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Structural change and wage inequality in the manufacturing sector: long run evidence from East Asia

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Abstract

This paper analyses the long run determinants of wage inequality in the manufacturing sector for a group of East Asian countries that have experienced rapid structural transformations over the last decades. In line with the Skill Biased Technological Change hypothesis, our results show that within manufacturing structural change –fostering the participation of higher skilled workers – is a strong determinant of the wage premium. However, the paper highlights also the peculiarity of the East Asian model, which shows how well-designed education policies, a prudent macroeconomic management and selective policies towards foreign capital can contribute to buffer the pressure of structural change on wage inequality, even in an open economy context.

Keywords: Structural change; Wage Inequality; East Asia

JEL Code: L16; E24

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1. INTRODUCTION

Though at different stages and with different speeds, over the last decades East Asian countries undertook deep structural changes, shifting resources from low-tech and labour intensive products to more sophisticated ones. In their process of industrialization, most East Asian countries showed a distinctive characteristic, following what has been defined as the "flying geese" pattern (Akamatsu, 1962). Also China - being anyway a specific case in its own - is following up this trend, as recent literature is increasingly pointing out (Li et al., 2012).

This process allowed some of these countries to rapidly catch-up with richer economies (Stiglitz, 1996), with growth being initially accompanied by equity (World Bank, 1993). Despite most of the economic success of East Asia was attributed to the market-friendly behaviour of governments (World Bank, 1993), some scholars highlight the crucial role played by Asian policy makers in "governing the market limitations" (Wade, 1990) and thus in reducing the possible negative consequences in terms of inequalities (Boltho and Weber, 2009).

What has been lately referred to as the "Asian Miracle" started to show signs of weakness in the mid-1980s and lost relevance during the 1997-8 crisis (Jomo, 2006). It is indeed during this phase that income inequality grew up - as represented by a sharp rise of the Gini coefficient (Cornia and Martorano, 2012) - together with an increase of the wage inequality in the manufacturing sector (see Figure A1 in the Appendix). In spite of these trends, wage inequality developed unevenly among countries, rising in most of them, but keeping stable in others, such as Korea (Kwack, 2010), Indonesia (Amiti and Cameron, 2012) and Thailand (di Gropiello and Sakellariou, 2010). Such variety of outcomes was due to the fact that, following the crisis and a further process of structural transformation, East Asian countries revised their development strategies, keeping some common traits with the past, but also implementing a range of different approaches.

In this paper, we look at one specific dimension of a country's inequality, represented by the average difference in earnings between manufacturing industries at different intensity of technology. Being theoretically grounded on the Skill Biased Technological Change (SBTC) hypothesis and its related literature (Card and di Nardo, 2002), our aim is to study which are the factors that have contributed to the widening in the wage gap between higher- and lower- technology sectors as the structural change in the manufacturing proceeded, explaining why some countries performed better than others. The emphasis of the paper is to understand which moderating factors are under the control of the policy makers, and what lessons can be extracted from the East Asian case in order to implement the right mix of policies. Our results show that, while the process of structural change – pushing the adoption of more advanced technologies – inevitably leads to greater demand for higher skilled workers, well-designed policies related to education and pragmatic macroeconomic policies – allowing greater participation of low-skilled workers – may contribute to compensate negative pressure on wage distribution.

The relevance of our contribution to the existing literature is twofold. On the one side, our results provide empirical support to the SBTC hypothesis and its related arguments, providing an empirical validation also in the context of rapidly growing emerging economies from East Asia. In doing this, however, we introduce some idiosyncratic features related to the East Asian model. For instance, we show that managing external flows through the exchange rate and the capital account has allowed to keep wage inequality under control. This sets contrary to the case of other emerging countries, such as Latin American ones (Cornia, 2014) – or the same East Asian countries before the crisis (Wood, 1997). Still, we show that the rising role of long-term capital inflows in the form of FDI has not contributed to a rise in wage inequality, contrary to the evidence for a large recipient of FDI such as Mexico (Feenstra and Hanson, 1997).

On the other side, we push our results further by isolating the contribution of individual policies, and are therefore able to define what – based on the experience of East Asian countries – can be viewed as an optimal policy

mix to counterbalancing the inequality enhancing effect of technological change on wage distribution. Our policy exercise shows that investments to expand a country's levels of education are a clear priority to take advantage of technological changes preventing negative pressures on wage distribution. Moreover, the right combination of labour and macroeconomic policies becomes crucial in order to get advantages from international integration in the form of both trade and capital openness.

The rest of the paper is organized as follows. Section 2 presents the theoretical background and the main research hypotheses. Section 3 presents the model, describes the data and the methodology, while Section 4 discusses the results of the empirical analysis. Section 5 concludes.

2. THE DETERMINANTS OF WAGE INEQUALITY – THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

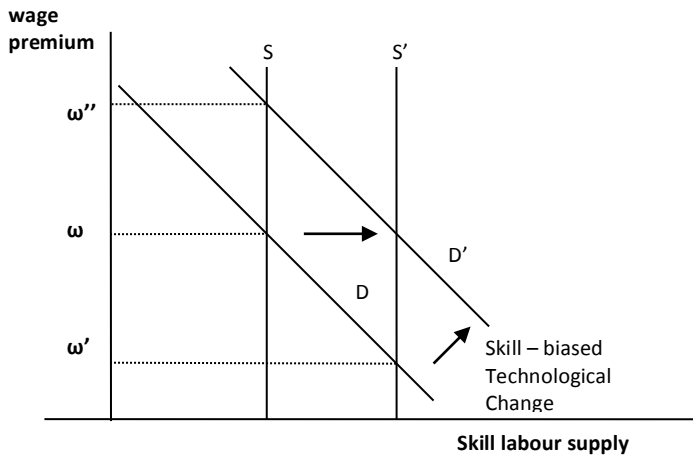
2.1 Structural change, technology upgrading and wage inequality

