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Industry upgrading and wage inequality
What lessons for China from the East Asian experience?[1]

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Abstract

This paper analyses the long run determinants of within manufacturing wage inequality for a group of East Asian countries that have experienced rapid structural transformations over the last decades. Results show that within manufacturing structural change – pushing the adoption of more capital intensive 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. However, the paper shows also that well designed education policies and a prudent management of the real exchange rate and capital account have contributed in some cases to buffer the pressure of structural change on wage inequality. Future scenarios for the Chinese economies are discussed based on simulations drawn from the model.

Keywords: Structural change; Wage Inequality; East Asia
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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 agriculture to manufacturing and services, as well as from resource-based, low-tech and labour intensive products to more sophisticated ones. In its process of industrialization, in particular, East Asia has showed distinctive characteristics. Practically all countries in the region have in fact followed what has been defined the "flying geese" pattern (Akamatsu, 1962). China, being anyway a specific case in its own, is following up this trend, as recent literature is increasingly pointing out (Yu, 2012; Li et al., 2012).

This process allowed some of these countries, and especially the newly industrialized countries (NICs), to rapidly catch-up with richer economies, with growth being initially accompanied by equity, giving rise to the so-called "Asian Miracle", also thanks to the fact that initial specialization in labour intensive sectors allowed a large number of workers to benefit from it. This model started to show signs of weakness already in the mid-1980s and collapsed during the 1997-8 Asian crisis. In some countries the myth of growth with equity was definitively displaced by a model of development characterized by rising inequality. Several factors contributed to these changes including the further process of liberalization, the structural transformation and the acceleration of technological change which led to an increase in the demand of qualified workers pushing up the skill premium, especially in countries without an adequate supply of skilled workers. However, inequality did not increase in all the countries since a group of them implemented policies to promote development without worsening the distributional conditions.

In light of the above discussion, the aim of our analysis is twofold. On one side, we study which are the factors that have contributed to the widening in the wage gap between sectors at different intensity of technology in the manufacturing[2] explaining why some countries performed better than others. On the other side, we use information collected from our analysis to simulate possible scenarios for the Chinese economy. More specifically, we want to test whether adopting a pattern of technology upgrading and policies along the lines of what other East Asian countries did in the last decades, will contribute and to what extent to a worsening in the wage inequality.

The rest of the paper is organized as follows. Section 2 describes the structural change experienced by East Asian economies and the evolution of wage inequality. Section 3 presents the model while section 4 describes the data and the methodology, reporting also the results of the empirical analysis. Section 5 concludes.

[2] Within manufacturing structural change is defined here as the upgrading in the composition of production from lower to higher technology sectors.

2. Structural change and wage inequality

2.1. The East Asian Miracle: Growth with equity

Starting from the end of the Second World War, the East Asian Economies experienced extraordinary growth giving origin to the so-called 'East Asian Miracle'. Thanks to their development strategies, these economies grew more than other developed and developing countries until mid-1990s. East Asian governments pursued import substitution policies in the 1950s and 1960s to promote the development of the national industries. In the early 1970s, they shifted to an export promotion strategy that gave them the possibility to experience a fast economic growth. Asian countries started investing in labor-intensive manufacturing industries producing goods of low skill intensity while they shifted to the production of goods of intermediate skill intensity in the 1980s.

If, on the one side, the economic success of East Asia was attributed to the market-friendly behavior of governments, (World Bank, 1993), some scholars highlight the crucial role played by the Asian policy makers in "governing the market limitations" (Wade, 1990) and thus having a crucial role in shaping the miracle (Boltho and Weber, 2009). As a matter of fact, although East Asian countries opened more their economies than other developing countries, several forms of protectionism and incentives for export coexisted in order to favour the development and competitiveness of the domestic industry. Moreover, in almost all countries governments assured macroeconomic stability that was considered a pre-condition for the development process. In particular, East Asian economies maintained low inflation rates, incurred on small deficits and kept low debt ratios. In addition, governments promoted private investments attracting also external capitals providing infrastructure and good governance. As a result, the outward oriented policy, the import of foreign technologies and the capacity to generate a skilled labour force gave them the possibility to fill the technological gap in few decades with more advanced economies (Stiglitz, 1996)[3].

This being said, it is important to remark for the purpose of this study that the East Asian development strategy has been considered a good model not only for the exceptional economic performance but also for its ability to achieve high rates of economic growth while maintaining an equitable distribution of income (World Bank, 1993). Positive distributional results were recorded especially in the years of high growth (Ranis, 1985). In contrast to the predictions of the Kuznets curve, these economies kept a low inequality level even if they experienced large structural changes. In contrast, East Asian countries recorded a drastic fall of poverty and inequality that was assured by high labor participation and low unemployment. Furthermore, the export-oriented strategy increased the demand for low skilled labour during the first stage of development, thus initially supporting the assumption that greater openness to

[3] Also demographic factors have been found to contribute to the rapid growth of many Asian countries, thanks in particular to the transition from high to low dependency ratio during this phase (Bloom and Williamson, 1997).

trade tends to narrow the wage gap between skilled and unskilled workers in developing countries (Wood, 1997: 33).

