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Integrated sectors - diversified earnings: the (missing) impact of offshoring on wages and wage convergence in the EU27

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Abstract

This paper assesses the impact of international outsourcing/offshoring practices on the process of wage equalization across manufacturing sectors in a sample of EU27 economies (1995-2009). We discriminate between heterogeneous wage effects on different skill categories of workers (low, medium and high skill). The main focus is on the labour market outcomes of vertical integration, so we augment a model of conditional wage convergence through the inclusion of sector-specific broad and narrow outsourcing/offshoring indices based on input-output data (World Input Output Database, April 2012 release). Two-way relations between trade and wages are addressed through the use of a gravity-based sector-level instrument. We find no evidence supporting unconditional skill-specific wage convergence in EU sectors. In a conditional setting, (slow) wage convergence takes place, but international outsourcing plays no role in wage equalization. Even though regression results indicate that offshoring reduces the wage growth of domestic medium- and low-skilled workers, we show that this negative effect is economically insignificant.

JEL: F14, F16, F66, C67

Keywords: wage, convergence, international outsourcing, offshoring, input-output

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1 Introduction

Despite the ongoing process of integration and the (unrealized) hopes of less developed EU members to catch up quickly with the living standards of Western European countries, wage differentials within the European Union are still very high. In 2011, average annual net earnings in the EU varied from around 1,698 euros in Bulgaria to almost 21,000 euros in Luxembourg (corresponding respectively to approximately 3,440 and 16,942 euros in PPS terms).[1] In 2009 the wages of low-skilled workers in manufacturing (with only primary education) ranged from only 13% of the EU27 average in Bulgaria to 221% in Belgium. Similar wage disparity also affects better educated workers, for instance the high-skilled (tertiary education) wage ranged between 17% (Bulgaria) and 212% (Germany) of the EU27 average. The largest wage dispersion is observed in traditional sectors – manufacturing, textiles, leather and footwear.[2] Hence, from the welfare point of view it is clear that the wage convergence process in the EU has not yet come to an end and, given the EU cohesion target, the question is still of great policy relevance.

Looking at the supply side, wages and salaries are the predominant component (ranging from 66% in Belgium to 87% in Denmark[3]) of the total expenditures born by European employers for the purpose of employing staff. Thus, cross-country wage dispersion directly influences the differences in total labour costs across the EU. Labour cost differentials, combined with a high degree of market and political integration between the 'old' and 'new' member states have stimulated new channels of international outsourcing/offshoring[4] across Europe (Baldone et al., 2001; Egger, 2006; Egger and Egger, 2002; Marin, 2006), exactly in the

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[1] Data from Eurostat

[2] Data refer to the average sectoral labour compensation per hour worked (authors' calculations with data from WIOD, 2012). Additionally, Magda et al. (2011) provide micro-based evidence on the existence of substantial differences in earnings across sectors in Eastern European countries compared to the Western European states analyzed, even when controlling for a wide range of employee, job and employer characteristics.

[3] The latest available observations (2011) from Eurostat.

[4] In the literature several names (outsourcing, de-localization, fragmentation, vertical specialization, slicing the value chain, production sharing) have been used to describe the increasing importance of the "geographic separation of activities involved in producing a good (or service) across two or more countries" (Feenstra and Hanson, 2001, p.1). We use the terms 'international outsourcing' and 'offshoring' interchangeably.

same way as elsewhere in the world (Feenstra, 2010*)*. We document that offshoring in EU27 manufacturing rose from 26% of value added in 1995 to 42% in 2008[5], when the effects of the crisis were about to appear.

Most of the related literature focuses on the consequences of the cross-border disintegration of the production process for wage differentials across skill groups (skilled/unskilled wage ratio, wage bill – among others, Feenstra and Hanson, 1996, 2001; Acemoglu and Autor, 2011; Egger and Stehrer, 2003). Our point is different: we ask how offshoring tendencies affect the *diversity* of the sectoral earnings of a given skill group across European countries. Consequently, the main aim of this paper is to assess the impact of international outsourcing practices on the process of wage equalization across EU sectors - we focus on the impact of offshoring on the conditional wage convergence mechanism.

