities (or "white collar")
WBC	Per-capita wage/payment made to BC workers
WWC	Per-capita wage/payment made to WC workers
VA	Value Added - value of census output less the value of census input
KA	Gross Fixed Capital Formation
SETI	Trade Value of Technology Import
SECTORS	International Standard Industrial Classification Rev. 2 - 28 Man. Sectors
COUNTRIES	23 LMICs - The World Bank Development Indicators - Classification at 1980
YEARS	Annual Observations - Time Period: 1980 - 1991

3.1 Methodological Issues

The absence of exhaustive sources of innovation and employment data in LMICs represents a common problem faced by applied research in this field. Such issue becomes critical in the context of a multi-country study since the lack of comparability between different national data sources restricts the choice of data providers to international agencies only. In particular, the only available dataset which offers data for "operative" and "non-operative" workers at the sector level is the UN-GIS Vol.

1. After 1993, the collection of industrial statistics changed over from UN to UNIDO. However, the new dataset, whose name became UNIDO Industrial Statistics, did not comprise data for "operative" workers by providing, instead, an aggregate variable "employees" only. Such methodological shift has resulted in the disturbing lack of updated cross-country statistics on relative employment and wage by worker categories. Nevertheless, the UN-GIS Vol. 1 represents a unique valuable source of information over the labour market of many LMICs in a very informative decade - the 1980s - which has witnessed the appearance of the globalization process in terms of exponential increase of total real trade between HICs and LMICs (Wood, 1994). Researchers have, therefore, adopted this data source to gain insights over the occurrence of some structural relationships - in the case of this paper, the impact of technology transfer on within-country inequality in LMICs - which, in turn, allow a useful assessment of the working mechanism of the economic system. Indeed, exactly this approach justifies recent use of this dataset among scholars (Berman and Machin, 2000 and 2004; Zhu, 2005).

The lack of primary data does not represent the only problem tackled by empirical research. The merging procedure of different available datasets allows to overcome the absence of a specific data source on innovation and employment in these LMICs (Appendix B). Nevertheless, this methodology requires some analytical assumptions to be taken (Section 3.2) due to another unsolved issue in the empirical international economics literature, namely the absence of a direct one-to-one conversion table between trade and sector classifications. In particular, such tables would result from the identification of some specific weights (conversion factors) which, applied to already available one-to-many conversion tables, would allow to obtain a unique (ISIC) sector value from an original (SITC) trade value[18].

Finally, a last issue worth mentioning in the context of LMICs refers to the different importance manufacturing assumes in each country. This point requires the admission that there will be no claim in this paper over the working mechanism of the full economy, since the data adopted allow only a partial picture of the labour outcome of the formal manufacturing sector, whose size is generally rather small in LMICs. A related necessary assumption is, therefore, the isolation of employment dynamics in the manufacturing sector from those occurring in the service, in the agricultural sector and in the informal economy.

3.2 Skill-Enhancing Technology Import (SETI)

The methodological problems discussed in the previous section have affected economic research in two ways. First, many studies dealing with TC and employment in LMICs have adopted a country-study approach[19]. Second, empirical research adopting a multi-country perspective has been mainly based upon means of indirect tests (Berman and Machin, 2000). In particular, technology transfer has been proxied by the occurrence of pairwise correlations of within-industry skill upgrading in different countries (Berman *et al.,* 1998) and by cross-country correlations between skill upgrading in LMICs and current and lagged technological variables in OECD countries (Berman and Machin, 2000 and 2004). While advocating the occurrence (and pervasiveness) of skill-biased technology transfer through evidence of its effect in the labour market of LMICs, this setting does not allow,

[18] The empirical analysis in this paper requires the conversion of trade values, coded by the Standard International Trade Classification (SITC) Rev. 2, into sector values, whose taxonomy is given by the International Standard Industry Classification (ISIC) Rev. 2.

[19] Some examples are the study of Robbins and Gindling (1999) for Costa Rica; Feliciano (2001) and Lopez-Acevedo (2002) for Mexico; Görg and Strobl (2002) for Ghana; Kang and Hong (2002) for Southern Korea; Mazumdar and Quispe-Agnoli (2002) for Perú; Attanasio *et al.* (2004) for Colombia; Berman *et al.* (2005) for India.

in fact, any empirical verification of a theoretical framework of technology transfer (i.e. Jensen and Thursby, 1987), since it neglects the identification of the actual technologies transferred, the transmission channels adopted and, therefore, the direct employment impact of technology transfer on different skills in LMICs.

In summary, the key issue is that "*... about low-income countries we know very little. Our data are not particularly informative about technology transfer...* " (Berman and Machin, 2004, p. 66). The absence of a direct measure of technology transfer inevitably weakens empirical analysis. Such ideal indicator would make possible a more reliable and straightforward assessment of the casual relationship between technology and employment of different skills in LMICs.

This paper provides an original measure of Skill-Enhancing Technology Import (SETI) which exactly aims at overcoming the use of indirect proxies of technology transfer. This indicator is direct and accountable since it comprises the annual sum of the economic value of trade flows from HICs to each LMIC of those specific goods which reasonably incorporate technological upgrading (Appendix C). Two motivations sustain the strategy adopted in the construction of this variable. First, HICs are also those economies which produce and employ the most advanced technologies[20]. Second, LMICs have a negligible level of R&D and innovative investment and their (almost) unique channel of technological upgrading is given by the import of TC from HICs (Section 2.3). The indicator of SETI allows, furthermore, a detailed analysis of such trade flows since goods are selected at the highest available level of detail, namely four-digit level of SITC Rev. 2 taxonomy.

However, the choice of such measure arises the problem of value conversion between different taxonomies (Section 3.1). This consists in a meaningful distribution of the aggregate SETI value - for instance 445.6 millions of US $ in Peru in 1986 - across recipient manufacturing sectors in this country. The objective of a meaningful conversion of trade values into feasible sector measures has led to the evaluation of three competing strategies. The first one requires the definition of a vector of (theoretical) sector weights for each (SITC) imported good - say Electronic Microcircuits - which would describe its final distribution across ISIC sectors. This hypothesis has been rejected because of the computational effort required in providing/assuming reasonable weights over time, across sectors and countries[21]. A second option suggests the aggregation of the total annual value of SETI for each LMICs and, then, its distribution through annual sector input-output tables. Unfortunately, such tables are not available at the necessary level of detail neither for the LMICs discussed in this paper nor for the years of interest.

The adopted choice consists, therefore, in an original procedure which aims at exploiting the different sources of variability available in the dataset without introducing heroic assumptions and possible distorsions in its empirical verification. This is based upon the following hypothesis:

Hypothesis: *An annual SETI value is distributed across the recipient country' sectors in each year by assuming the following relationship:*

$$(1)\qquad \frac{(SETI)_{cit}}{Tot(SETI)_{ct}} = Sh(SETI)_{cit} \;=\; Sh(KA)_{cit} = \;\frac{(KA)_{cit}}{Tot(KA)_{ct}}$$

[20] The following countries are classified as HICs: USA, UK, Italy, Japan, Israel, Switzerland, Sweden, Norway, Germany, France, Netherlands, Australia, Austria, Belgium, Canada, Denmark, Finland, Iceland, New Zealand.