2.2. The end of the Miracle: Growth without equity

The Asian Miracle became less remarkable after the mid-1980s and it vanished completely during the 1997-8 crisis when many economic activities collapsed causing, among the others, a surge in unemployment.

The effects of the crisis on income inequality spread unevenly among countries. As can be seen by table 1, wage inequality kept stable in Korea and Malaysia and it even decreased in Thailand.

Table 1. Wage inequality for selected East Asian countries

Country	trend after 1997	Source
China	↑	Han et al (2012)
Philippines	↑	di Gropello and Sakellariou(2010)
Hong Kong	↑	UTIP UNIDO data
Indonesia	↑	Lee and Wie (2013)
Singapore	↑	UTIP UNIDO data
Malaysia	=	UTIP UNIDO data
Korea	=	Kwack (2010)
Thailand	↓	ILO (2008)

Source: author's compilation. Note: Assessments are made based on different measures of wage inequality. Refer to the sources for the methodologies adopted.

Following the crisis, East Asian countries undertook diverse development strategies, but it is still possible to identify some common policy factors among them.

First of all, these countries experienced a further process of structural transformation. Looking at the manufacturing, the initial focus shifted away from the production of labor-intensive goods (such as clothing or food processing). The value added of high technology and capital intensive sectors grew either because some countries, such as Korea, were able to set a domestic productive system or because of the involvement in global production networks, as in the case of Malaysia, Thailand or China (Haraguchi and Rezonja, 2009). The shift to the production of higher skill intensive goods and, in some cases, the process of deindustrialization widened the wage differentials between skilled and unskilled workers. The greater demand for skilled labor increased the return to higher education in several East Asian countries (ADB, 2012). Mehta et al (2011) show that the premium of tertiary to secondary education rose in the Philippines and Thailand. Also in China, the wage differentials shifted favoring the highly

educated workers at an increasing pace (Li et al., 2012). A similar pattern has been observed for Vietnam and Indonesia (World Bank, 2007; di Gropiello and Sakellariou, 2010).

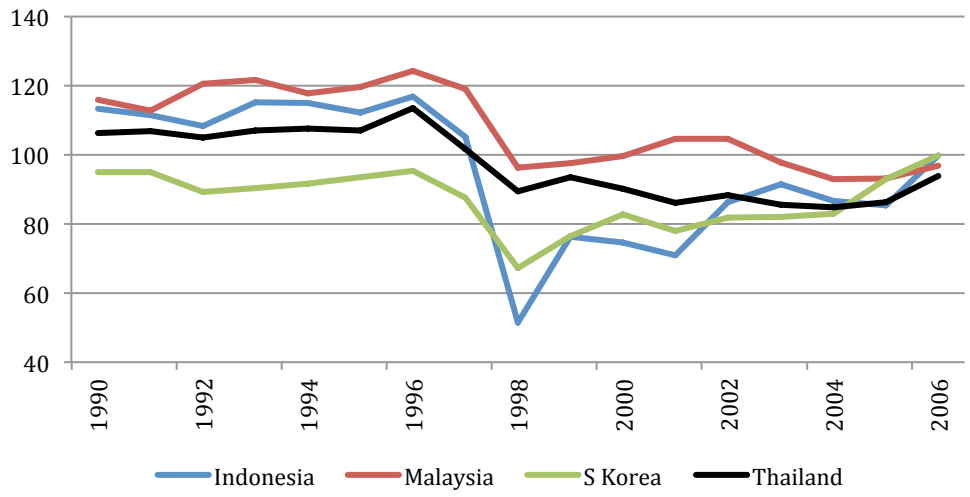
Wage differentials have also been pushed by the shortage of skilled workers. This is the case of fast growing economies as China and Vietnam that experienced large changes in the skill premium also because the supply of skilled workers changes slowly in the short and medium time.

In contrast, other countries were able to reduce wage inequality or to maintain a low level of wage premium thanks to the high supply of human capital. According to Birdsall et al (1995), the combination of high demand and supply of skilled labour is one of the factors that contributed to the growth with equity achieved by the East Asian economies until the 1990s. South Korea represents perhaps 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). Also Malaysian authorities invested on education promoting the access to post – primary education and contributing to the increase of human capital resources especially among the poorer (Ragayah, 2011).

Secondly, East Asian countries undertook a further process of liberalization fostering trade openness and the entry of large flows of capital. The participation of East Asian countries to international networks of production became more relevant during the most recent years, favoring the integration into the global supply chains (Haraguchi and Rezonja, 2009). Such new context affected wage inequality since it fostered the demand for higher skilled workers, given that outsourcing activities created new jobs relatively more skill intensive compared to the host country average (World Bank, 2007).