Economic theory offers alternative views on the international fragmentation-wages nexus. The traditional explanation based on the Hecksher-Ohlin theory predicted that international trade in goods naturally leads to factor price equalisation in general, and wage convergence in particular. However, ambiguous effects of trade in parts and components on wages and the factor price equalisation mechanism are present in a large number of models. Already in the 1990s, Jones and Kierzkowski (1990, 1998) showed that offshoring can be thought of as technological progress[6] with very complex effects and the possibility of an 'anti-Stolper-Samuelson effect'. The possibility of non-factor price equalisation and factor convergence *or* divergence is present in many models of offshoring, e.g. those by Deardorff (2001), Venables (1999), Kohler (2004), Markusen (2005) and Grossman and Rossi-Hansberg (2008). Offshoring need not produce obvious winners and losers (typically perceived to be low-skilled labourers in the West hurt by trade with less developed countries – as argued by Wood,

[5] Broad offshoring with respect to value added of the domestic sector (eq.2), weighted average across 13 manufacturing sectors listed in Table 2A; authors' calculations with data from WIOD (2012).
[6] Acemoglu et al. (2012) introduce directed technological change into a Ricardian model of offshoring and show that offshoring and technical change are substitutes in the short run but complements in the long run. Consequently, unskilled labourers can either see their wages either rise or fall.

1995 and others[7]) and workers whose jobs are lost as a result of international outsourcing can also gain. In particular, recent theoretical models view offshoring as trade in tasks (among others, Grossman and Rossi-Hansberg, 2008; 2012; Baldwin and Robert-Nicoud, 2010), producing rather complex effects on the wages of workers of differing (skill) type, especially the low-skilled[8]. In sum, it is evident that, according to alternative models and their underlying assumptions, offshoring can either decrease or increase domestic wages and the problem of international wage equalization is instead an empirical question to be answered with the use of real data.

The theoretical basis of our analysis draws on the canonical model of wage differentials across skills (Acemoglu and Autor, 2011) combined with the literature incorporating heterogeneous workers into models of international trade and the global integration of value chains (surveyed in Grossman, 2013). In the empirical part of this paper, we extend a traditional estimation of the wage convergence equation, performed with aggregate earnings, and consider wage patterns by skill category. Therefore, our paper is naturally strongly linked to the empirical literature on real convergence. Following the huge wave of research on that topic in the 1980s and 1990s[9], the focus was mainly on the cross-country convergence of income per capita (or productivity) levels, with the "iron-law" beta convergence rate being found to be approx. 2% per year (see the discussion on the current state of the debate in Barro, 2012). The general conclusion is that the process of convergence is far from automatic: it is conditional on specific countries' characteristics, policies and institutional setting. Global differences between developed

[7] Along these lines, in a widely-cited paper Feenstra and Hanson (1999) argue than outsourcing significantly lowers the cost share of production labour in the US. Interesting micro-level evidence on low-skill workers losing, in terms of wages, as a result of outsourcing is provided in a study on Germany by Geishecker and Görg (2008). They find that a 1 p.p. increase in outsourcing reduces the wage in the lowest skill category by up to 1.5% (high-skill wages rise). Similarly, Hummels et al. (2011) in a Denmark-specific micro-level study find that offshoring tends to decrease the low skilled-wage (by 1.6%) and increase the high-skilled wages (by 3.6%).

[8] Grossman and Rossi-Hansberg (2008) show that 'the effect of offshoring on low-skill wages depends on interplay between the 'productivity effect,' the 'relative price effect,' and the 'labour supply effect'. The final outcome concerning low-skill workers in the 'West' in particular is ambiguous and depends on the intensity of offshoring. A similar effect is found by Acemoglu et al. (2012).