[21] However, an unweighted single conversion table has been developed by the author and it is available on request. This comprises the following taxonomies: 5-digit SITC, Rev. 2; 4-digit SITC, Rev. 2; 5-digit SITC, Rev. 3; 4-digit ISIC, Rev. 2; 4-digit ISIC, Rev. 3; SITC - modified by Statistics Canada; BEA - Bureau of Economic Analysis of the U.S. Department of Commerce.

where $Sh(SETI)_{cit}$ and $Sh(KA)_{cit}$ represent the annual share (over total manufacturing) of SETI and KA respectively, for each sector i of country c in year t. A sector's distribution of total manufacturing investment is used to distribute the annual value of SETI received by each LMIC across its different manufacturing sectors. The assumption is that cross-sectoral differences in SETI, in each country and each year, may be reasonably proxied by the inter-sectoral shares of total investment. This means that sectors with a relatively high share of total investment are also those sectors with a higher proportion of SETI in each country.

A statistical implication of this assumption is that the variables KA and SETI are correlated in one of the three dimensions of variability, namely in the "within-country/year cross-sector" component. This might arise a problem of collinearity in the following econometric exercise where both variables will be used as regressors. However, two sets of evidence support such allocative procedure among sectors as indicated in the following table:

Table 2. Pairwise Correlations between SETI - KA and KA - Machinery

Source of Variability:	Overall (1)	Country Year (2)	Country Industry (3)	Industry Year (4)	Sectors (5)
SETI - KA	-0.0244	-0.1022	-0.0370	0.1350*	1 (by construction)
Obs.	5015	204	560	336	28
KA - MACH	0.8869**	0.9810**	0.9591**	0.7003**	0.9097**
Obs.	2500	104	299	329	28

Notes:
1) * significant at 5%; ** significant at 1%
2) Each column indicates the source of data variability. For instance column (1) refers to the entire dataset while column (2) means that the dataset does not include observations for different manufacturing sectors within country/years.
3) Column (5) indicates the within-country/year cross-sector variability component only.
4) MACH indicates the investment in machinery and equipment. This variable belongs to the UN-GIS Vol. 1, but the scarce number of observations hampers its direct use in the analysis.

The first group of correlations between SETI and KA indicates that the joint effect of different sources of variability makes these two variables not statistically correlated, except column (4) where the coefficient appears, however, quite small (0.1350). At the same time, the strong significant correlation of KA and MACH (note 4) advocates the assumption described above as a workable solution to the problem of a correct sector distribution of SETI; in fact, investment in machinery can be considered a good proxy of a sector's potential in implementing embodied technological change.

4 Econometric Issues

This section provides a framework for the theoretical specification of an employment equation and highlights the econometric strategy adopted for its empirical analysis. The SETI hypothesis, namely the relationship between the imports of technology from HICs and the increase of relatively skilled employment in LMICs over time, is verified through GMM techniques applied to two distinct employment equations for skilled and unskilled labour.

4.1 Model Specification

The starting framework for the empirical estimation of an employment equation is given by the consideration of a perfectly-competitive industry operating under the following general constant elasticity of substitution (CES) production function:

$$Y = H[(AL)^{\frac{\sigma-1}{\sigma}} + (BK)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \quad (2)$$

where Y is the output, L and K represent conventional inputs such as labour and capital; H, A and B distinguish the three possible effects of technology on production factors, that is a Hicks-neutral, a labour-augmenting and a capital-augmenting technology respectively. The first-order profit-maximization condition for labour allows to express the previous equation in the following format:

$$\ln(L) = \ln(Y) - \sigma \ln(W) + (\sigma - 1)\ln(A) \quad (3)$$

where W indicates real wages (equated with the marginal product of labour) and $\sigma = \frac{1}{(1-\rho)}$ measures the elasticity of substitution between capital and labour (Van Reenen, 1997). This setting may be extended by including some proxies of the unobserved labour-augmenting technology component. Two variables, and their related competing hypotheses, are tested directly in the specification adopted. The first variable, namely capital deepening, verifies the importance of capital-skill complementarities as described by Griliches (1969), Krusell *et al.* (2000) and Tyers and Yongzheng (2000). Similarly to Berman *et al.* (1994) and Zhu (2005), this paper defines capital deepening as KA_{cit}/VA_{cit}[22]. The second measure is represented by the SETI indicator (Section 3.2) which is obtained in a similar way ($SETI_{cit}/VA_{cit}$) for comparative reasons.

The empirical analysis - whose results are presented in Section 6 - focuses, therefore, on the following stochastic specification of the two employment equations:

$$\begin{aligned} BC_{cit} &= \alpha + \beta BC_{cit-1} + \gamma VA_{cit} + \delta WBC_{cit} + KD_{cit} + TID_{cit} + (\varepsilon_i + v_{cit}) \\ WC_{cit} &= \alpha + \beta WC_{cit-1} + \gamma VA_{cit} + \delta WWC_{cit} + KD_{cit} + TID_{cit} + (\varepsilon_i + v_{cit}) \end{aligned} \quad (4)$$

where all variables are expressed in logs. BC_{cit} and WC_{cit} are, respectively, the number of "blue-collar" workers (or operatives) and "white-collars" (or non-operatives) in sector i of country c at time t. VA represents Value Added, WBC and WWC the wage of each skill category. KD indicates capital deepening whereas TID represents the sector share of "technological import deepening" (Table 1 and Appendix A provides a description of the variables adopted in this study). Finally, the error term includes the idiosyncratic individual and time-invariant sector fixed effect ε_i and the usual white-noise error term v_{cit}.

[22] The capital-output ratio represents the correct measure of capital intensity (Pasinetti, 1981, pp. 180-188). Indeed, since the relative price of capital and labour is the real interest rate, the capital-output ratio ensures that more expensive capital raises the prices of more capital-intensive goods with respect to less capital-intensive goods.

4.2 Econometric Analysis

This paper adopts a dynamic specification for studying the relationship between TC and skills. Labour economics literature suggests this choice (Van Reenen, 1997; Rouvinen, 2002) mainly because of the occurrence of significant employment adjustment costs which determine serial correlation in such series (Nickell, 1984).

Both the presence of sector-specific effects and the dynamic specification of the econometric model lead the pooled ordinary least squares (POLS) estimator to provide inconsistent and upward biased estimates (Sevestre and Trognon, 1985; Hsiao, 2003)[23]. While the presence of sector-specific effects does not affect the within-group (WG) estimator, the violation of the assumption of strict exogeneity makes the WG estimator inconsistent and downwards biased (Nickell, 1981; Judson and Owen, 1999)[24]. A more effective solution to obtain consistent estimates in a dynamic panel framework is, therefore, to consider a first-difference transformation (Anderson and Hsiao, 1981; Baltagi, 2001) which wipes out time-invariant sector effects and provides consistent estimators with an instrumental variable (IV) procedure[25]. The availability of additional moment conditions when the time dimension increases can be used to increase the efficiency of the estimator by means of a Generalized Method of Moments (GMM) procedure (Holtz-Eakin *et al.*, 1988; Arellano and Bond, 1991; Ahn and Schmidt, 1995). Based on Arellano (1989), which compares the use of instruments in difference and level, Arellano and Bond (1991) define the first-differenced GMM (GMM-DIF) where standard deviations and t-statistics are based on a heteroscedasticity-robust covariance matrix (White, 1980) and each instrument depends on the specific assumption made about endogeneity, predetermination and exogeneity of the corresponding instrumented variable. However, two conditions weaken the efficiency of the GMM-DIF estimator, namely a short time dimension of the panel and/or a strong persistence in the time series[26]. If one of these circumstances applies, the available instruments are only weakly correlated with the variables in first differences and the GMM-DIF estimate is close to its WG estimate (Bond *et al.*, 2001). In this case, an efficiency improvement may be obtained through the addition of the original equations in level, instrumented by their own first differences, to the equations in first differences which are instrumented as in the GMM-DIF case (Arellano and Bover, 1995)[27]. Indeed, this new estimator, called system GMM (GMM-SYS), exploits all available information through these additional moment conditions and it is based on the assumption that $E(\Delta v_{cit}\varepsilon_i) = 0$ (Blundell and Bond, 1998; Bond, 2002).