However, some countries introduced the necessary measures to counterbalance these effects (Cornia and Martorano, 2012). The adoption of a competitive real effective exchange rate (REER) not only pushed up the growth of exports favoring a fast economic recovery after the 1997 crisis but also reduced the potential negative effects on wage distribution. The pattern of countries such as Malaysia, Indonesia, Korea and Thailand looked very similar in this sense (Figure 1), while this did not happen in the case of China, where exchange rate was kept fixed (Yu, 2012).

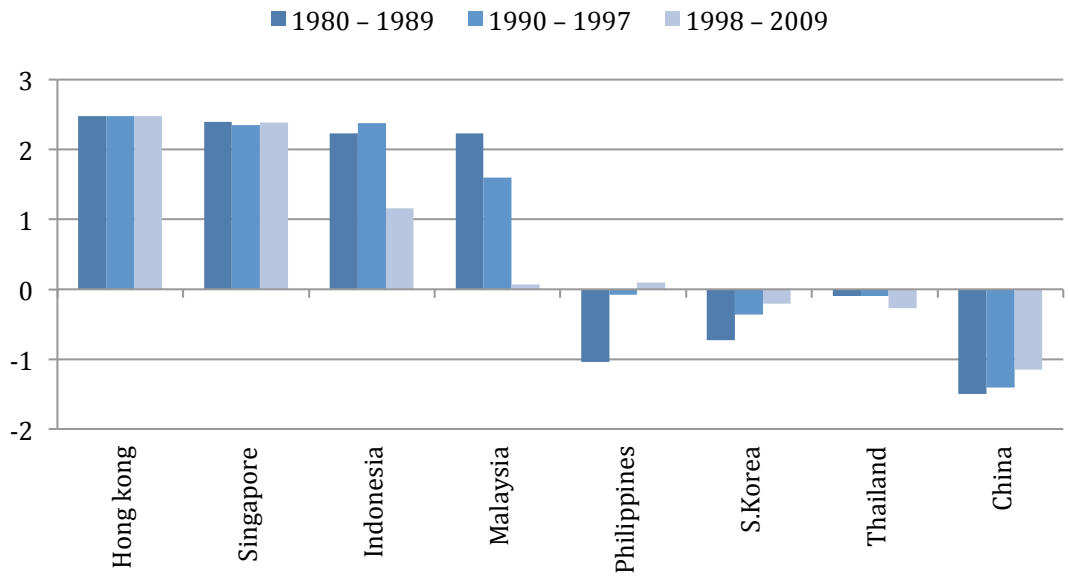
Figure 1 Trends in REER for selected East Asian countries (2007=100)



Source: Bank for International Settlements (BIS)

Moreover, Malaysia and Thailand implemented explicitly and temporary measures on capital account to reduce the pressure on real exchange rate coming from the large inflows of external capital, whereas Indonesia introduced capital controls at a later stage (Figure 2).

Figure 2. Index of capital account openness (Kaopen) for selected countries



Source: Author's elaboration on data by Chinn and Ito (2008).
Note: The Kaopen index is a positive function of the openness. The index has been normalized around a mean value of 0.

Lastly, small changes were also implemented in the labor market. Some Asian governments tried to face the post crisis period introducing adequate policy measures. In Thailand, the government implemented specific programs to support agricultural activities especially via the input provisions and micro-credit schemes. In Malaysia, labor market policies helped to reduce ethnic inequality ensuring the creation of well-paid jobs and supporting economic activities (Ragayah, 2011). Nonetheless, the weakness of labor market institutions favored the worsening of working conditions as well as contributed to the increase in wage inequality in the majority of East Asian countries. After the 1997 Crisis, the objective of rising competitiveness pushed many East Asian countries towards the search of a larger flexibility in the labor market. The concurrence of low level of unionization, low coverage of collective bargaining (ILO, 2008) and the surplus of labor force weakened the bargaining power of unskilled workers favoring at the same time worse work conditions and the increase of wage inequality (ADB, 2012). One of the most emblematic examples is China where the labor market policies tried explicitly to keep low the level of wage. State controlled trade-unions and the lack of effective policies on wage regulation contributed to rising income inequality by moderating the requests for wage increases despite large rises in profits and productivity (Cornia and Martorano, 2012). Due to the social instability generated by the increasing number of protests the Chinese government implemented a new 'contract labor law' in 2008 to improve the condition of workers. Finally, minimum wage legislation and related reforms have taken greater prominence across the region only in more recent years, including in Hong Kong, Malaysia and the Philippines (ILO 2012).

3. Model specification

We start by considering the production function of a given industry in the manufacturing sector as employing capital (K) and labor, which is in turn characterized by a combination of low-skilled (U) and high-skilled (H) workforce. In what follows, we assume that the aggregate production is represented by a Cobb-Douglas production function:

$$Y_t = F(K_t, U_t, H_t) \tag{1}$$

where the labor component can be represented using a constant elasticity of substitution (CES) function:

$$Y_t = K_t^{\alpha}[A_t^U (U_t)^{\rho} + A_t^H (H_t)^{\rho}]^{(1-\alpha)/\rho} \tag{2}$$

where α is the elasticity of substitution between capital and labor, and $\rho \leq 1$. The two parameters A_t^U and A_t^H are factor augmenting technology terms determining the productivity of the two categories of workers. $\sigma \equiv 1/(1-\rho)$ represents the elasticity of substitution between skilled and unskilled workers. Assuming $\sigma > 1$, skilled and unskilled workers are gross substitutes, whereas they complement each other when $\sigma < 1$.