[9] The most-cited works include (among others): Baumol (1986), De Long (1988), Barro (1991), Barro et al. (1991), Barro and Sala-i-Martin (1992).

and developing countries, despite rapid growth episodes in some parts of the world (China, India), are likely to continue (Rodrik, 2011).[10]

The literature on *wage* convergence mechanisms is much scarcer. In the specific case of Europe, which is our main interest,[11] it seems that despite a documented rise in offshoring practices (Baldone et al., 2001; Marin, 2006; Schwörer, 2013), its link with a cross-border wage convergence mechanism has not been fully explored. In the past, studies of the EU15 economies (or subsamples of them) focused mainly on the effects of the common market, trade integration and the common currency on factor price equalization and did not reach a common conclusion in terms of wage/labour cost convergence (Tovias, 1982; Andersen et al., 2000, Mora et al, 2005[12] – see the survey in Ramskogler, 2010, 2012, which documents the state of wage convergence in the EMU and the role of Germany as a transnational wage leader). Very few studies take into account the New Member States and industry-specific wage developments.

Our analysis is closer to those few existing contributions which are limited in country cover and/or time span on the wage equalization observed in the enlarged EU context at the industry level.[13] Egger (2006) draws on data on real monthly wages in 14 NACE 2-digit manufacturing industries and concludes that outsourcing fosters the sigma convergence[14] of industry-specific wages and limits cross-country differences at the industry level. Egger and Pfaffermayr (2004) reject the hypothesis of unconditional beta wage convergence both within the EU and in five central and eastern European countries (CEEC)s in the years 1993-2000, but support the

[10] Rodrik (2013), using data on a large sample of over 100 countries over four decades, documents that, unlike economies as a whole, manufacturing industries exhibit strong unconditional convergence in labour productivity. However, despite strong convergence within manufacturing, aggregate convergence does not take place due to the small share of manufacturing employment in low-income countries and the slow pace of industrialization.

[11] Given the scope of our paper, we leave aside the literature on price convergence (Fischer, 2012; Wolszczak-Derlacz, 2010).

[12] In particular, Mora et al. (2005) conclude that in the case of Euro-area countries analyzed between 1981 and 2001 a reduction in the dispersion of nominal wages and unit labour costs is observed, but convergence did not take place either in terms of productivity or real wages.

[13] In general, most studies on transition economies focus on aspects loosely related to our research, e.g. the effects of foreign direct investment and trade on wages (Egger and Egger, 2002; Onaran and Stockhammer, 2008; Polgár and Wörz, 2010) or the wage-bill and skill premiums (Egger and Stehrer, 2003; Esposito and Stehrer, 2009).

[14] While beta convergence focuses on the negative relationship between the initial level of the variable of interest and its subsequent pace of growth, sigma convergence analysis measures changes in the degree of dispersion of income or wages, according to the subject of analysis.

hypothesis of international (cross-country) factor price equalization as a result of outsourcing practices.

To the best of our knowledge, there is no up-to-date sector-level study that takes into account a wide set of both old and new EU member states and simultaneously analyses the effects of international outsourcing on wage convergence patterns considering different skill groups of workers. Hence, we contribute to the existing literature in several ways. First of all, this is likely to be the first study to examine the effect of offshoring on sectoral earning in such a wide sample of EU countries over a time span long enough to capture the effects of East-West integration from the European Agreements to the economic crisis (2008-2009). Our empirical analysis is based on a sector-level database which links trade and labour market data for 13 manufacturing sectors for *all* the EU27 economies (both old and new member states) for the years 1995-2009. Secondly, we discriminate between heterogeneous responses of different skill categories of workers (low, medium and high skill). The main focus is on the labour market outcomes of vertical integration (offshoring), so we augment a dynamic model of unconditional wage convergence by including sector-specific offshoring indices. An important contribution is the fact that by using recent international input-output statistics (WIOD – World Input Output Database, release April 2012) we are able to construct precise, sector-level measures of outsourcing (broad and narrow) for both the EU15 and the new member states. Additionally, we compare the effects of international outsourcing (offshoring) with national outsourcing. Finally, two-way relations between trade and wages and the resulting endogeneity issues are addressed by means of a GMM system estimator and the use of a gravity-based sector-level instrument for offshoring indices. Our basic results are supported by a set of robustness checks.