Several diagnostic tests may be applied in a dynamic panel data estimation framework (Arellano and Bond, 1991). A Wald test, asymptotically distributed as χ^2 where the degrees of freedom (*dof*) equates the number of restricted coefficients, allows to test the overall significance of the independent

[23] Indeed, the former determines - by construction - the correlation between the lagged dependent variable y_{cit-1} and the individual fixed effect ε_i whereas the latter implies the presence of an endogenous first-order lagged dependent variable and the consequent violation of the assumption of strict exogeneity of the regressors.

[24] Kiviet (1995) provides a correction of the WG estimator bias. However, although the size of such bias declines as the time dimension approaches infinity, the panel structure adopted in this analysis, characterised by a limited time dimension and a large number of cross-section units, does not allow the use of a WG estimator.

[25] IV techniques are necessary since the lagged difference of the dependent variable, Δy_{cit-1} is correlated by construction with the differenced error term Δv_{cit}. Generally, the lagged level (y_{cit-2}) or difference (Δy_{cit-2}) can be used as instruments if there is not serial correlation in the v_{cit} process. Moreover, this means that further lags are valid too as instruments.

[26] This condition represents a common problem in the context of production functions due to persistence of the capital series (Griliches and Mairesse, 1998).

[27] Blundell and Bond (1998 and 1999) and Blundell *et al.* (2000) verify for the AR(1) model the efficiency improvement of GMM-SYS estimator by using Monte Carlo analyses. GMM-DIF and GMM-SYS are connected by the common presence of the equations in differences and by a general rule which applies to the instruments of both estimators: in particular, Δx_{cit-s} represents a good instrument for the equations in levels if it is not correlated with ε_i and $x_{cit-(s+1)}$ is a valid instrument for the first-difference equations.

variables and both time and individual effects. Since the consistency of the GMM estimates requires non serial-correlated errors v_{cit}, Arellano-Bond (1991) provide a Lagrange multiplier (LM)-based test of autocorrelation which is applied to the residuals of the first-difference equation in order to drop the time-invariant fixed effect ε_i[28]. A Sargan test of overidentifying restrictions verifies the overall validity of the GMM instruments where the H_0 suggests that the instruments are uncorrelated to some set of residuals[29]. The improved efficiency of the GMM-SYS versus GMM-DIF estimator may be tested through a Difference-Sargan statistic which tests the validity of additional instruments, namely the instruments used in the equation in levels[30]. The (robust) Hansen J statistic, which is the minimized value of the two-step GMM criterion function, replaces the Sargan statistic in both one-step GMM robust estimation and two-step GMM estimation since the latter is not robust to either heteroskedasticity or autocorrelation. A two-step GMM estimation results in asymptotically more efficient standard errors than a one-step GMM estimation. Although these may be strongly biased downwards in presence of a small sample size and/or heteroschedasticity (Blundell and Bond, 1998), a small-sample variance correction suggested by Windmeijer (2000) eliminates such bias and suggests, therefore, the adoption of this two-step estimator which will be used in the following econometric estimates.

5 Descriptive Analysis

A first assessment of the sources of variability in the dataset comes from the results of Table 3. In particular, an ANOVA analysis indicates that all the three dimensions which characterise the data sample, that is countries, sectors and year, are relevant for explaining the observed variability in the growth rates of the relevant variables.

Table 3. Factorial ANOVA. Annual Growth Rates of Key Variables.

	BC	WC	WBC	WWC	VADDED	KD	TID
Country	16.01**	7.48**	27.89**	8.43**	7.38**	2.20**	2.48**
Industry	6.05**	5.95**	2.94**	2.31**	4.03**	2.20**	1.64*
Year	25.71**	18.07**	25.98**	18.04**	11.55**	3.63**	9.71**

Notes:
1) * significant at 5%; ** significant at 1%
2) Data are weighted by the annual sector number of employees.

[28] This test, which is distributed as $N(0,1)$ under the H_0 of no autocorrelation, generally provides strong evidence of AR(1) in first differences because of the correlation between the first differences of the (uncorrelated) errors Δv_{cit} and Δv_{cit-1} due to the common term v_{cit-1} while the absence of AR(2) supports the consistency of the GMM estimator.

[29] The Sargan statistic is distributed as a χ^2 with $(p-k)$ *dof,* which equate the number of overidentifying restrictions, where p is the number of instruments and k is the number of variables in the regression.

[30] This statistic is the difference between the Sargan tests of the GMM-SYS and GMM-DIF estimates where the H_0 supports the former, namely a model with the total set of instruments, whereas the H_1 supports the latter, that is the use of a restricted set of instruments (Rouvinen, 2002). This is distributed as χ^2 with the *dof* which equates the number of instruments used in the levels equation.

A detailed summary of the main features of the data is provided by Tables 4 and 5 which provide the growth rates of the variables adopted in the econometric analysis at the sector and country level respectively[31].

Table 4. Sector Annual Growth Rates of Key Variables

	ISIC Rev. 2 - Sectors	Tech. Intensity[32]	BC	WC	Rel. Wage	VA	KD	TID
3110	Food Products	Low	-.0069	-.0002	.0055	.0947	.0265	.0895
3130	Beverages	Low	.0084	.0176	.0303	.0823	.0594	.0608
3140	Tobacco	Low	.0167	-.0110	.0709	.0198	.3144	.3132
3210	Textiles	Low	-.0155	-.0050	.0013	.0121	.0519	.1091
3220	Wearing Apparel	Low	.0463	.0783	.0023	.0960	.1360	.1543
3230	Leather and Products	Low	.0320	.0638	-.0001	.0943	.1306	.2315
3240	Footwear	Low	.0068	.0460	.0104	.0311	.2711	.3112
3310	Wood Products	Low	.0084	-.0014	.0223	.0496	.1694	.1695
3320	Furniture, Fixtures	Medium-Low	.0245	.0534	.0239	.0651	.1327	.2008
3410	Paper and Products	Low	.0078	.0149	.0111	.0563	.2125	.2370
3420	Printing, Publishing	Low	.0067	.0332	.0153	.0670	.1810	.2185
3510	Industrial Chemicals	Medium-High	.0165	.0208	.0064	.1171	.0867	.1155
3520	Other Chemical Products	High	.0119	.0230	-.0041	.0651	.1062	.1434
3530	Petroleum Refineries	Medium-Low	.0242	.0729	-.0415	.2425	.3978	.3302
3540	Petroleum, Coal Products	Medium-Low	.0302	.0171	.0281	.2437	.6071	.7625
3550	Rubber Products	Medium-Low	.0434	.0637	-.0174	.1072	.1504	.1608
3560	Plastic Products n.e.c.	Medium-Low	.0513	.0841	-.0044	.1053	.0878	.1524
3610	Pottery, China etc.	Medium-Low	.0259	.0532	.0225	.0806	.2893	.2911
3620	Glass and Products	Medium-Low	.0007	.0231	.0227	.0693	.3864	.4404
3690	Non-metal Products n.e.c.	Medium-Low	.0160	.0331	.0337	.0797	.1826	.1781
3710	Iron and Steel	Medium-Low	.0019	.0031	.0133	.0650	.1665	.1402
3720	Non-ferrous Metals	Medium-Low	.0158	.0476	.0090	.1528	.3035	.3371
3810	Metal Products	Medium-Low	.0097	.0254	.0061	.0705	.0689	.0980
3820	Machinery n.e.c.	Medium-High	.0230	.0430	.0019	.0824	.0605	.0896
3830	Electrical Machinery	Medium-High	.0459	.0519	.0110	.1214	.0804	.0907
3840	Transport Equipment	Medium-High	.0147	.0169	.0062	.0818	.0851	.1357
3850	Professional Goods	High	.0416	.0686	.0042	.1166	.2508	.2230
3900	Other Industries	Low	.0300	.0510	-.0064	.0898	.1852	.2049

[31] Growth rates at the country level are computed for the available period on data for the total Manufacturing sector ("Major Division 3"). Other industrial sectors, such as Mining and Quarrying ("Major Division 2") and Electricity, Gas and Water ("Major Division 4"), do not belong to the dataset. Differently, the unbalanced structure of the panel makes the analysis of annual growth rates more meaningful at the sector level. These growth rates are weighted by the sector' share of total manufacturing employment.