According to the Skill Biased Technological Change (SBTC) hypothesis, the adoption of new technologies causes an increase in the demand for highly skilled workers, which in turn lead to a rise in earnings inequality (Card and di Nardo, 2002). The theoretical assumption is that higher technology intensive sectors are those employing relatively more skilled workers compared to the others. Consequently – as illustrated by Figure 1 - the process of structural transformation implies a shift in the relative demand curve (from D to D$^{'}$) of skilled workforce contributing to a rise in the wage differential between sectors at different intensity of technology (from w to w^{ii}) (Acemoglu, 2002; Zhu and Trefler, 2005). The shift towards higher technology industries can also affect the distribution between capital and labour, reducing the relative share of the latter. According to the SBTC hypothesis, this change increases the demand of skilled workers and their wages (*price effect*) due the high complementarity between capital and skills (Welch, 1970).

A large amount of evidence has been produced in support of this hypothesis, showing that wage inequality between the skilled and the unskilled workers has been rising over time, both in developed (Acemoglu, 2002; Card and di Nardo, 2002) and in developing countries (Zhu and Trefler, 2005; Attanasio et al., 2004; Caselli, 2014). Similar results can be expected also in the East Asian case[1]. In the region, especially after the 1997/8 financial crisis, specialization moved away from the production of labour-intensive goods to more capital-intensive ones, with some countries able to set up a domestic productive system (e.g. Korea) while others more involved in global production networks (Malaysia, Thailand or China)[2]. The shift to the production of skill intensive goods increased the demand of skilled workers pushing up the return to higher education (ADB, 2012).

So far, we have looked at the demand side, ignoring the supply side. However, a central argument of the SBTC hypothesis is that there is an inverse relation between the wage gap and the relative supply of skilled labour (*quantity effect*). In absence of technological change, the increase of the number of skilled workers (from S to S') implies a reduction of the wage premium (Figure 1)

Figure 1. The Supply and Demand of Skilled Workers



Source: Acemoglu (2002)

[1] Using firm level data, Almeida (2010) shows that technological upgrading was one of the major determinants of wage inequality among East Asian economies.
[2] See Haraguchi and Rezonja (2009).

Also in this case, there is a large empirical literature confirming this relation. In a paper closely related to our study, Avalos and Savvides (2006) show that countries (both from East Asia and Latin America) with a higher relative supply of skilled workers experience lower levels of wage inequality. Along these lines, a more recent work on a larger group of developing countries shows that the higher the initial endowment of human capital, the lower the impact of external liberalization on wage inequality (Mamoon and Mushed, 2012). On this latter point, it is interesting to observe that the increase in wage inequality experienced by some Latin American countries during the '90s was attributed to a lack of adequate supply of well-educated workers to compensate the increase in demand due also to the trade-induced SBTC (Gasparini and Cruces, 2011).

Existing evidence from East Asia convincingly shows that countries were able to keep wage inequality under control thanks to the high supply of human capital. Indeed, the combination of high demand and supply of skilled labour was one of the factors that contributed to the growth with equity on wage distribution achieved by the East Asian economies until the 1990s (Birdsall et al., 1995). South Korea represents the most noticeable case, considering that education policies have been able to match the evolution of the productive structure of the country over time (Jankowska et al., 2013).

2.2 Impact of openness, labour and macroeconomic policies on wage distribution

Having discussed the major mechanisms related to the SBTC hypothesis, in what follow we introduce other factors that are likely to influence the relative distribution of wages at different skill levels.

Among them, globalization has long been evocated as one of the leading causes of wage inequalities. The Stolper-Samuelson corollary of Heckscher-Ohlin theory of trade points out that opening up to foreign trade will equalize the remuneration of factors of production leading also

to an increase in wages for unskilled labour. This assumption has been tested in different contexts, with highly contrasting findings – especially in the case of developing countries (Goldberg et al., 2007). On the one hand, in fact, there is a number of cross-country analyses (Avalos and Savvides, 2006; Acar and Droguel, 2012; Mamoom and Mushed, 2012) as well as country-specific studies (Attanasio et al., 2004 on Colombia; Calì, 2014 on Uganda) that provides empirical support to this hypothesis. On the other hand, more recent evidence seems to consistently point out that more openness worsens the wage distribution in developing countries (Goldberg and Pavcnik, 2007; Szekely and Samano, 2012). This has been explained by the fact that trade liberalization can also induce skill biased technological change thanks to the access of more sophisticated inputs and new technologies (Cornia, 2005; Caselli, 2014).

To some extent, the experience of the Asian success stories has been peculiar. Exports were promoted while imports were only slowly liberalized, so that the measures implemented by some countries have proven initially able to protect the employment in existing sectors while supporting the rise of new tradable sectors (Rodrik, 2009), somehow cushioning the overall impact on wage inequality.[3] As a result, early evidence has pointed out that liberalization resulted in an improvement in wage inequality (Wood, 1997). After the crisis, East Asian countries undertook a further process of import liberalization that resulted in an upward pressure on wages[4].

On the other hand, opening the capital account aims at increasing financial flows to stimulate investment and productivity growth. The channels through which capital liberalization affects wage distribution are diverse. In a Solow growth model, opening to capital flows lowers interest rates allowing firms to increase their rates of investment and so the

[3] This has been done in different ways: Korea and Taiwan implemented export subsidies to nontraditional sectors, while other countries such as Malaysia and Thailand relied on export processing zones and China on export incentives and special economic zones (Rodrik, 2009).
[4] Another work extending the analysis up to 1999 does not find any significant association between openness and wage inequality in the region (Avalos and Savvides, 2006).

capital ratio over labour that, as mentioned above, has a skill-biased impact on wage distribution (Chari et al., 2012). In reality, however, the situation is more complex and it often happens that large inflows from abroad end up increasing interest rate, which in turn rises the demand of non–tradable goods (with a rigid supply) pushing up inflation and appreciating the exchange rate (Taylor, 2000). The rising costs push firms to cut jobs or reduce the wage level, especially for unskilled workers (Cornia, 2005).