Assuming labor market as being competitive and workers maximizing labor income (Acemoglu, 2002), wages must be set equal to their marginal products. After deriving (2) respect to skilled and unskilled labor, respectively, and combining the equations obtained as the marginal products of skilled and unskilled labor, the relative wage of skilled workers compared to unskilled can be represented as:

$$wage_{gap} = \frac{w_H}{w_U} = \left(\frac{A_t^H}{A_t^U}\right)^{\rho}\left(\frac{H_t}{L_t}\right)^{-(1-\rho)} = \left(\frac{A_t^H}{A_t^U}\right)^{(\sigma-1)/\sigma}\left(\frac{H_t}{L_t}\right)^{-1/\sigma} \quad (3)$$

Where the first term represents the technology level, whose increase has a positive impact on the wage gap, while the second term represents the relative endowments of labor between skilled and unskilled, which shows a negative relation between the wage gap and the supply of skilled labor.

In order to derive our model, we now need to make some assumptions on the two terms of (3). We explicitly consider technological change, assuming that it will imply a shift in the relative demand curve, showing that an increase in skilled workforce contributes to a rise in the wage gap (Acemoglu, 2002; Zhu and Trefler, 2005). We do this in our model by including variables related to the process of structural transformation within the manufacturing sector and to external liberalization policies. Within manufacturing structural transformation is defined here as the upgrading in the composition of production from lower to higher technology sectors. The theoretical assumption is that higher technology intensive sectors are those employing relatively more skilled workers compared to the others. We measure technological change in the manufacturing sector by means of different indicators related to the production process. The structural change in production is represented by relative share of the value added in higher-tech industries compared to the manufacturing total. An increase in the output of the technology intensive industries influences income distribution given that the adoption of advanced technologies embodied in such sectors pushes a rapid skill upgrading, which lead to greater inequality (Acemoglu, 2002). Technological change and the shift towards higher technology industries can also affect the distribution of income between capital and labor, reducing the relative share of the latter. Acemoglu (2002) develops a model showing that the increase in the adoption of advanced technology fosters the reallocation of K to skilled labor force, depressing the wages of unskilled workers.

A second group of factors affecting technology relates to the impact of external liberalization on income inequality. Following some recent literature, here we focus on liberalization policies (Taylor, 2000; Cornia, 2005; Aizenman et al., 2012; Chari et al., 2012; ADB, 2012). While policies related to trade openness have generally been meant to move production from the non-tradable to the tradable sector, replacing import substitution with comparative advantage enhancing policies (see Lin, 2011 for the case of China), opening the capital account aims at increasing financial flows with the aim of stimulating investment and productivity growth. Policies of openness to capital have become popular during the '90s, pushed by different motives, such as the need for external sources of finance to cover fiscal deficits or to attract foreign exchange to finance

imports (Taylor, 2000). The channels through which capital liberalization affects inequality 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 capital ratio over labor, which – 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 in a credit expansion, so that interest rates increase pushing exchange rate to an appreciation that depress the tradable sectors (Taylor, 2000; Cornia, 2005).

In addition, in our model we control for the relative endowment of labour, which is set to be affected by the level of education of the labour force, as suggested in some literature (Avalos and Savvides, 2006). Though the levels of education are an imperfect proxy of human capital (Lim and Tang, 2006), there is substantial evidence pointing out that inequality of education is a major determinant of income inequality given that returns to education are increasingly high (ADB, 2012; World Bank, 2012). As predicted from (3), in absence of technological change, an increase in the relative supply of skilled labour force should reduce the skill premium given that the demand side does not adjust accordingly.

4. Data, model specification and methodology

4.1 Data and model specification

Our 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 1963-2008. Data available from this database includes information on – among others – total wages, employment, capital, value added and production disaggregated at the 2-digit level of the International Standard Industrial Classification (ISIC) revision 2. Based on this classification, we have selected the industries classified as "medium-high" and "high" technology using the OECD definition according to their global technological intensity. For each of these industries, we have calculated our measure of wage inequality adopting the following approach:

$$wage\_gap_{i,x,t} = \frac{wage\_pc_{i,x,t}}{\sum_n wage\_pc_{i,t}}$$

where *i* denotes the country[4], *x* each of the medium and high tech industries[5] in the manufacturing, *n* all the low-tech manufacturing industries[6] and *t* the year.

[4] 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; Philippines; Indonesia and China.

[5] 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.

[6] In this group are included, 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.