[32] Technological intensity is defined by OECD Science, Technology and Industry Scoreboard which classifies ISIC sectors according to the three-digit Rev. 3 taxonomy (at four-digit for some specific sub-sectors). Sector conversion from ISIC Rev. 3 to ISIC Rev. 2 is provided by the author (see note 21). Another source of equivalent information on technological intensity is provided by Keller (2002) which finds that about 80% of all manufacturing expenditure in R&D is conducted in the following industries: Chemical Products (3510/3520), Electrical and Non-Electrical Machinery (3820/3830) and Transportation Equipment (3840).

Table 5. Growth Rates of Key Variables by Country

	BC	WC	Rel. Wage	VA	KD	TID	Period
Middle-Income Countries							
Chile	.4399	.4530	.0099	.6412	.0256	.1334	1980-1990
Cyprus	.2475	.3128	.0280	.4755	-.2804	.0838	1980-1991
Greece	-.2089	.2698	-.0911	-.0572°	-.3007	.4768	1980-1990
Ireland	-.1971	-.0045	.0601	.7372°	-.4396	-.0396	1980-1989
Malaysia	.7560	.1387	.3295	.9955°	.8149	.0064	1983-1990
Malta	-.0926	.1536	.0080	.2150	.7339	.0888	1980-1988
Mexico	-.1640	.2617	.4151	-.0418	.3319	1.4537	1986-1991
Panama	-.1080	-.0216	-.1908	-.1951	-.7022	-.2147	1981-1989
Portugal	-.0966	-.0164	.1415	.1059	-.2573	.1250	1980-1987
South Korea	.4213	.6420	-.0984	2.1222	.0382	-.0804	1980-1990
Spain	-.2256	-.0861	.1671	-.0308°	.4927	2.0223	1980-1990
Turkey	.1408	.8146	-.1139	1.0770	.7104	.3889	1980-1990
Venezuela	.1223	.4846	-.0161	.2558	.1093	-.3429	1981-1991
TOT - MICs♣	.1118	.3179	.0757	.7953	.2526	.6547	1980-1991
Low-Income Countries							
Bangladesh	.1443	.0226	.0036	.2634	.1095	-.5299	1981-1988
Colombia	-.1168	.1775	-.0189	.2931	.9445	-.2517	1980-1990
Egypt	.1453	.3548	-.0509	.8656	-.5262	-.1951	1980-1988
Ethiopia	.1889	.6340	-.1211	.1646	.1559	.6800	1980-1988
Guatemala	-.3149	.1082	-.1966	-.2287	-.4480	.3916	1980-1988
India	-.0207	.0302	-.0763	.5922°	.1043	.0624	1980-1988
Pakistan	.1347	.1593	.2015	.6704	-.2188	.3641	1981-1988
Peru	.0663	.2056	.1552	.4197	-.4205	-.6732	1980-1988
Philippines	-.2386	1.1727	-.4131	.3189	-.3832	-.5733	1980-1988
Tanzania	-.1123	.0894	.1049	-.2910°	.1432	-.0751	1980-1985
TOT - LICs♣	-.0145	.1850	-.0787	.5452	.0118	-.0586	1980-1990
TOT♣	.0438	.2463	-.0074	.6606	.1229	.2705	

Notes:

1) Chile: 1987-1988 not available. Cyprus: 1987 not available. Malaysia: 1984 not available.
2) Malta. Purchasing Power Parity from The World Bank Development Indicators 2004.
3) Mexico. The econometric analysis refers to the 1980-1991 period (1986 not available). Estimates of the total manufacturing investment for missing years are computed through a three-years backward moving average in order to calculate sector shares. Value Added and Gross Capital Formation from UNIDO Industrial Statistics Database 2002.
4) Pakistan: 1985 not available. Panama: 1986-1987-1988 not available.
5) Perú. Employment from UNIDO Industrial Statistics Database 2002.

° Value added based on factor prices - otherwise measured on producer´s prices.

♣ Weighted by the country' share of the total manufacturing employment averaged over the initial and final period. These values are obtained from data on the aggregate manufacturing sector.

At the sector level, there has been *relative* skill bias in 25 industries out of 28, except for Tobacco (3140), Wood Products (3310) and Petroleum, Coal Products (3540). Such widespread increase in the ratio of skilled to unskilled employment has not been followed by a similar marked trend in the ratio of skilled to unskilled wages which, differently, has appeared quite constant over time (Berman and Machin, 2000). This pattern is consistent also across countries. Indeed, there has been *relative* skill bias in all countries with the exception of Malaysia and Bangladesh where the growth rate of BC has been faster than the growth rate of WC. Eight countries out of 23 (three LICs) have witnessed absolute diverging employment paths between WC and BC whereas four countries - all MICs - have experienced a decrease in both the employment of "operative" and "non operative" workers.

The preliminary evidence presented in this Section has focused on the source of variability which affect the evolution over time of WC and BC employment. Next Section deals directly with the determinants of employment by skills through the theoretical setting and the econometric analysis described in Section 4.

6 Empirical Results

Section 4.2 has already discussed the reasons which suggest the adoption of GMM techniques for the empirical estimation of an employment equation. In particular, the two conditions which recommend the adoption of a GMM-SYS estimator, namely a short time dimension of the panel and a strong persistence in the time series, occur in the context of the empirical analysis of this paper. Indeed, the time span in this analysis covers only a decade whereas Table 6 shows the high persistence of the employment series of both BC and WC.

Table 6. Time Persistence in the Employment Series

	BC	WC
AR(1)	.9851***	.9928***
	(.0011)	(.0014)

Notes:
1) *** significant at 1%
2) Standard errors in brackets.
3) AR(1) computed on OLS in levels.

The adopted econometric strategy consists in the estimation of two similar employment equations for BC and WC workers. While previous research has discussed the relative upskilling of the workforce mainly through shifts of the payroll share of skilled labour in a cost function setting (Bartel and Lichtenberg, 1987; Berman et al, 1994; Haskel and Heden, 1999), the approach developed in this paper allows a greater detail over the *direct* effect of TC on the employment dynamics of BC and WC workers. For instance, while a single-equation setting cannot distinguish between *relative* and *absolute* skill bias, the analysis of two independent employment equations allows a straightforward assessment of these two conditions.