The rest of the paper is structured as follows. In Section 2, we present the data and some descriptive statistics on wage differentials and outsourcing patterns emerging in our sample. In Section 3, we present a simple theoretical framework of the model and its empirical specification (a dynamic model of sector-level wage convergence). Next, in Section 4, we provide the results of the estimation, revealing the effects of outsourcing on the evolution of the wage conditions of workers with various skill levels. Finally, Section 5 concludes.

2 Empirical setting

2.1 Data and measurement

Specifically for the purposes of this study we construct a sector-level database matching labour market data with outsourcing and offshoring measures at the level of single sectors observed in the years 1995-2009. Our analysis takes into account 27 EU countries (Table 1A in the Appendix) and 13 manufacturing sectors (Table 2A in the Appendix)[15]

We draw mainly on industry-specific data that has been recently made available from The World Input Output Database (WIOD)[16] (April 2012 release - see Timmer et al. 2012 for an overview; we also take into account the March 2013 update). This provides a set of harmonized supply and use tables, alongside data on international trade in goods and services, integrated into sets of intercountry input-output tables[17] which can be matched with socio-economic indicators. We use WIOD's Socio-Economic Accounts to obtain statistics on labour remuneration and hours worked to calculate the wages per hour of different categories of workers. WIOD provides data for three groups (high-, medium- and low-skill labour).[18]

For some countries, nominal variables are originally expressed in national currencies. Thus we use the bilateral exchange rates from the Penn World Table (PWT 7.1) to put all wages into dollars, and the CPI from the World Bank to report all nominal values in constant terms

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[15] Theoretically, WIOD provides data for 35 industries. We concentrate on the manufacturing sectors, excluding services (where several of the statistics are based on extrapolations and are very noisy) and the sector "Coke, Refined Petroleum And Nuclear Fuel" (code 23) which is highly dependent on resource abundance and is an outlier (in terms of very low levels of value added which for some of the countries leads to extremely high outsourcing intensity).
[16] WIOD provides an update and a substantial extension of the EU KLEMS database.
[17] The construction of the world input-output tables in WIOD is described in Dietzenbacher et al. (2013).
[18] Skills are defined here on the basis of educational attainment. High skill corresponds to academic education, medium skill to upper secondary education and low skill to primary education.

(2009=100). In addition, we also calculate wages expressed in purchasing power (using PPP indices from PWT 7.1).

The construction of precise measures of offshoring was possible with the use of the World Input-Output Tables – WIOT (which are a part of WIOD; see Dietzenbacher et al., 2013 for an application). We adopt the division into narrow and broad international outsourcing (Feenstra and Hanson, 1999) and compute the measures based on the input-output tables by following the definitions in Hijzen and Swaim (2007). Intra-industry offshoring ('narrow' international outsourcing) measures the share of imported intermediate inputs from the same industry in terms of industry added value. Formally, narrow offshoring for sector *j* (we suppress the country and time subscripts for simplicity) is computed as:

$$IntOUT_j^N = \frac{I_{k=j}}{VA_j}, \tag{1}$$

where *I* refers to imported intermediate purchases from foreign industry *k=j* by domestic industry *j* and *VA* denotes the value added. Inter-industry offshoring ('broad' international outsourcing) is given by the ratio of imported intermediate purchases by industry *j* from all industries *k* other than *j* to the added value:

$$IntOUT_j^B = \frac{\sum_{k=1}^{K} I_{k \neq j}}{VA_j}. \tag{2}$$

In both cases (1) and (2) we consider imported intermediates from the whole world (global offshoring)[19].