Employing natural logarithms to transform (3) and developing the terms representing technological change and relative labor supply according to the above discussion, our final empirical specification is the following:

$$wage\_gap_{ix,t} = \alpha + \beta_1 output_{ix,t} + \beta_2 K\_E_{ix,t} + \beta_3 yedu_{i,t} + \beta_4 reer_{i,t} + \beta_5 kaopen_{i,t} + \varepsilon_{ix,t} \quad (4)$$

where α is a constant $\varepsilon_{ix,t}$ represents the error term, whose properties will be discussed later in this paragraph.

As discussed in paragraph 3, wage inequality is expected to be influenced by the structural change coefficient, represented by the relative importance of industry *x* production (*va*) compared to the manufacturing total as well as by 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 addition, we control the effects of external liberalization taking into account country-specific policies towards liberalization, namely the real effective exchange rate (*reer*) and the Chinn-Ito index (*kaopen*) measuring a country's degree of capital account openness (Chinn and Ito, 2008). In order to control for the relative supply of skill labor, we include a variable representing the effects of human capital endowments measured as the average numbers of years of education (*yedu*).

Table 2. 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 (2010)
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).

4.2 Methodology

As the methodology is concerned, having to deal with a macro panel poses a number of constraints to the adoption of standard estimators (Wooldridge, 2010; Cameroon and Trivedi, 2009). The first issue to be dealt with 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, 2008 for an overview). However, only few of these tests work with an unbalanced panel structure. We use a Fisher-type of 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 4. 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. For the variable representing openness to capital 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 3. Results after the Fisher type unit root test for panel data

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

Source: author's 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[7] (Greene, 2000) and find that we have to reject the null of homoscedasticity and adopt robust standard errors. 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[8], which cannot reject the null pointing thus to the absence of serial correlation in the error (Wooldridge, 2010; Drukker, 2003).

Different solutions exist to estimate (4). The emerging literature exploring 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 case of macro panels, through the properties of the latter make the former inefficient under different dimensions (see Eberhardt, 2012). 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, 2002; Cameroon and

[7] Test statistics (chi2=7.8e+26, p>chi2=0.0000) have been computed by means of the STATA command xttest3.

[8] Test statistics (F=0.034, p>F=0.8544) have been computed by means of the STATA command xtserial (Drukker, 2003).

Trivedi, 2009), while being also indicated to deal with unbalanced panels (Baltagi, 2008).

However, considering the complex structure of our data, whereas our unit of analysis – the countries – are 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 allow the 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 likelihoods 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 to more than one levels of analysis and are also applicable with longitudinal data (Rabe-Hesketh and Skrondal, 2008).
As our case is concerned, a linear multilevel can be represented in the following general form:

$$Y_{tix} = \alpha + \sum_{k=1}^{s} \beta_k Z_{tix} + \sum_{h=1}^{n} \beta_h X_{ti} + \mu_{ix} + \rho_x + \varepsilon_{ixt} \qquad (5)$$

where Y_{tix} 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 $\varepsilon_{ixt}$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 (5) we run a likelihood ratio test. Results of the test, reported in the result's tables, strongly refuse the null of no random intercept, suggesting the choice of a multilevel approach over standard estimators.

4.3 Regression Result

Table 4 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, it is possible to observe that the results are consistent across the different estimators adopted. Following the discussion on the methodology, for the rest of the paragraph we will concentrate our comments on the output of column (III) and subsequent.

Table 4. Regressions results, main model

	(I) OLS	(II) GLS	(III) Multilevel	(IV) Multilevel
va	0.0191***	0.0243***	0.0114***	
	[0.003]	[0.002]	[0.002]	
k_e	0.0368***	0.0418***	0.0228***	0.0279***
	[0.013]	[0.006]	[0.006]	[0.006]
yedu	-0.0215***	-0.0142***	-0.0117**	-0.0145***
	[0.006]	[0.004]	[0.005]	[0.005]
reer	0.0009***	0.0005***	0.0005**	0.0004*
	[0.000]	[0.000]	[0.000]	[0.000]
kaopen	-0.0483	-0.0286	-0.0206	-0.0128
	[0.031]	[0.018]	[0.021]	[0.022]
lab_prod				0.0001
				[0.001]
Constant	1.3483***	1.2737***	1.6116***	1.6375***
	[0.064]	[0.042]	[0.056]	[0.055]
Observations	1,220	1,220	1,220	1,214
R-squared	0.090			
LR-test (chi2)			488.83	523.76
			(0.0000)	(0.0000)

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

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. Also the coefficient referred to the capital per employee is consistently positive and statistically significant. Taken together, these results confirm that the process of structural change within the manufacturing can be associated to a rise of the wage premium due to the creation of new skilled jobs and the related greater demand for educated workers pushed by the increasing recourse to more advanced technologies and capital in such new industries. Indeed, the positive coefficient of the capital per employee ratio seems to confirm the complementarity between capital investment and the demand for more skilled labor.