Finally, wage inequality is also influenced by labour market policies. Indeed, rules concerning wage or employment regulation inevitably affect the way in which demand and supply of labour interact. For example, the implementation of a minimum wage is generally designed to protect the most vulnerable workers. If this is the case, it will impact on the wage distribution reducing the gap between the remunerations of skilled and unskilled workers. On the other hand, it has been argued that the definition of a minimum wage threshold can also translate in a negative impact on the labour demand for unskilled workers (Fields and Kanbur, 2005). Yet – in a context of technological modernization - a minimum wage fixed at a proper level could be useful in protecting the wage level of unskilled workers without improving efficiency.

Empirical literature shows mixed results (Card and Krueger, 1995). Nonetheless, recent evidence from Latin America points out that minimum wage played an important role in reducing wage dispersion (Kristensen and Cunningham, 2006). Only a few works focus on the East Asian case.[5]. One of the reason is that in these countries labour market institutions developed only in recent years. The presence of measures such as unemployment insurance or minimum wage was felt useless in a condition close to full-employment, as in the case of some of these economies before the 1990s (Cornia and Martorano, 2012). The arrival of the 1997 Crisis generated a sharp increase of unemployment and a drop in labour

[5] One of these works, focusing on Indonesia, seems to suggest that the introduction of a minimum wage legislation has contributed to reduce wage inequality in the country (Chur and Khor, 2010).

incomes. Consequently, some Asian governments (such as Thailand and Malaysia)[6] tried to react introducing ad-hoc policy measures. In general, however, the weakness of local labour market institutions favoured the worsening of working conditions and contributed to an increase in wage inequality in the majority of East Asian countries (ILO, 2008; ADB, 2012).

3. DATA AND METHODOLOGY

3.1 Data and model specification

Our empirical analysis is based on data from the Industrial Statistics Database of the United Nations Industrial Development Organization (UNIDO), which provides annual information on the manufacturing sector for a long period covering the years from 1963 to 2008.[7] This database also includes information on: total wages, employment, capital, value added and production disaggregated at the 2-digit level of the International Standard Industrial Classification (ISIC) revision 3. Based on this classification, we have selected the industries classified as "medium-high" and "high" technology using the OECD definition based on their global technological intensity. For each of these industries, we have calculated our measure of wage inequality adopting the following approach:

$$wage\_gap_{i,x,t} = \frac{wage\_pc_{i,x,t}}{\sum_n wage\_pc_{i,t}} \quad (1)$$

where *i* denotes the country[8], *x* each of the medium and high tech industries[9] in the manufacturing, *n* all the low-tech manufacturing industries[10] and *t* the year.

[6] In Thailand, for instance, the government implemented specific programs to support agricultural activities in the poor rural areas while reducing migration to the urban areas via input provisions and micro-credit schemes. In Malaysia, labour market policies helped to reduce ethnic inequality ensuring the creation of well-paid jobs and supporting economic activities (Ragayah, 2011).

[7] For non-OECD countries, information included in the database has been collected through questionnaires of national statistical offices. Coverage, especially of the informal sector, may be incomplete as, for instance, homeworkers are not included in the count of total employees.

[8] Due to poor data availability for some countries (such as Taiwan and Vietnam), our analysis includes eight countries: Republic of Korea, Hong Kong, Singapore, Malaysia, Thailand, the Philippines, Indonesia, and China.

Following the theoretical discussion of section 2, our final specification is based on the following functional relation:

$$wage\_gap = f(va; k\_e; yedu; reer; kaopen; mw) \quad (2)$$

In our specific setting, the SBTC is measured by within-manufacturing technological change, which is considered here as the upgrading in the composition of production from lower to higher technology sectors. To measure the technological change we consider the relative importance of industry *x* production (*va*) compared to the manufacturing total, as well as the dynamics of the main factors of production. The latter includes a coefficient measuring the relative endowments of capital per employees (*k_e*), calculated at the industry *x* level as a share of the manufacturing total. In view of what discussed in section 2.1, we expect that an increase in the output of the technology intensive industries – pushing the adoption of advanced technologies – affects the distribution of wages via an increase in the demand of skilled workers (Acemoglu, 2002).

Looking at the supply side, we control for the relative endowment of skilled labour including a variable representing the effects of human capital endowments measured by the average numbers of years of education (*yedu*). Though the levels of education are an imperfect proxy of human capital (Lim and Tang, 2006), there is substantial evidence pointing out that education inequality is a major determinant of wage inequality (Checchi, 2001).

To control for macroeconomic policies related to international integration, we initially consider the real effective exchange rate (*reer*) and the Chinn-

[9] Also in this case, the availability of data allowed to compute our measure of relative wage inequality for the following industries: chemicals and chemical products; machinery and equipment; electrical machinery and apparatus; medical, precision and optical instruments; motor vehicles; other transport equipment.

[10] This group includes low-tech manufacturing industries that produce manufacture of: food and beverages; tobacco; textiles; apparel; footwear; wood and of products of wood and cork; pulp, paper and paper products; publishing, printing, and reproduction of recorded media.