Additionally, for comparison, by using national input-output tables we compute analogous measures of domestic narrow and broad outsourcing ($DomOUT_j^N$ and $DomOUT_j^B$

[19] The World Input-Output Tables (WIOT) provide separate data on the supply of intermediates imported from 40 countries and the rest of the world (RoW), so we are able to account for global offshoring practices. These 40 countries encompass the 27 EU countries, Australia, Brazil, Canada, China, India, Indonesia, Japan, Korea, Mexico, Russia, Taiwan, Turkey and the US). A restriction to European offshoring (encompassing imports of intermediates from manufacturing sectors located in EU27 countries only) is provided in one of our robustness checks.

respectively). These consider only inputs coming from and used in home sectors (and thus account for flows of intermediates within one country).

In order to build gravity-based instrument for trade variables (described below) we draw on bilateral sector-level trade data from the WIOD combined with gravity variables from the CEPII.[20]

2.2. Descriptive evidence on wage and outsourcing patterns in EU27 countries

Figure 1 illustrates the presence of huge wage differentials in manufacturing across the EU27 countries, which are typical for all skill categories in the labour force. For instance, the typical hourly wage of low-skilled workers in 2009 (the last year for which we have the data) ranged between only 13% of the EU27 average in Bulgaria to 221% in Belgium. These huge wage differentials not only concern the low skilled; they are typical also for medium- and high-skill workers. Unsurprisingly, wages are highest in rich Western European economies such as Germany, Benelux or the Scandinavian countries, while they are the lowest in new member states from Central and Eastern Europe.

In terms of the degree of wage inequality within each skill group category, the variation in wages in the EU27 is the highest in the case of workers with only primary education and the lowest in the case of those with completed tertiary education (Figure 2). In terms of evolution over time, the changes are relatively negligible (a slight decrease in the standard deviation of wages took place between 2003 and 2008).

[20] The CEPII provides the data for the period 1948-2006. We have updated the series concerning time-varying variables (eg. common currency or trade agreements) for the years 2007-2009. See Head and Mayer (2013) for the details on the gravity procedure and Santos Silva and Tenreyro (2006) for a discussion of alternative estimators in the gravity equation estimation.