Technological change can also affect the distribution of wages between skilled and unskilled workers by increasing labor productivity of industries employing a relatively larger share of the former group. In order to check this hypothesis, we test the impact of sectoral labor productivity in an additional specification reported in column (IV). The coefficient measuring labor productivity is found to marginally affect wage inequality, but it is not significant. As reported by McMillan and Rodrik (2011), structural change in Asian countries has contributed to rise between-sectors productivity levels which, in turn, contributed to foster economic growth much more than in other developing countries. One of the reasons why in presence of increases in labor productivity labor income lagged behind in Asia is due to the existence of large reserves of unskilled labor force from rural areas, which depress wages (ADB, 2012). This trend is nowadays reversing even in countries like China, whereas wages are

increasing even faster than productivity, also in labor-intensive industries (Li et al., 2012).

In line with the predictions of the theory, our results show also that human capital endowments, measured through the years of education, contribute to reduce wage inequality. Rising the levels of education allows in fact to match the greater demand for skilled workers. As a consequence, a greater supply of educated workers prevents the rise of skill premium allowing to take advantage from technological changes.

Moving to the impact of external liberalization 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 side, this supports the view that a competitive exchange rate (i.e. a decrease of reer) has favored the reduction of wage differential by promoting the exports of the labor-intensive sectors (Damill and Frenkel, 2012). On the other, it shows that countries who appreciated their exchange rates have incurred in a worsening in the wage gap. An appreciation of the exchange rate can have favored the import of capital and more sophisticated inputs from more advanced countries, thing that generally requires the recourse to higher skilled workforce (Cornia, 2005). 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 showed by figure 2 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. Next paragraph with specifically deal with these issues.

4.3.1 From policies to outcomes: 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 been found to have a significant effect on wage inequality whereas the variable measuring the openness to foreign capital has turned out to provide no relevant results.

As the latter variable is considered, we can assume that different kind capital inflows could generate different impact according to their nature. As reported in section 2 – 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 of the countries. In contrast, other capital flows such as portfolio investments are often considered as causing inequality since they are directed to activities not benefitting low-skilled workers. Moreover, sudden increases in short-term capital flows may also raise the risks of financial crises, whose distributional impacts are often inequality-enhancing (Cornia, 2005).

Moving to the trade channel, much literature has focused so far on the impact of trade liberalization on inequality (Attanasio et al., 2004; Wood, 1997). The Storper-Samuelson corollary of Hecksher-Ohlin theory of trade points out that opening up to foreign trade will lead to equalize the remuneration of factors of production, leading to an increase in wages for unskilled labor in developing countries. Evidence is inconclusive on this respect, also because some of the main assumptions of the model are hardly met in reality (Cornia, 2005). As a matter of fact, in most countries current account liberalization undertook a similar pattern. Slowly abandoning import substitution policies, quota restrictions have turned out in tariffs (Taylor, 2000). The experience of Asian success stories has been different to some extent, given that 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 inequality.[9] When current account opens up to external trade, the composition of local demand shifts towards imported goods, this effect being reinforced in presence of an exchange rate overvaluation. This may result in two kinds of effects. On the one side, imports raise competition in the modern sector of the economy, pushing firms to reorganize by improving labor productivity. This, as seen, contributes to an increase of the gap between skilled and unskilled workers, also because the latter group reduces its employment or moves to the informal sector. On the other side, greater openness could make imports of previously restricted capital-intensive investment goods (such as machineries and more sophisticated inputs) more convenient. Such "skill-enhancing" trade can in turn rise the demand for skilled workers and their wages relative to the unskilled (Avalos and Savvides, 2006; Cornia, 2005; Zhu and Trefler, 2005; Chari et al., 2012).

In light of such considerations, table 5 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 share of overall trade (export+import) on GDP, the latter computed directly at the industry *i* level combining historic NBER data from Feenstra et al. (2005) with UN Comtrade ones for the most recent years. Given that we cannot reject the null of unit root in the series, both variables are first differenced and so they must be considered as yearly changes in the relevance of external flows on GDP.

Overall, results show that even replacing policies with outcomes does not affect the behavior of common variables compared to table 4. So, results pointing out to the impact of structural change and education on wage inequality remain almost unchanged and will not be further discussed.

[9] 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).

Table 5. Regressions results, model incl. liberalization outcomes

	(I) OLS	(II) GLS	(III) Multilevel	(IV) Multilevel	(V) Multilevel
va	0.0154***	0.0189***	0.0059***	0.0080***	0.0047***
	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
k_e	0.0555***	0.0797***	0.0422***	0.0402***	0.0420***
	[0.018]	[0.008]	[0.007]	[0.007]	[0.007]
yedu	-0.0457***	-0.0349***	-0.0251***	-0.0307***	-0.0260***
	[0.006]	[0.004]	[0.005]	[0.005]	[0.004]
fdi_lia_gdp	-0.3046***	-0.2201***	-0.1981***	-0.1811***	-0.1811***
	[0.036]	[0.027]	[0.024]	[0.026]	[0.023]
port_lia_gdp	0.8043***	0.5517***	0.2962***	0.3174***	0.2311**
	[0.113]	[0.084]	[0.091]	[0.091]	[0.091]
open_gdp	0.2004	-0.1262	0.7670***		
	[0.258]	[0.197]	[0.196]		
m_gdp				0.0029	
				[0.004]	
x_gdp					0.0199***
					[0.003]
Constant	1.5991***	1.4626***	1.4675***	1.5200***	1.4836***
	[0.045]	[0.028]	[0.042]	[0.045]	[0.040]
Observations	1,043	1,043	1,043		
R-squared	0.157				