Ito index (*kaopen*) that measures a country's degree of capital account openness (Chinn and Ito, 2008). A stable and competitive exchange rate is expected to favour economic stability and promote the growth of the tradable sector. Especially in countries with a specialization in labour intensive sectors, it raises the demand for unskilled workers generating positive effects on the wage distribution, proving more protective on the domestic manufacturing sector than tariff rates (Helleiner, 2011). In contrast, we expect that a higher degree of capital account openness can lead to more inequality.

Finally, as a proxy for labour market policies, we use the ratio between the minimum and the average wage (*mw*). Despite the empirical evidence has so far showed mixed results, we expect that minimum wages can contribute to reduce wage inequality (Freeman, 1996).

Table 1 describes the variables included in (2), while their summary statistics and correlations are reported in Tables A1 and A2 in the appendix.

Table 1. Description of the variables used in the regression analysis

Variable	Description	Unit of Measurement	Data Source
wage_gap	Wage differential between medium-high tech on lower tech industries	Ratio	UNIDO
va	Value Added, share of the industry on manufacturing total	Ratio	UNIDO
k_e	Capital per employee, share of the industry on manufacturing total	Ratio	UNIDO
yedu	Number of years of education of adults (25+)	Absolute Number	Barro and Lee (2011)
reer	Real effective exchange rate index	Index 2007=100	Bank for International Settlements
kaopen	Index of capital openness	By construction, the series has a mean of zero	Chinn and Ito (2008)
mw	Minimum on average wage	Ratio	Aleksynska and Schindlerfor (2011)[11]

[11] For Indonesia, data is extracted from the ILO global wage database.

3.2 Methodology

Having to deal with a macro panel poses a number of constraints to the adoption of standard estimators. The first issue is the assumption of stationarity, which is usually justified in standard micro panel data model, but is more restrictive for macro panels with large T.

The econometric literature has recently proposed a range of different tests for unit roots in panel data (see Baltagi, 2005, for an overview). However, only few of these tests work with an unbalanced panel structure. We use a Fisher-type test combining the p-values of unit root tests for each cross section (Maddala and Wu, 1999). The test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Results of the test on each variable are reported in table 2. We find that the null hypothesis of a unit root can be rejected for the majority of our variables, including the index of wage inequality. Despite the long run of the series, this is not surprising given the fact that some of the variables have been computed as shares or indexes (see table 1). Only for the variables representing openness to capital and the minimum wage we cannot reject the null of a unit root. In order to reduce concerns, we apply a transformation based on the filter proposed by Hodrick and Prescott (1997), which modifies the cyclical component removing the trend.

Table 2. Results after the Fisher type unit root test for panel data

	wage_pc	**va**	**k_e**	**yedu**	**reer**	**Kaopen**	**mw**
chi2	388.41	193.68	693.31	530.89	181.56	73.55	44.21
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.9571	1.0000

Source: authors' elaboration

Having reduced the risk of running spurious regressions, we check for two additional problems that are likely to affect our data. The first is the existence of heteroskedasticity in panels. We adopt the modified Wald statistic for groupwise heteroskedasticity in the residuals of a fixed effect

regression[12] (Greene, 2003) and find that the null of homoscedasticity is rejected. The second issue has to do with serial correlation in the residuals. Especially in long panels, serial correlation biases the standard errors and produces less efficient results. We adopt Wooldrige's test to detect serial correlation,[13] which cannot reject the null pointing thus to the absence of serial correlation in the error (Drukker, 2003).

Different solutions exist to estimate our model. Emerging literature exploring the so-called panel time series econometrics correctly points out that, for most of the time, the same methods used for micro panels are adopted in the case of macro panels, though the properties of the latter make the former inefficient under different dimensions. A possible solution is represented by the feasible generalized least squares (GLS) method, specifying the error term being independent with a variance difference for each panel, which allows for efficient estimation in the presence of autocorrelation, cross-sectional correlation and heteroskedasticity across panels (Greene, 2003), while being also indicated to deal with unbalanced panels (Baltagi, 2005).

However, considering the complex structure of our data, where our unit of analysis – the country – is nested in more aggregate levels, including sectors, we opt for a multilevel analysis. While clustering the error term assumes homogeneous correlation structures for all the country groups and fixed effects estimators allows for unique variability within groups, a multilevel approach controls for the larger complexity given by the hierarchical levels in the data. This, in turn, translates in the adoption of a maximum likelihood estimator leading to more efficient estimates of the coefficients and their standard errors (Snijders and Bosker, 1999; Maas and Hox, 2004). Multilevel models can be adopted in presence of more than one levels of analysis and are also applicable with longitudinal data (Rabe-Hesketh and Skrondal, 2008).

[12] Test statistics (chi2= 2.2e+05, p>chi2=0.0000) have been computed by means of the STATA command xttest3.
[13] Test statistics (F=0.176, p>F= 0.6771) have been computed by means of the STATA command xtserial (Drukker, 2003).

Regarding our case, a linear multilevel can be represented using the following general form:

$$Y_{ixt} = \alpha + \sum_{k=1}^{s} \beta_k Z_{ixt} + \sum_{h=1}^{n} \beta_h X_{it} + \mu_{ix} + \rho_x + \varepsilon_{ixt} \qquad (3)$$

where Y_{ixt} is the dependent variable (*wage_gap*), *h* and *k* are the number of covariates observed at the level of the country and of the sector, respectively. μ_{ix} and ρ_x are the second and third level residuals while ε_{ixt} is the first level residual, both *iid* distributed with mean zero and constant variance. While keeping the independence structure of the error term, we model the residuals in a way to estimate a distinct variance for each country, so to take into account for heteroskedasticity.

In order to check for the significance level of the two additional levels as random intercepts in (3) we run a likelihood ratio test. Results of the test, reported in the results tables, strongly refuse the null of no random intercept, suggesting the choice of a multilevel approach over standard estimators.