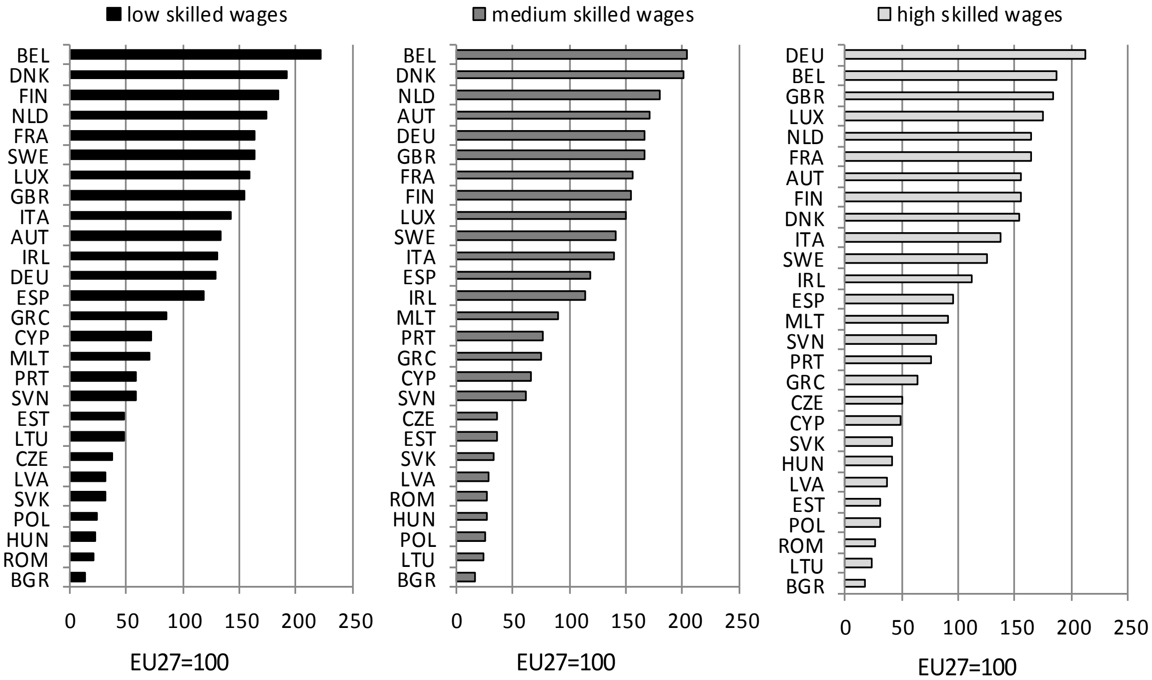

Figure 1. Cross-country differences in average wages in manufacturing sectors, by skill type, EU27=100, 2009
Note: Weighted averages across 13 manufacturing sectors in single EU27 countries; weights correspond to sector size (employment).
Source: own elaboration with socioeconomic accounts data from WIOD (2012).

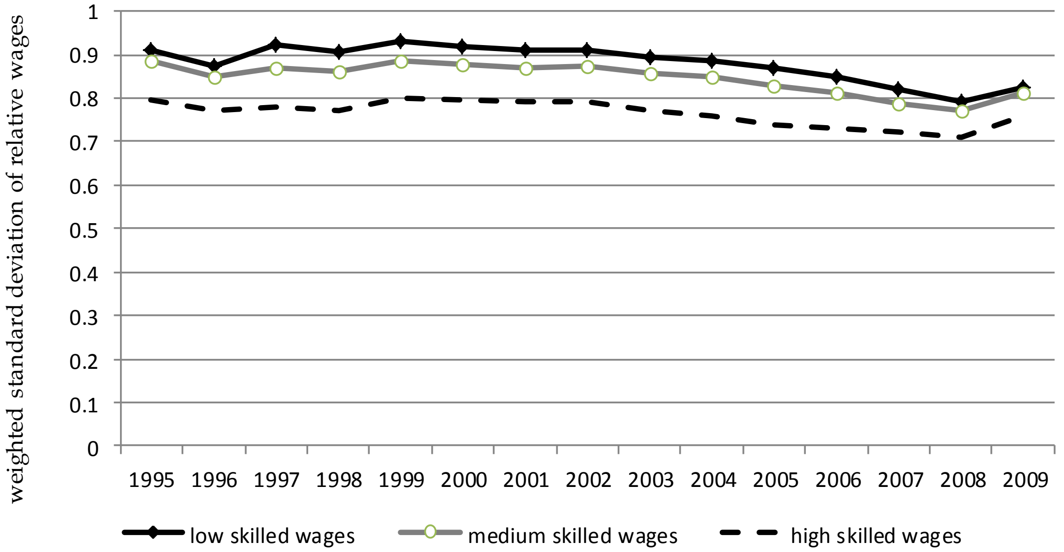

Figure 2. Dispersion of relative wages (EU27=100) across manufacturing sectors in EU27 countries, by skill type, 1995-2009
Note: Weighted standard deviation of relative wages across EU27 countries and 13 manufacturing sectors; weights correspond to sector size (employment).
Source: own elaboration with socioeconomic accounts data from WIOD (2012).

We further investigate the manufacturing sector in which the disparity of earnings is the highest. It turns out (Figure 3) that the greatest degree of wage inequality across the EU27 is to be found in traditional sectors such as the manufacturing of leather and footwear or textiles. This pattern is common for all skill types.

Figure 3. Inequality of relative wages (EU27=100) within manufacturing sectors across EU27 countries, by skill type, 2009
Note: Weights correspond to sector size (employment).
Codes: Sectors as in Table 2A in Appendix.
Source: own elaboration with socioeconomic accounts data from WIOD (2012).