This Section presents the outcome of the two employment equations, together with some sensitivity checks. In particular, each specification is augmented by the inclusion of country and sector dummies (time dummies are always included) to control the robustness of the results obtained. Further tests and results are presented in the Appendices. In particular, Appendix D offers the results obtained by the estimation of a single relative employment equation, where the dependent variable is the number of WC over the total number of employees. Appendix E provides a set of POLS and WG estimators related to the estimations discussed in this paper. Finally, Appendix F supplies a similar set of related GMM-SYS estimates where the hypotheses of "Capital Deepening" and SETI are tested separately.

Table 7. Employment Equation of "Blue Collar" Workers

Dependent Var. Employment "Blue Collar" Workers			
Variable	GMM - SYS		
	(1)	(2)	(3)
Lag_Employment	0.889***	0.859***	0.921***
	(0.038)	(0.050)	(0.024)
BC Wages	-0.112***	-0.219**	-0.073***
	(0.034)	(0.089)	(0.020)
Value Added	0.094**	0.115**	0.066***
	(0.034)	(0.045)	(0.022)
Capital Deepening	0.048***	0.057***	0.039***
	(0.009)	(0.018)	(0.006)
SETI Deepening	-0.014***	-0.031**	-0.006*
	(0.004)	(0.014)	(0.004)
Constant	-0.658**	-0.810**	-0.436**
	(0.270)	(0.344)	(0.177)
Country Dummies		3.06***	
Sector Dummies			1.99***
Time Dummies	7.48***	6.56***	9.17***
Wald Test	7.48***	7.00***	5.18***
Hansen Test	16.93	19.07	17.52
AR(1)	-6.60***	-6.38***	-6.68***
AR(2)	-0.82	-1.24	-0.60
Observations	3468	3468	3468

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

Table 7 provides the GMM-SYS estimator for the BC equation. All the three estimates obtain similar and significant results. There is a confirmation of the high persistence of the employment series and a predictable behaviour of the coefficients of BC wages and value added. In particular, wages depict the usual negative relationship which occurs between a factor price and its quantity adopted. On the contrary, the expansion of a sector's value added generally affects the derived employment of the production factor "labour" in a positive way. An interesting pattern emerges from the comparison between the coefficients of Capital Deepening and SETI Deepening since they provide opposite effect on the employment of BC workers. This result appears at odds with the homogeneous treatment of capital stock and technology commonly adopted in empirical literature. In particular, "generic" capital, rather than weakening employment of BC workers, displays a positive significant coefficient. On the contrary, the coefficient of SETI deepening, namely of capital goods which embody the technological level of most advanced countries, is more consistent with the setting described in Section 2.2 and it indicates a direct negative effect - although small - on the employment of unskilled workers.

All these results appear robust to the introduction of country and sector dummies which, in turn, are jointly significant, as indicated in Table 7.

The Hansen test and the AR tests support the overall validity of the model in all the three specifications. In particular, the former supports the goodness of the GMM instruments, which have been chosen through a comparison of different hypotheses for the relationship between the regressors and the white-noise error term v_{cit}. The outcome obtained by the Differenced Hansen test suggests the assumption of strict exogeneity of wages and SETI deepening, and predetermination of value added and capital deepening. Further support to the overall validity of the chosen GMM-SYS estimator comes from the robustness checks of Appendix E. As it can be seen, the coefficients of the lagged dependent variable in table 7 lie within the lower and upper bounds obtained by the WG and OLS estimates respectively (see Section 4.2). Finally, the different effect of Capital Deepening and SETI Deepening on BC employment is confirmed by Table F1 in Appendix F, which shows the outcome of GMM-SYS estimations similar to those of Table 7, except that the two regressors are included separately. Again, the coefficient of Capital Deepening appears positive and significant while SETI Deepening turns out not statistically significant.

Table 8. Employment Equation of "White Collar" Workers

Dependent Var. Employment "White Collar" Workers			
Variable	GMM - SYS		
	(1)	(2)	(3)
Lag_Employment	0.807***	0.743***	0.799***
	(0.039)	(0.051)	(0.039)
WC Wages	-0.120***	-0.222***	-0.113***
	(0.032)	(0.064)	(0.030)
Value Added	0.154***	0.222***	0.156***
	(0.034)	(0.049)	(0.033)
Capital Deepening	0.105***	0.076**	0.114***
	(0.023)	(0.037)	(0.025)
SETI Deepening	0.029**	0.062**	0.035**
	(0.015)	(0.029)	(0.015)
Constant	-1.104***	-1.643***	-1.058***
	(0.281)	(0.412)	(0.268)
Country Dummies		2.19***	
Sector Dummies			1.47*
Time Dummies	3.94***	2.77***	3.04***
Wald Test	3.94***	3.05***	2.58***
Hansen Test	70.82	80.75	71.57
AR(1)	-7.57***	-8.99***	-8.70***
AR(2)	-0.12	-0.38	-0.22
Observations	3468	3468	3468

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

Table 8 provides the GMM-SYS estimator for the WC equation. Also in this case, the three estimates obtain similar and significant results. The coefficient of the lagged dependent variable indicates a high persistence of the employment series of WC. The coefficients of WC wages and value added are similar to the ones of the BC equation by showing a negative and positive sign respectively. Nevertheless, the growth of value added seems more friendly to these workers. The coefficient of capital deepening is positive and higher than the one in the BC equation. Capital deepening affects, therefore, the *relative* skill bias of the employment series since it increases the labour requirement of both BC and WC. In turn, this result is consistent with another stream of literature which has related the employment of skills in LMICs to the capital-skill complementarity hypothesis (Griliches, 1969; Barba Navaretti *et al.,* 1998; Goldin and Katz, 1998; Flug and Hercowitz, 2000)[33]. On the

[33] For instance, Berman and Machin (2000 and 2004) verify the occurrence of SBTC in LMICs through changes in capital-labour ratios (based on the capital-skills complementarity hypothesis) whereas Wood (1994, p. 224) controls

contrary, SETI deepening determines *absolute* skill bias since it affects positively the employment of skilled labour while, at the same time, its coefficient in the BC equation is negative. As can be seen from the comparison of Tables 7 and 8, this outcome is robust to the inclusion of both country and sector dummies.

The Hansen test, the AR tests and the robustness checks of Appendix E validate the model of Table 8. However, the procedure driven by the Differenced Hansen test suggests a different choice of the instruments for the WC wage, which appears predetermined rather than exogenous (as in the BC equation).

Finally, the importance of SETI deepening is reinforced by the findings presented in Tables D2 and in Appendix F. This variable turns out to be the relevant factor affecting the relative upskilling of the labour force in the relative employment equation of Appendix D. On the contrary, the coefficient of capital deepening does not appear statistically significant, even after the inclusion of both country and sector dummies. A similar result is described by Table F2 and F3. The former shows a positive effect of SETI deepening on WC employment while it was not significant in the BC equation. The latter indicates that technology, rather than generic capital investment, affects the witnessed upskilling trend of the employment series.

To sum up, the amount of evidence described in this paper suggests the occurrence of different factors which explain the widening differentials between skilled and unskilled workers. However, econometric results highlight that technology transfer from HICs, rather than homogeneous measures of capital deepening, seems to lead the tendency towards a larger employment divide in LMICs.

7 Concluding Remarks

This paper has discussed the occurrence of Skill-Enhancing Technology Import (SETI) in a sample of LMICs.

By providing an original measure of technology transfer, this study has offered a unified multi-country analysis for the empirical verification of the hypothesis of capital-skill complementarity and SETI through an econometric analysis on an (unbalanced) panel of 4934 observations for 28 manufacturing sectors of 23 LMICs in the period 1980-1991.