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Moving on to the new variables, contrary to table 4, we are now able to understand better the effects of capital openness on 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 hurt wage inequality. In contrast, the FDI coefficient is negative and statistically significant. As expected, especially in the case of many East Asian countries greatly involved in the international fragmentation of production, the large share of FDI in the manufacturing sectors has proved to be more "inclusive" in the sense that – even when targeted to higher technology industries – they have created a large demand for low or semi-skilled labor force involved in lower value-added activities within global value chains (GVCs).

Finally, we find that greater openness to trade has a positive effect on wage inequality at the industry level, contradicting thus provisions from the traditional trade theory. More detailed results are those obtained when distinguishing trade in its components. Additional results in columns (IV) and (V) show that both larger shares of exports and imports on GDP have a disequalizing impact on relative wages, with the former flow reporting a stronger and statistically significant coefficient. While in the case of imports, such result is consistent with theoretical assumptions quoted at the beginning of the paragraph and reinforces the results described for the exchange rate, the coefficient of exports can have a different explanation. We believe that the

positive coefficient of exports can provide an additional support to the hypothesis of the disequalizing impact of structural change. An increase of the relevance of higher technology sectors over total GDP can be understood in fact as a further sign of the rising relevance of such sectors in the domestic production system, with all the consequences on wage inequality as explained in previous sections.

4.3.2. Two different scenarios for China

To some extent, the development pattern followed by the Chinese economy shares some similarities with that of other East Asian economies. This is especially true when looking at the process of structural transformation in the manufacturing sector, whereas in the country low value added production is leaving space to more sophisticated output (Yu, 2012).

In light of this, we can make the assumption that in the years to come the country will undertake a similar trajectory in the relative wages between higher and lower technology intensive industries. In paragraph 2, we noticed however that East Asian economies followed two distinct patterns starting from mid-1990s, given that wage inequality increased in some countries, but it kept stable or even decreased in others.

In what follows, based on the results of our empirical analysis, we try to understand how trends in sectoral wage inequality can change in China over the next future. To do this, we build two different scenarios. In the best scenario, China will follow the same development path of Korea, Malaysia and Thailand. According to the worst scenario, the Chinese economy will follow the same path of the other East Asian countries included in our sample.

We implement a simple simulation in two different steps. In the first step we calculate the gap for all the variables (var_{gap}) used in the base model (retrieved from column 4 of table 4) between China ($var\ (china)$) and the average values of the same variables in the two different groups of countries ($\overline{var}\ (group_j)$) over the mid-2000s:

$$var_{gap_i} = \overline{var}_{\ i}(group_j) - var_i\ (china)_{\ i} \qquad (6)$$

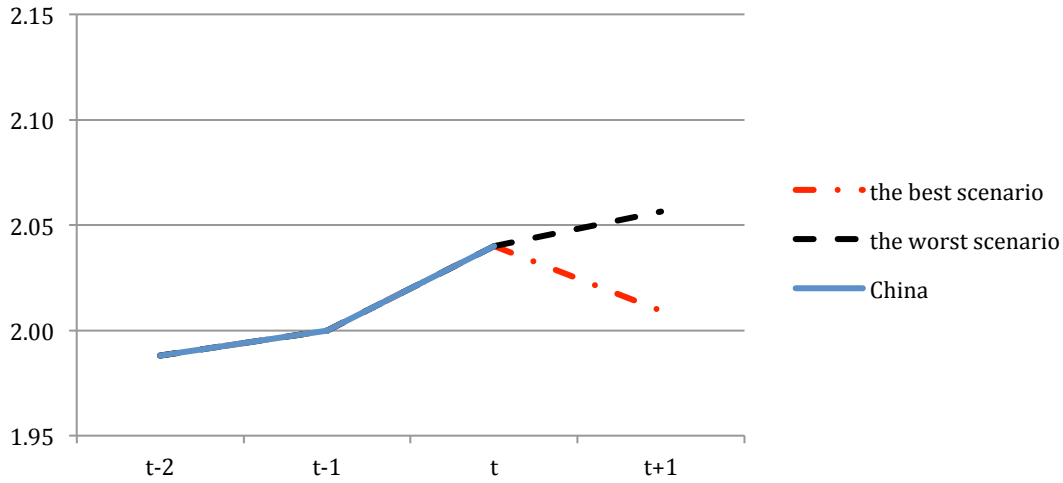
where the subscript *i* indicates the variables of model (4) and *j* the groups of countries. In order to get the predicted level of the wage premium ($wage\_gap$) - we multiply the gaps (var_{gap}) for the respective coefficients *(c)* for all the *i* variables included in the model:

$$wage\_gap_j = \sum_i\ var_{gap_i} * c_i \qquad (7)$$

Following this approach, we can now observe two different values for $wage\_gap_j$ in relation to the evolution of Chinese economy toward the worst or the best scenario. We are aware about the limitations of such a model concerning its simplified assumptions and considering that it ignores the labor market

conditions. Nonetheless, we can consider this model and the related simulation useful to understand the possible changes of the wage premium assuming no changes in the other conditions. The outcomes of (7) are depicted in Figure 3. If China was to follow the pattern of the worst performing countries, the wage gap will keep rising up steadily, while it would be kept under control according to the best scenario.