Hence, the picture that emerges from these descriptive statistics proves the presence of significant and somewhat persistent wage differentials in EU27 manufacturing. We are interested in seeing if wage patterns are in any way influenced by fragmentation of the production process. Indeed, in the period of analysis offshoring practices (Figure 4) increased substantially: when measured in the broad sense (eq. 2), the ratio of globally imported intermediate inputs to the value added rose from 26% in 1995 to 42% in 2008 (subsequently a drop was registered due to the global crisis). Figures for narrow offshoring (eq.1) are slightly lower (21% in 1995 to 37% in 2009). In the case of domestic outsourcing (Figure 5), narrow outsourcing was fairly constant and there was a rise only in broad domestic outsourcing practices.

Figure 4. Trends in offshoring. in manufacturing, EU27, 1995-2009

Note: International outsourcing (offshoring) measured as a ratio of globally imported intermediate inputs to the value added (exact formulas in the text). Weighted averages across 13 manufacturing sectors in single EU27 countries; weights correspond to sector size (employment).
Source: own elaboration with input-output data from WIOD (2012)

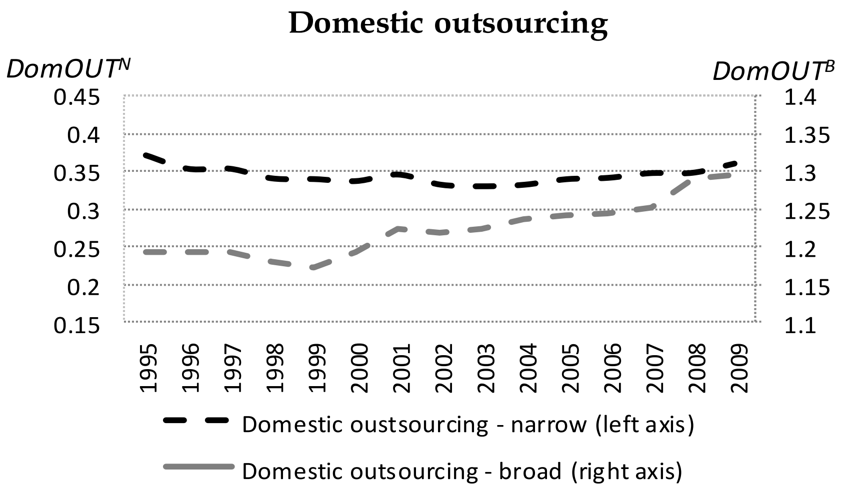

Figure 5. Trends in domestic outsourcing in manufacturing, EU27, 1995-2009

Note: Domestic outsourcing measured as a ratio of domestically outsourced intermediate inputs to the value added (exact formulas in the text). Weighted averages across 13 manufacturing sectors in single EU27 countries; weights correspond to sector size (employment).
Source: own elaboration with input-output data from WIOD (2012)

3 Skill-specific wage convergence model

3.1 Theoretical framework

In order to provide a theoretical framework for the empirical convergence analysis of wage patterns in the presence of worker heterogeneity, we first derive an analytical expression which defines the main determinants of the wages of different skill groups. We will consider the 'Ricardian model' of the labour market (Acemoglu and Autor, 2011, pp. 45-83), which is an extension of the 'canonical model' used in the labour economics literature and which allows for trade in tasks, as in the recent theories of offshoring reviewed in the introduction. Such an approach emphasizes the role of technologies replacing tasks previously performed by labour and the similar role played by offshoring. As factors of production, there are three types of labour – high- (*h*) , medium- (*m*) and low-skilled (*l*) workers (with inelastic labour supplies Lab_h, Lab_m and Lab_l, respectively) – and capital/technology embedded in machines (*K*). The allocation of skills to tasks is such that workers of the same skill level can perform different tasks, but in equilibrium they receive the same wage ("law of one price"). Wage levels can be obtained as the values of marginal products of different types of skills (for an exact exposition, see Acemoglu and Autor, 2011, pp. 50), and consequently we can express the wages of different skill groups as functions of their productivity (*A*), the labour supply (*Lab*) and a task allocation term (*I*)[21]: $W_h = f(A_h, Lab_h, I_h)$, $W_m = f(A_m, Lab_m, I_h, I_l)$, $W_l = f(A_l, Lab_l, I_l)$. Importantly, this framework allows us to analyze the wage implications of international outsourcing practices[22], "offshoring" tasks to countries where they can be performed at lower cost, which is modelled through changes