4. RESULTS

Table 3 reports the first set of results, obtained through different estimation methods including pooled regression with robust standard errors, feasible GLS and the multilevel approach. Overall, results for the different variables are robust across the different estimators adopted[14]. For the rest of the paragraph we comment the output of column (III) and the following.

We find that the coefficient measuring the relative value added of industry *i* compared to the rest of manufacturing is positive and statistically significant in all the different specifications. These results are in line with

[14] Following some literature (Acemoglu, 2002), we run an alternative specification where value added, capital on employees and education are treated as endogenous variables. Results – based on a system GMM approach and reported in table A3 in Appendix – are in line with those in table 3 and show also a strong reliance of the dependent variable over its lagged levels.

the SBTC hypothesis and confirm that in East Asia the process of structural change within the manufacturing – pushing the adoption of advanced technologies and capital - rises of the wage premium due to the creation of new skilled jobs and the related greater demand for educated workers (Almeida, 2010; Lee and Wie, 2013). In addition, the positive and significant coefficient of the capital per employee ratio seems to confirm the complementarity between capital investment, technological upgrading and an increase in demand for more skilled labour.

In line with the predictions of the theory, our results also show that human capital endowments, measured through the years of education, contribute to reduce wage inequality. However, using a variable representing the average years of education does not add much information about the existence of thresholds on the supply of educated workers nor on returns on education. In order to investigate these issues in more detail, column (V) introduces an alternative variable representing the share of working age population with secondary or tertiary education levels (*skilled*). Results are straightforward since they seem to show that wage inequality decreases with an increase in the share of the population with higher educational levels. Considering also the negative sign of the coefficient *yedu*, this means that the returns on education for the (fewer) educated workers tend to grow large compared to the compensations for the majority of the workforce. Conversely, when a greater share of more educated workers enters the labour market, the wage gap reduces. Raising the level of education allows in fact to match the greater demand for skilled workers so that a greater supply of educated workers prevents the rise of skill premium allowing to take advantage of technological changes. This result is in line with the theory and evidence (Acemoglu, 2002; Mamoon and Mushed, 2012) and seems to support the view that the East Asian context provides an useful benchmark for other developing countries in terms of the effectiveness of their investment in human capital. As a matter of fact, when comparing East Asian with Latin American countries Avalos and Savvides (2006) showed that the relative supply of skilled workers explains more than 50% of the difference in the average wage inequality between the two groups of countries.

No significant results are found for the variable representing minimum wages, even if its sign is consistently negative, therefore suggesting a contribution in reducing wage inequality. The not significant impact of the variable can be interpreted in a number of ways. The first is that, as noted before, labour market institutions have been historically weak in East Asian countries, even if some changes have been implemented in recent years, though in a heterogeneous manner (see Chur and Khar, 2010, for the case of Indonesia). In addition, the redistributive capacity of such specific measure is highly related to a range of factors, which we cannot control, including for instance the percentage of workers covered or its inclusion in a more comprehensive institutional system (Freeman, 1996).

Moving to the impact of macroeconomic policies, we find some interesting results. The coefficient of *reer* is positive and statistically significant. This result confirms two different provisions of the existing literature. On the one hand, this supports the view that – especially during the first stages of development – a competitive exchange rate (i.e. a decrease of *reer*) favours the reduction of wage inequality by promoting the exports of the labour-intensive sectors (Damill and Frenkel, 2012). This seems to be a specific feature of East Asian countries, as other studies find the opposite (e.g. Verhoogen, 2008, on Mexico). On the other hand, an appreciation of the exchange rate can favour the import of capital and more sophisticated inputs from more advanced countries, something that generally requires the recourse to higher skilled workforce (Cornia, 2005), as previously found in other developing countries (Caselli, 2014; Acar and Droguel, 2012). Besides this, we find that also the coefficient measuring changes in the degree of openness of the capital account is generally negative but always not significant. This can be due to the high heterogeneity between countries concerning policies on openness to capital implemented by the different countries in the region, as well as by the lack of further specification among the different measures of capital liberalization.

Finally, in order to control for the changes that followed the financial crisis of 1997, we introduce a time trend covering the period going from 1997

to 2008. Not surprisingly, we find that the variable has a strongly significant coefficient in all the specification, meaning that for most countries wage inequality increased faster during the post-crisis phase.

Table 3. Regressions results

	(I) OLS	(II) GLS	(III) Multilevel	(IV) Multilevel	(V) Multilevel
Va	0.0192***	0.0236***	0.0119***	0.0117***	0.0118***
	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
k_e	0.0382***	0.0437***	0.0258***	0.0258***	0.0269***
	[0.013]	[0.006]	[0.006]	[0.006]	[0.006]
yedu	-0.0212***	-0.0136***	-0.0112**	-0.0177***	
	[0.006]	[0.004]	[0.005]	[0.005]	
reer	0.0009***	0.0005***	0.0005**	0.0005**	0.0006**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
kaopen	-0.0448	-0.0269	-0.0144	-0.0108	-0.0121
	[0.031]	[0.018]	[0.022]	[0.022]	[0.022]
mw	-0.1665	-0.1100	-0.1836	-0.1587	-0.1588
	[0.289]	[0.141]	[0.181]	[0.183]	[0.182]
crisis				0.1422***	0.1289***
				[0.038]	[0.038]
skilled					-0.0013**
					[0.001]
Constant	1.2879***	1.2188***	1.2817***	1.2945***	1.2230***
	[0.062]	[0.041]	[0.053]	[0.053]	[0.045]
Observations	1,252	1,252	1,252	1,252	1,252
R-squared	0.129				
LR test			484.73	433.77	433.66
(chi2)			(0.0000)	(0.0000)	(0.0000)

Robust Standard Errors in brackets

***p<0.01, **p<0.05, *p<0.1

4.1 External liberalization in practice and its effects on wage inequality

Results reported in the previous paragraph have analysed the impact of external liberalization on wage inequality based on the outcomes of two specific instruments under the control of policy makers, namely the exchange rate and the capital account liberalization policies. We observed in particular that exchange rate policies have a significant effect on wage inequality while the variable measuring the openness to foreign capital has provided no relevant results.