Figure 3. Evolution of the wage premium according two different scenarios



Such very simple simulation shows that polices could play an important role even though the process of structural change generates upward pressure on the skill premium.

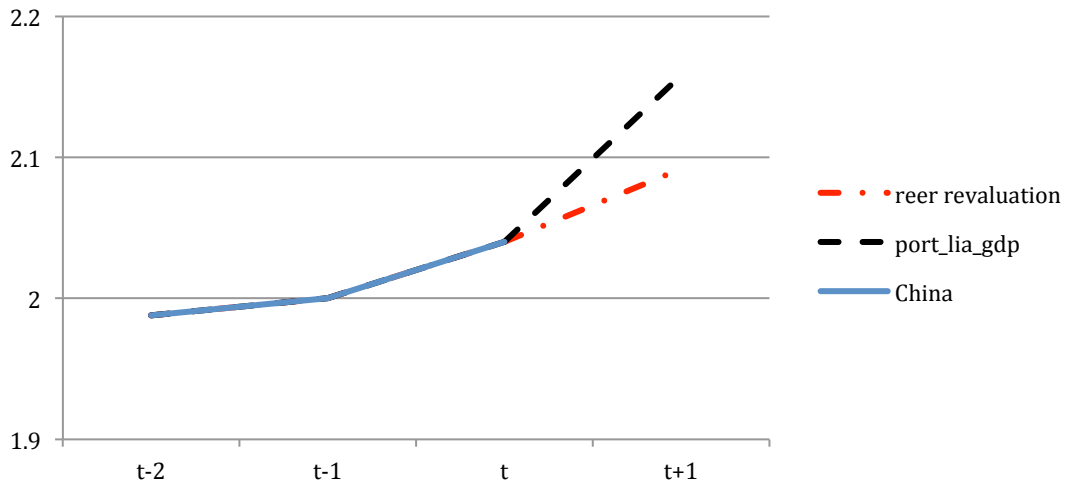
In order to understand better the likely impact of some of the relevant instruments discussed in the paper, in what follows we run a simple counterfactual analysis. To simulate the changes in the wage premium according to changes in specific factors, we make the simplistic hypothesis that it will evolve at the same rate of the previous year. To this trend, we then add the specific value due to a change in the policy variables:

$$wage\_pc_{t+1} = wage\_pc_t + (wage_{pc_t} - wage_{pc_{t-1}}) + policy\_change \quad (8)$$

For instance, while we have found that keeping a competitive exchange rate generally favors the reduction of wage differential between low and high skilled workers, we show that if China will accept a revaluation of the REER of about 30 points wage premium keeps on increasing – *ceteris paribus* - of about 5 per cent (Figure 4).

More dramatic will be the worsening of the wage inequality coefficient following to a greater openness of capital account related to the portfolio investment inflows. Wage premium will increase – *ceteris paribus* - of about 11 points if Chinese economy will double the level of portfolio investment inflows on GDP in the next years (Figure 4).

Figure 4. Evolution of the wage premium according two different scenarios: reer revaluation or capital openness



5. Conclusions

By 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 tries to explain why some East Asian countries performed better than others.

The paper shows that within manufacturing structural change – 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 sectoral wage inequality in the future.

This said, we find however that some countries have been able to mitigate such effect by means of education policies supporting the supply of labor force to the market and the good management of liberalization policies.

More specifically, the findings of our paper show that a considerable and sustained investment on education is crucial to boost economic development and also to reduce wage premium. Indeed, countries reaching an adequate supply of educated workers proved able to reduce the relative pressures on wage distribution generated by the increasing demand for skilled labor from advanced sectors.

In addition, we show that prudent management of openness related policy could be strategic in promoting developing without scarifying equity. Overall, one of the major findings of the paper is to confirm recent views suggesting that it is

possible to observe a reduction of inequality also under open economy conditions (Cornia, 2012).

Our results show that greater openness to trade contribute to increase the wage premium, contrary to provisions of the theoretical literature and to previous research on Asia (Wood, 1997). This notwithstanding, we showed that some countries that adopted a competitive exchange rate have favored the promotion of their low value added exports, thus avoiding further negative consequences in terms of wage distribution.

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 of the capital flows. Estimation results explain that wage inequality increased in countries that received large portfolio inflows during the recent years, while the same is not true when looking at FDI flows. The latter result confirms the view that in East Asia FDI in the manufacturing sectors has proved to be more "inclusive", creating a large demand for low or semi-skilled labor force.

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