GMM techniques have been applied to the estimation of two similar employment equation for both BC and WC. In turn, this setting has allowed to distinguish the determinants of *relative* and *absolute* skill bias of employment over time. In particular, capital deepening seems responsible for relative shifts toward skilled labour which, however, do not reduce the absolute employment of unskilled labour. Differently, SETI is responsible for an *absolute* diverging path between skilled and unskilled employment.

for the average ratio of investment to GDP (capital skill complementarity).

Appendix A: Variables Definition and Data Source

Number of Operatives / Blue Collars (BC): All employees engaged in production or the related activities of the establishment, including any clerical or working supervisory personnel whose function is to record or expedite any step in the production process. **Source: United Nations General Industrial Statistics, Vol. 1 (GIS)[34].**

Number of Non Operatives / White Collars (WC): All persons engaged other than working proprietors, active business partners, unpaid family workers and operatives. **Source: GIS.**

Wage: All payments in cash or in kind made to "*operatives*" or "*non operatives*" during the reference year. The payments include: (a) direct wages and salaries; (b) remuneration for time not worked; (c) bonuses and gratuities; (d) housing allowances and family allowances paid directly by the employer; and (e) payments in kind. Excluded are the employers' contributions in respect of their employees paid to social security, pension and insurance schemes, as well as the benefits received by employees under these schemes and severance and termination pay. **Source: GIS.**

Value Added: The value of census output less the value of census input, which covers: (a) value of materials and supplies for production (including cost of all fuel and purchased electricity); and (b) cost of industrial services received (mainly payments for contract and commission work and repair and maintenance work). The valuation may be in factor values or in producers' prices, depending on the treatment of indirect taxes and subsidies. **Source: GIS.**

Gross fixed capital formation: The value of purchases and own-account construction of fixed assets during the reference year less the value of corresponding sales. The fixed assets covered are those, whether new or used, with a productive life of one year or more which are intended for the use of the establishment, including fixed assets made by the establishment's own labour force for its own use. Major additions, alterations and improvements to existing assets which extend with normal economic life or raise their productivity are also included. **Source: GIS.**

Skill-Enhancing Technology Import (SETI): The annual value of the import from high income countries (HICs) of a detailed list of capital goods which embody a technological component (Appendix C). **Source: World Trade Analyzer (WTA).**

Purchasing Power Parity: The number of currency units required to buy goods equivalent to what can be bought with one unit of the base country (US). **Source: Penn World Tables 6.1.**

US GDP Deflator: Rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Base year = 1986. **Source: World Bank Development Indicators 2004.**

[34] Economic literature adopts two competing definitions of skills based on either the wage level of the workers or the amounts of education, training and experience they possess. The two indicators are often correlated, but they can also diverge (Wood, 1994, p. 47). The concept of skills throughout this paper refers to the latter concept - namely human capital accumulated through education which is assumed to be reflected by the dycothomic distinction between occupational categories in this empirical analysis. A craftsman with low education is therefore classified among blue collars and he will be loosely considered as an "unskilled" worker.

Appendix B: Dataset Creation Procedure

The dataset adopted for the empirical analysis in this paper results from the merging of different data sources. This Appendix provides an overview of the issues which have emerged during the procedure of data codification, selection and analysis.

First, the original UN General Industrial Statistics Database, Vol. 1 (GIS) has required the development of an algorithm aimed at making its data compatible with new available statistical softwares such as STATA v. 9. In particular, the original UN file displays the data in "long format" where each observation is described as follows:

702 21 3830 88 61+009424

where the first four codes refer, respectively, to the country (e.g., 702 =Singapore), to the variable of interest (21 = Gross Fixed Capital Formation), to the Industry Code (3830 = Electrical Machinery), and, finally, to the year (1988). The compatibility problem arises in the conversion of the last value, since the first two digits in the fifth code refer, respectively, to its power (6 = 10^6 = 1000000) and to the number of decimals (1 = 0.1). Therefore, the value has to be correctly interpreted as +942400000 and the algorithm has provided such conversion.

Then, countries with consistent data on the variables of interest have been selected. Moreover, the need of comparability across countries and over time has required a double data correction, since values in the GIS dataset are expressed in local currency at the current monetary level. In particular, local currency values have been converted in US dollars by using Purchasing Power Parity data obtained from Penn World Tables v. 6.1 which allow to both express all values in a unique monetary scale and to smooth some cross-country differentials which official exchange rates are not able to catch. The resulting data have been merged with the Skill-Enhancing Technology Import (SETI) variable - computed through data obtained by World Trade Analyzer (WTA) - provided by Statistics Canada which supplies bilateral trade flows for all countries over 1980-1997, classified according to the Standard International Trade Classification (SITC), Rev. 2. Then, all monetary variables - at this point all expressed in current US $ - have been converted by using the US GDP deflator - obtained by The World Bank Development Indicators 2004 - where 1986 has been chosen as the base year.

Finally, an outlier analysis has cleaned the dataset from several data inconsistencies and computational mistakes. The analysis has been conducted through two tests available on STATA environment under the commands "*hadimvo*" and "*iqr*". The former identifies outliers in multivariate data by using the iterative procedure described by Hadi (1992 and 1994). The second computes interquantile ranges which, in turn, allow outlier identification. These two tests have been applied to both the ditribution in levels and in differences. No outlier has been removed automatically; in fact, a visual inspection has anticipated data elimination.

Appendix C: Skill-Enhancing Technology Import (SETI)

SETI is created through the sum of the following SITC Revision 2 codes[35]:

SITC	DESCRIPTION
7111	Steam & Other Vapour Generating Boilers
7112	Auxiliary Plant For Use With Boilers, Condensors
7119	Parts Of Boilers & Aux. Plant Of 711.1- / 711.2-
711A	Steam & Other Vapour Generating Boilers & Parts
7126	Steam & Other Vapour Power Units, Steam Engines
7129	Parts Of The Power Units Of 712.6-
712A	Steam & Other Vapour Power Units, Steam Engines
7131	Internal Combustion Piston Engines For Aircraft
7132	Int. Combustion Piston Engines For Propelling Veh.
7133	Int. Combustion Piston Engines For Marine Propuls.
7138	Int. Comb.Piston Engines, N.E.S.
7139	Parts Of Int. Comb. Piston Engines Of 713.2- / 713.8-
713A	Internal Combustion Piston Engines & Parts
7144	Reaction Engines
7148	Gas Turbines, N.E.S.
7149	Parts Of The Engines & Motors Of 714- And 718.8-
714A	Engines & Motors, Non-Electric
7161	Motors & Generators, Direct Current
7162	Elect.Motors & Generators, Generating Sets
7163	Rotary Converters
7169	Parts Of Rotating Electric Plant
716A	Rotating Electric Plant And Parts
7187	Nuclear Reactors And Parts
7188	Engines & Motors, N.E.S. Such As Water Turbines Etc.
718A	Other Power Generating Machinery And Parts
71AA	POWER GENERATING MACHINERY AND EQUIPMENT

[35] Letter A indicates the sum of the related sub-SITC codes. SETI represents the total annual economic value of the following goods classified at the four-digit level of SITC Rev. 2.