As for the latter variable, we can assume that different kinds of capital inflows could generate a different impact according to their nature. Foreign capital inflows in terms of FDI in the manufacturing sector played a crucial role in the development strategy of some East Asian countries. Since they generated a greater demand of unskilled and semi - skilled workers we can expect that they have reached equalizing effects in most countries. In contrast, other capital flows such as portfolio investments are often considered to cause wage inequality since they are directed to activities not benefitting low-skilled workers.

In light of such considerations, table 4 reports the results of our model including three new variables: the share of FDI and portfolio investment flows on the host country GDP as well as the value of mean tariff rate[15]. Overall, results show that even introducing these new variables does not affect the behaviour of common variables compared to Table 3. Thus, results pointing out to the impact of structural change and education on wage inequality remain almost unchanged and will not be further discussed.

Moving on to the new variables, contrary to table 3, we are now able to understand better the effects of capital openness on wage inequality by showing that the nature of capital flows matters. We find, in particular, that the coefficient of portfolio investment inflows is positive and statistically significant. Indeed, the large inflows of financial capital are associated with increasing pressure on the real exchange rate and instability that usually hurts wage inequality. In contrast, the FDI coefficient is negative and statistically significant. As expected for the case of countries greatly involved in the international fragmentation of production, even when targeted to higher technology industries, FDI have created a large demand for low or semi-skilled labour force involved in lower value-added activities within global value chains (on this see

[15] For the latter, data have been extracted from the 2012 Economic Freedom dataset (Gwartney et al. 2012). Due to the lack of sectorial data for such a long series, we use information on the unweighted mean of tariff rates.

McNabb and Said, 2013, for the case of Malaysia). Indeed, as documented by Thorbecke and Salike (2011), the strong interconnections between East Asian countries allowed to generate a system where the labour-intensive industries expanded rapidly. This finding looks quite peculiar to the East Asian case and set it in contrast with the existing evidence, which has so far showed a negative impact of FDI on wage inequality due the higher-skilled nature of the activities involved (i.e. Feenstra and Hanson, 1997, on Mexican *maquiladoras*).

Table 4. Regressions results, model including liberalization outcomes

	(I) OLS	(II) GLS	(III) Multilevel	(IV) Multilevel
va	0.0193***	0.0181***	0.0099***	0.0099***
	[0.003]	[0.002]	[0.002]	[0.002]
k_e	0.0565***	0.0792***	0.0412***	0.0410***
	[0.017]	[0.007]	[0.007]	[0.007]
yedu	-0.0399***	-0.0428***	-0.0322***	-0.0334***
	[0.007]	[0.004]	[0.005]	[0.005]
reer	0.0010***	0.0005***	0.0008***	0.0009***
	[0.000]	[0.000]	[0.000]	[0.000]
fdi_gdp	-0.2068***	-0.1737***	-0.1649***	-0.1713***
	[0.029]	[0.021]	[0.021]	[0.021]
portfolio_gdp	0.2978***	0.1886***	0.2333***	0.2549***
	[0.103]	[0.069]	[0.079]	[0.082]
tariffs				-0.0075
				[0.006]
mw	-0.1235	0.0353	-0.1384	-0.2758
	[0.291]	[0.114]	[0.186]	[0.213]
crisis	0.2298***	0.2242***	0.1901***	0.1882***
	[0.033]	[0.014]	[0.042]	[0.043]
Constant	1.3818***	1.4195***	1.3946***	1.4012***
	[0.065]	[0.043]	[0.054]	[0.054]
Observations	1,127	1,127	1,127	1,127
R-squared	0.229			
LR test			441.51	442.62
(chi2)			(0.0000)	(0.0000)

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Finally, we find a negative, but not significant, coefficient for the variable representing tariffs. Although it is not possible to report that tariffs' reduction impacts negatively on wage inequality, this result also contradicts provisions from the traditional trade theory about their positive distributional effects (Attanasio et al., 2004). However, it is also necessary to consider that the period of analysis is large and the initial dis-equalizing impact of trade openness could be smoothed in the long term, as showed by Szekely and Samano (2012) for Latin American countries.

4.2 Dissecting the impact of policies on wage inequality – a scenario based exercise

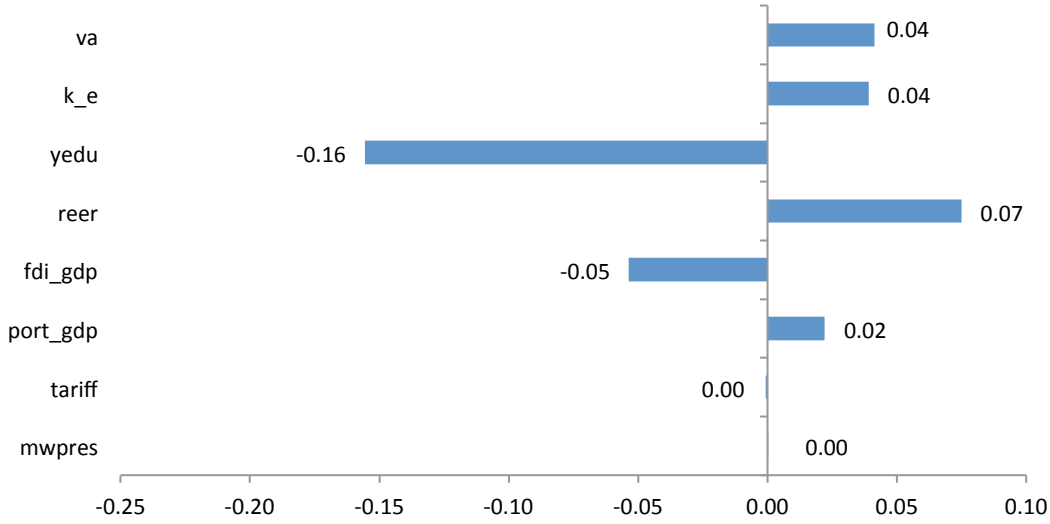
After having identified the factors that have contributed to changes in wage inequality over the long run in East Asia, we try to move the analysis further by presenting here a simple simulation exercise based on the results of our empirical analysis. The objective is to single out a set of instruments available to the policy makers, whose action can contribute to moderate the negative impact of structural transformation on wage inequality.