7243	Sewing Machines, Furniture For Sewing Mach.& Parts
7244	Mach. For Extruding Man-Made Textiles And Parts
7245	Weaving, Knitting Mach. For Preparing Yarns, Parts
7246	Auxil. Machinery For Headings 724.51 / 52 / 53
7247	Mach. For Washing, Cleaning, Drying, Bleaching Text.
7248	Mach. For Preparing, Tanning Or Working Hides
724A	Textile & Leather Machinery And Parts
7251	Mach. For Mak. / Finis. Cellul. Pulp, Paper, Paperbo.
7252	Paper & Paperboard Cutting Mach. Of All Kinds
7259	Parts Of The Mach. Of 725–
725A	Paper & Pulp Mill Mach., Mach For Manuf. Of Paper
7263	Mach., Appar., Access. For Type Founding Or Setting
7264	Printing Presses
7267	Other Printing Mach. For Uses Ancillary To Printing
7268	Bookbinding Machinery And Parts
7269	Parts Of The Machines Of 726.31, 726.4-, 726.7-
726A	Printing & Bookbinding Mach. And Parts
7271	Mach. For Working Of Cereals Or Dried Vegetables
7272	Other Food Processing Machinery And Parts
727A	Food Processing Machines And Parts
7281	Mach. Tools For Specialized Particular Industries
7283	Mach. For Sorting, Screening, Separating, Washing Ore
7284	Mach. & Appliances For Spezialized Particular Ind.
728A	Mach. & Equipment Specialized For Particular Ind.
72AA	MACHINERY SPECIALIZED FOR PARTICULAR INDUSTRIES
7361	Metal Cutting Machine-Tools
7362	Metal Forming Machine Tools
7367	Other Mach. - Tools For Working Metal Or Met. Carbide
7368	Work Holders, Self-Opening Dieheads & Tool Holders
7369	Parts Of The Machine-Tools Of 736-
736A	Mach. Tools For Working Metal Or Met. Carb., Parts
7371	Converters, Ladles, Ingot Moulds And Casting Mach.
7372	Rolling Mills, Rolls Therefor And Parts
7373	Welding, Brazing, Cutting, Soldering Machines & Parts
737A	Metal Working Machinery And Parts
73AA	METALWORKING MACHINERY

7411	Producer Gas And Water Gas Generators And Parts
7412	Furnace Burners For Liquid Fuel And Parts
7413	Ind. & Lab. Furnaces And Ovens And Parts
7414	Refrigerators & Refr. Equipment, Ex. Household, Parts
7415	Air Conditioning Mach. Self-Contained And Parts
7416	Mach. Plant & Sim. Lab. Equip. Involv. A Temp. Change
741A	Heating & Cooling Equipment And Parts
7421	Reciprocating Pumps, Other Than 742.81
7422	Centrifugal Pumps, Other Than 742.81
7423	Rotary Pumps, Other Than 742.81
7428	Other Pumps For Liquids & Liquid Elevators
7429	Parts Of The Pumps & Liq. Elevators Of 742-
742A	Pumps For Liquids, Liq.Elevators And Parts
7431	Air Pumps, Vacuum Pumps & Compressors
7432	Parts Of The Pumps & Compressors Of 743.1-
7433	Free-Piston Generators For Gas Turbines, Parts
7434	Fans, Blowers And The Like, And Parts
7435	Centrifuges
7436	Filtering & Purifying Mach. For Liquids & Gases
7439	Parts Of The Machines Of 743.5-, 743.6-
743A	Pumps & Compressors, Fans & Blowers, Centrifuges
7441	Work Trucks, Mechanically Propelled, For Short Dist.
7442	Lifting, Handling, Loading Mach.Conveyors
7449	Parts Of The Machinery Of 744.2-
744A	Mechanical Handling Equip. And Parts
7451	Tools For Working In The Hand, Pneumatic, Parts
7452	Other Non-Electrical Mach. And Parts
745A	Other Non-Electrical Mach.Tools, Apparatus & Parts
7491	Ball, Roller Or Needle Roller Bearings
7492	Taps, Cocks, Valves Etc. For Pipes, Tanks, Vats Etc
7493	Transmission Shafts, Cranks, Bearing Housings Etc.
7499	Other Non-Electric Parts & Accessories Of Mach
749A	Non-Electric Parts And Accessories Of Machines
74AA	GENERAL INDUSTRIAL MACHINERY & EQUIPMENT, AND PARTS
7511	Typewritters; Cheque-Writting Machines
7512	Calculating Machines, Cash Registers. Ticket & Sim.
7518	Office Machines, N.E.S.
751A	Office Machines

7521	Analogue & Hybrid Data Processing Machines
7522	Complete Digital Data Processing Machines
7523	Complete Digital Central Processing Units
7524	Digital Central Storage Units, Separately Consigned
7525	Peripheral Units, Incl.Control & Adapting Units
7528	Off-Line Data Processing Equipment. N.E.S.
752A	Automatic Data Processing Machines & Units Thereof
7591	Parts Of And Accessories Suitable For 751.1-, 751.8
7599	Parts Of And Accessories Suitable For 751.2-, 752-
759A	Parts Of And Accessories Suitable For 751- Or 752-
75AA	OFFICE MACHINES & AUTOMATIC DATA PROCESSING EQUIP.
7641	Elect. Line Telephonic & Telegraphic Apparatus
7642	Microphones, Loudspeakers, Amplifiers
7643	Radiotelegraphic & Radiotelephonic Transmitters
7648	Telecommunications Equipment
7649	Parts Of Apparatus Of Division 76-
764A	Telecommunications Equipment And Parts
76AA	TELECOMMUNICATIONS & SOUND RECORDING APPARATUS
7711	Transformers, Electrical
7712	Other Electric Power Machinery, Parts Of 771-
771A	Electric Power Machinery And Parts Thereof
7721	Elect. App.Such As Switches, Relays, Fuses, Pwgs Etc.
7722	Printed Circuits And Parts Thereof
7723	Resistors, Fixed Or Variable And Parts
772A	Elect. App. Such As Switches, Relays, Fuses, Plugs Etc.
7731	Insulated, Elect. Wire, Cable, Bars, Strip And The Like
7732	Electric Insulating Equipment
773A	Equipment For Distributing Electricity
7764	Electronic Microcircuits
7781	Batteries And Accumulators And Parts
7782	Elect. Filament Lamps And Discharge Lamps
7783	Electr. Equip. For Internal Combustion Engines, Parts
7784	Tools For Working In The Hand With Elect. Motor
7788	Other Elect. Machinery And Equipment
778A	Electrical Machinery And Apparatus, N.E.S.
77AA	ELECTRICAL MACHINERY, APPARATUS & APPLIANCES N.E.S.

Appendix D: Relative Employment Equation

Table D1. Time Persistence in the Relative Employment Series

	Relative Employment
AR(1)	.9759***
	(.0011)

Notes:
1) *** significant at 1%
2) Standard errors in brackets.
3) AR(1) computed on OLS in levels.

Table D2. Relative Employment Equation

Dependent Var. Relative Employment			
Variable	GMM - SYS		
	(1)	(2)	(3)
Lag_Rel. Employment	0.697***	0.392***	0.716***
	(0.063)	(0.072)	(0.060)
Relative Wages	-0.109***	-0.404***	-0.099***
	(0.020)	(0.039)	(0.017)
Value Added	0.086***	0.068	0.084***
	(0.027)	(0.059)	(0.025)
Capital Deepening	-0.007	-0.036	-0.020
	(0.047)	(0.030)	(0.047)
SETI Deepening	0.067**	0.044*	0.068***
	(0.027)	(0.026)	(0.025)
Constant	-1.311***	-1.291**	-1.411***
	(0.312)	(0.647)	(0.340)
Country Dummies		6.26***	
Sector Dummies			1.15
Time Dummies	2.58***	4.08***	2.92***
Wald Test	2.58***	5.77***	1.85***
Hansen Test	19.94	17.31	20.51
AR(1)	-9.06***	-7.27***	-9.33***
AR(2)	-0.09	-0.90	-0.08
Observations	4177	4177	4177