In order to identify this "mix" of policies, we firstly retrieve standardized coefficients from the results of Table 4 by measuring the elasticity of all the independent variables. Figure 2 reports such elasticities, and shows that the process of structural transformation results in an increase of wage dispersion. More precisely, a one per cent increase in *va* or *k_e* leads to an increase of wage inequality by 0.04 per cent. A similar raise in the portfolio investment flows over GDP determines an increase of inequality by 0.02 per cent.

On the other hand, our results show to what extent a number of different measures can be applied in order to moderate the increase in wage dispersion during the process of economic development and in a context of open economy. By and large, the strongest contribution to the reduction of wage inequality is related to the supply of educated workers.

Figure 2 shows that an increase by 1 per cent in the years of education reduces wage inequality by 0.16 per cent. Secondly, the promotion of longer-term investments from abroad results in positive distributional effects since a 1 per cent rise of the FDI/GDP ratio promotes a decrease of wage inequality by 0.05 per cent. Lastly, Figure 2 confirms that the adoption of a competitive exchange rate leads to a drop of wage inequality, by a 0.07 per cent for a 1 per cent devaluation.

Figure 2. Elasticity of independent variables on wage inequality



Source: Authors' elaboration

As discussed above, starting with the four "Tigers", East Asian countries undertook a peculiar process of industrialization and production upgrading, following the so-called "flying geese" pattern. On the basis of this, we design a baseline scenario on the assumption that the rest of emerging East Asian countries will embark in a further process of structural transformation achieving the value added shares of high tech industries recorded by the Asian Tigers included in our sample (South Korea, Hong Kong and Singapore) during the post-crisis period.

As can be shown by Figure 3, this implies that their value added share should increase by 46 per cent, i.e. from the actual average value of 4.6 to the predicted one of 6.7. Everything else being equal, this will lead to

significant increases in the wage gap, more precisely in the order of 2 points, or up to a value of 3.5 (Scenario 1 in Figure 3).

As reported above, the policymakers of these countries have a range of tools to balance these effects and to favor a process of redistribution.

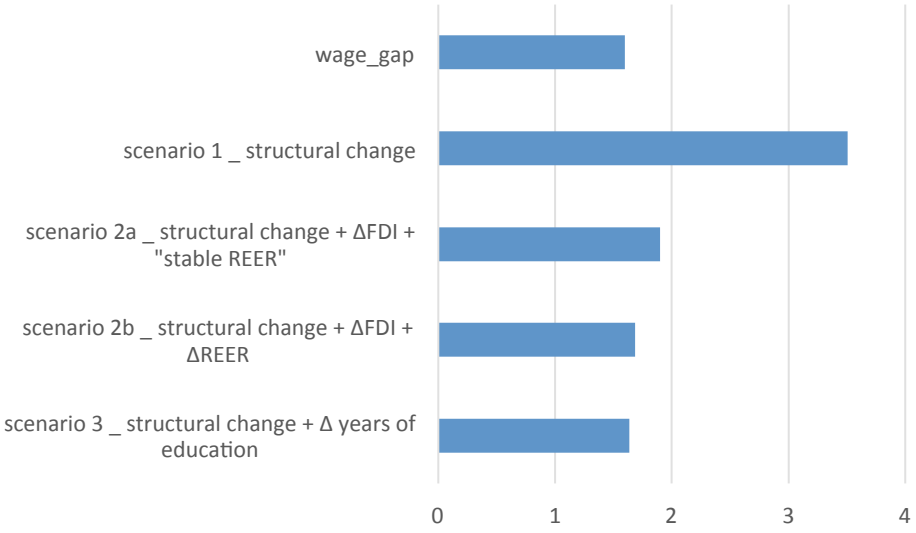
In a country with a specialization in labor-intensive sectors, the increase of the amount of FDI together with the adoption of a stable and competitive exchange rate could be useful to keep wage dispersion under control during a process of structural transformation (Scenario 2 in Figure 3). Since in these countries the FDI/GDP ratio is low and close to 0.25, in presence of a stable exchange rate, it is possible to show that an effort to increase this ratio by 30 per cent (i.e. up to 0.34) would partially contribute to compensate the expected increase in wage inequality predicted under the Scenario 1 (Scenario 2a). On the other hand, a smaller increase of FDI (by 20 per cent), together with a 10 per cent devaluation would further reduce wage inequality, bringing the countries only 0.1 points above to their original level (Scenario 2b).

Beyond this, the successful and distinctive characteristic of the East Asian Model was the high level of investment in education. Thus, Scenario 3 in Figure 3 shows that the increase in wage dispersion could be counterbalanced, for instance, by strengthening the supply side through larger investments in education. In particular, an increase by 12 per cent in the average years of education in the working age population will almost completely compensate the effect predicted by the Scenario 1.