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

Appendix E: Robustness Checks - OLS and WG Estimates of the Employment Equations

Variable	BC		WC	
	OLS	WG	OLS	WG
Lag_Employment	0.964***	0.582***	0.918***	0.453***
	(0.003)	(0.011)	(0.005)	(0.012)
Wages	-0.044***	-0.195***	-0.077***	-0.349***
	(0.003)	(0.013)	(0.005)	(0.013)
Value Added	0.032***	0.225***	0.074***	0.233***
	(0.003)	(0.008)	(0.005)	(0.010)
Capital Deepening	0.029***	0.027***	0.035***	0.019**
	(0.003)	(0.006)	(0.004)	(0.008)
SETI Deepening	-0.009***	0.008	-0.005*	0.022***
	(0.002)	(0.006)	(0.003)	(0.008)
Constant	-0.183***	-1.567***	-0.566***	-1.341***
	(0.031)	(0.098)	(0.047)	(0.122)
Observations	4177	4177	4177	4177

Variable	Relative Employment	
	OLS	WG
Lag_Employment	0.962***	0.342***
	(0.005)	(0.013)
Wages	-0.042***	-0.347***
	(0.005)	(0.010)
Value Added	0.000	-0.038***
	(0.001)	(0.007)
Capital Deepening	0.000	-0.009
	(0.003)	(0.006)
SETI Deepening	-0.002	0.008
	(0.001)	(0.006)
Constant	-0.029	-0.190**
	(0.026)	(0.091)
Observations	4177	4177

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) Standard errors in brackets.
3) OLS and Within-Group estimates are in levels.
4) Time Dummies included in the regressions

Appendix F: Robustness Checks - Employment Equations with either Capital Deepening or SETI Deepening

Table F1. Employment Equation of "Blue Collar" Workers[36]

Dependent Variable: Employment "Blue Collar" Workers						
Variable	GMM - SYS			GMM - SYS		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag_Employment	0.889***	0.896***	0.922***	0.869***	0.875***	0.875***
	(0.037)	(0.059)	(0.024)	(0.069)	(0.061)	(0.044)
BC Wages	-0.103***	-0.212**	-0.074***	-0.123**	-0.250**	-0.109***
	(0.035)	(0.083)	(0.022)	(0.058)	(0.108)	(0.033)
Value Added	0.097***	0.086*	0.071***	0.121*	0.105**	0.120***
	(0.033)	(0.051)	(0.021)	(0.065)	(0.054)	(0.043)
Capital Deepening	0.037***	0.022**	0.032***	———	———	———
	(0.009)	(0.010)	(0.007)			
SETI Deepening	———	———	———	0.006	0.032	0.018
				(0.012)	(0.024)	(0.013)
Constant	-0.689***	-0.508	-0.487***	-0.963*	-0.612	-0.985***
	(0.262)	(0.400)	(0.166)	(0.551)	(0.375)	(0.369)
Country Dummies		5.89***			4.39***	
Sector Dummies			2.52***			1.15
Time Dummies	7.37***	6.11***	9.23***	4.88***	3.65***	4.98***
Wald Test	7.37***	8.33***	5.35***	4.88***	8.06***	4.49***
Hansen Test	18.05	19.65	17.28	18.99	19.28	17.50
AR(1)	-6.60***	-6.08***	-6.67***	-6.02***	-6.02***	-6.32***
AR(2)	-0.71	-0.83	-0.57	-0.65	-0.74	-0.60
Observations	3468	3468	3468	3487	3487	3487

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

[36] The number of observations varies among different estimates because of the chosen instrument matrices, whose final structure has been obtained by the Difference Hansen test and implemented by the command *xtabond2* in STATA v. 9.2. More specifically, the introduction of two-period (or longer) lags in the instrument matrix as an IV-style standard instrument reduces the number of observations in the sample (Baum *et al.*, 2003). The instrument matrices of the estimates in Appendix F maintain the same assumptions about the relationship between the regressors and the white-noise error term v_{cit} already discussed in Section 6.

Table F2. Employment Equation of "White Collar" Workers

Dependent Variable: Employment "White Collar" Workers						
Variable	GMM - SYS			GMM - SYS		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag_Employment	0.797***	0.756***	0.793***	0.764***	0.746***	0.742***
	(0.042)	(0.050)	(0.043)	(0.057)	(0.054)	(0.054)
BC Wages	-0.137***	-0.181***	-0.125***	-0.129**	-0.245***	-0.137***
	(0.032)	(0.056)	(0.031)	(0.053)	(0.076)	(0.049)
Value Added	0.146***	0.208***	0.137***	0.207***	0.223***	0.223***
	(0.032)	(0.048)	(0.031)	(0.057)	(0.052)	(0.053)
Capital Deepening	0.141***	0.124***	0.156***	———	———	———
	(0.034)	(0.029)	(0.037)			
SETI Deepening	———	———	———	0.076***	0.098***	0.081***
				(0.015)	(0.020)	(0.015)
Constant	-0.935***	-1.650***	-0.733***	-1.784***	-1.660***	-1.890***
	(0.257)	(0.424)	(0.264)	(0.497)	(0.455)	(0.469)
Country Dummies		2.61***			2.89***	
Sector Dummies			1.32			1.30
Time Dummies	4.41***	2.96***	3.83***	3.04***	3.06***	2.95***
Wald Test	4.41***	3.26***	2.25***	3.04***	2.94***	1.98***
Hansen Test	69.79	80.23	72.51	45.02	46.65	43.36
AR(1)	-6.41***	-8.92***	-7.42***	-7.60***	-9.03***	-8.37***
AR(2)	-0.11	-0.61	-0.17	1.00	1.03	0.88
Observations	3481	3481	3481	4154	4154	4154

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

Table F3. Relative Employment Equation

Dependent Variable: Relative Employment (WC/TOT)						
Variable	GMM - SYS			GMM - SYS		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag_Employment	0.691***	0.404***	0.716***	0.695***	0.399***	0.718***
	(0.057)	(0.068)	(0.050)	(0.063)	(0.069)	(0.061)
BC Wages	-0.136***	-0.395***	-0.132***	-0.110***	-0.399***	-0.098***
	(0.021)	(0.037)	(0.022)	(0.020)	(0.037)	(0.017)
Value Added	0.069***	0.069	0.081***	0.083***	0.069	0.083***
	(0.021)	(0.056)	(0.022)	(0.025)	(0.056)	(0.027)
Capital Deepening	-0.014	0.004	-0.029	———	———	———
	(0.043)	(0.044)	(0.049)			
SETI Deepening	———	———	———	0.064***	0.014**	0.065***
				(0.023)	(0.007)	(0.025)
Constant	-1.319***	-1.334**	-1.589***	-1.276***	-1.301**	-1.358***
	(0.315)	(0.617)	(0.375)	(0.261)	(0.608)	(0.321)
Country Dummies		6.30***			6.43***	
Sector Dummies			0.95			1.14
Time Dummies	2.57***	3.58***	2.62***	2.88***	4.27***	3.23***
Wald Test	2.57***	5.62***	1.65**	2.88***	5.79***	1.75***
Hansen Test	13.80	20.47	13.02	19.25	18.78	19.77
AR(1)	-9.54***	-7.48***	-9.73***	-9.25***	-7.43***	-9.37***
AR(2)	0.06	-0.58	0.01	-0.08	-0.67	-0.07
Observations	4177	4177	4177	4177	4177	4177

Notes:
1) * significant at 10%; ** significant at 5%; *** significant at 1%
2) White-robust standard errors in brackets.
3) Wald Test applied to the joint significance of the dummies.

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