In summary, Figure 3 suggests couple of ways through which policy makers in developing countries can implement pragmatic policies to promote a model of economic development with redistribution. In the context of growing economies undertaking a rapid process of structural transformation, investing in education is a clear priority to provide an adequate supply of skilled workers in order to match the changes in the demand caused by the adoption of more technological intensive production processes. Moreover - in a context of open economy - the

implementation of the right policy mix becomes crucial in order to get advantages from international trade and capital openness, as showed by Asian countries in the period before the 1997 crisis and some Latin American countries during the last decade.

Figure 3. Simulation of different scenarios of wage inequality changes



Source: Authors' elaboration. **Notes:** Scenario 1 is constructed under the assumption that the group of countries made up by Malaysia, Indonesia, Thailand, Philippines and China will reach the same share of value added of high-tech industries on the manufacturing experienced by Korea, Hong Kond and Singapore. All the values refer to the average levels for the post-crisis period.

5. Conclusions

Looking at factors that have contributed to the widening in the wage gap between sectors at different intensity of technology in the manufacturing, this paper has tried to explain why some East Asian countries performed better than others.

Our analysis shows that structural change within manufacturing– pushing the adoption of more capital intensive and productive technologies and fostering the participation of higher skilled workers – is a strong determinant of the wage premium of higher tech sectors compared to

traditional ones. Being this a process linked to a country's development, other things being equal, it will most likely lead emerging and developing East Asian countries towards a further deterioration in wage inequality in the future.

This said, our work shows that some countries have been able to mitigate such effect by means of education policies supporting the supply of labour force to the market and the good management of macroeconomic policies.

More specifically, the first important finding of our paper is that a considerable and sustained investment on education is crucial to boost economic development and also to reduce the wage premium. Indeed, countries reaching an adequate supply of well-educated workers can prove able to reduce the skill premium. This has been one of the key features that allowed to some East Asian countries such as Korea to promote an equitable growth even in presence of structural transformation. On the other hand, as it has been observed in Latin American countries during the 1990s, the lack of adequate supply would inevitably result in an upward pressure on wage distribution, due the increasing demand for skilled labour.

In addition, our results show that the right mix of macroeconomic policies could be strategic in promoting economic development without scarifying the equity on wage distribution. Indeed, the second major finding of the paper is to confirm recent views suggesting that it is possible to observe a reduction of wage inequality also under open economy conditions (Cornia, 2012). In particular, we show that the adoption of a competitive exchange rate policy can favour the promotion of exports in countries with a specialization in labour intensive sectors since it raises the demand for unskilled workers.

On the other hand, a greater openness of the capital account is found to have an ambivalent effect on wage inequality, and it is strongly dependent on the nature and the direction of the capital flows. Estimation and simulation based-results explain that wage inequality increased in

countries that received large portfolio inflows during the recent. The introduction of market-based and administrative controls on portfolio inflows are crucial not only in reducing the pressure on the exchange rate, but also in reducing the risk of crisis and the negative consequences for the wage distribution. In contrast, our results confirm the view that FDI in the manufacturing sectors proved to be more "inclusive", creating a large demand for low or semi-skilled labour force in labour-intensive sectors. This seems to be a finding peculiar to the case of East Asian countries, as it sets contrary to the view that FDI inflows to developing countries enhance wage disparities. It suggests that selective investment attraction policies could generate positive distributional effect being at the same time an important component of a country's industrial policy.

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APPENDIX

Appendix Figure 1. Evolution of the Gini income index and Wage inequality in the manufacturing sector over the period 1960s – 2000s*

Source: Authors' elaboration on data by the SWIID database and Industrial Statistics Database of the United Nations Industrial Development Organization (UNIDO)

*The graph reports average values for the countries in the sample (see footnote 8 for a list). For a description on how the index of wage inequality in the manufacturing has been computed see paragraph 3.1.

Table A1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
wage_gap	1597	1.383	0.4125	0.3403	3.7361
va	1610	5.621	5.2014	0.0066	39.7037
k_e	1264	1.367	1.4404	-3.8672	16.9188
yedu	2064	6.016	2.0793	2.264	11.24
reer	2064	126.508	61.2515	51.4542	492.844
kaopen	1722	0.628	1.4108	-1.8556	2.4557
mw	1668	0.150	0.2345	0.0000	0.8260

Table A2. Correlation matrix

	wage_gap	va	k_e	yedu	reer	kaopen	mw
wage_gap	1.0000						
va	0.2481	1.0000					
k_e	0.1668	0.1251	1.0000				
yedu	-0.1743	0.0418	-0.0584	1.0000			
reer	0.1851	-0.0386	-0.0047	-0.4811	1.0000		
kaopen	-0.0317	0.0671	0.0088	-0.0059	-0.0742	1.0000	
mw	-0.0157	-0.0087	0.0037	0.0017	0.0188	0.0093	1.0000

Table A3. Regression Results: SYS – GMM model

	(IV) Multilevel	SYS - GMM
L.wage_gap2		0.8536***
		[0.037]
Va	0.0117***	0.0036
	[0.002]	[0.002]
k_e	0.0258***	0.0112*
	[0.006]	[0.006]
yedu	-0.0177***	-0.0086*
	[0.005]	[0.005]
reer	0.0005**	0.0002*
	[0.000]	[0.000]
kaopen	-0.0108	0.0056
	[0.022]	[0.009]
mw	-0.1587	-0.1005
	[0.183]	[0.108]
crisis	0.1422***	0.0399**
	[0.038]	[0.018]
low_edu		
skilled		
Constant	1.2945***	0.1996***
	[0.053]	[0.066]
Observations	1,252	1,168
AR(1)		0.061
Sargan		0.193