[21] All tasks $i<I_l$ are performed by low-skilled workers, $i>I_h$ are performed by high-skilled workers and intermediate tasks are performed by middle-skilled workers ($0<I_l<I_h<1$).

[22] Given the theme of our paper, we focus on the effects of offshoring on wage structure. Of course, the model can be used to derive predictions of the implications of task-replacing technologies (embodied in machines), directly displacing workers from tasks they were previously performing. See Acemoglu and Autor (2011, 62-69) for the details concerning changes in relative wages after the introduction of machines substituting workers and performing a part of the task range.

in the thresholds [I_l ,I_h], which are a function of outsourcing opportunities: I_s = *f(OUT)*, *s*={*h,m,l*}[23].

In sum, in the light of task-based theory, labour supply (Lab_s), technological change (capital/machines replacing skills, *K*) and trading opportunities (outsourcing intensity *OUT*) will affect wages. These implications guide the choice of the basic factors to be considered in the sector-level and skill-specific model of wage determination to be estimated.[24] Consequently, concerning the domestic sector, we can express the wages of different categories of workers as a function:

$$W_{sjt} = f\left(K_{jt}, LAB_{sjt}, OUT_{jt}\right) \quad \vee s = \{h, m, l\} \ , \tag{3}$$

and similarly in the foreign (*) sector:

$$W^*_{sjt} = f\left(K^*_{jt}, LAB^*_{sjt}, OUT^*_{jt}\right) \quad \vee s = \{h, m, l\} \ , \tag{4}$$

where *s*-={*h,m,l*} refers to the skill type, *j* denotes sector and *t* time (country subscripts are omitted), *K* denotes the capital to labour ratio, LAB_s measures the abundance of each type of workers and *OUT* indicates outsourcing intensity and captures the proportion of tasks performed abroad[25].

Combining (3) and (4) into a relative wage, we get the expression for the sector-level domestic/foreign (*) wage differential:

$$\frac{W_{sjt}}{W^*_{sjt}} = f\left(\frac{K_{jt}}{K^*_{jt}}, \frac{LAB_{sjt}}{LAB^*_{sjt}}, \frac{OUT_{sjt}}{OUT^*_{sjt}}\right) \vee s = \{h, m, l\} \tag{5}$$

3.2. Empirical specification of the wage convergence model

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[23] For instance, if the tasks in the range $\left[I^{'}, I^{''}\right] \subset \left[I_l, I_h\right]$ are now offshored, then high-skilled workers are likely to benefit at the expense of medium- and low-skilled ones.

[24] Not all the terms are directly observable, i.e. the absence of direct information on A_h ,A_m ,A_l can be an obstacle, but they are all sector-specific and thus indirectly depend on K. Additionally, following Acemoglu and Autor (2011) and Tinbergen's hypothesis we assume a log-linear increase in the demand for skills *over time* coming from technology, which will be captured by the introduction of appropriate dummies into the model.

[25] We are aware that wages are highly likely to be higher in sectors with higher productivity but this cannot be introduced directly into the empirical model as it is collinear with the capital to labour ratio. The correlation coefficient between value added per hour worked and K equals 0.77.

Being particularly interested in sector-level wage differentials across EU countries, we calculate relative hourly wages with respect to the EU27 average value (so that * in eq.5 corresponds to EU27). Thus for each country *i*, sector *j*, time period *t* and skill category *s,* relative wages are expressed as the ratio:

$$w_{sijt} = \frac{W_{sijt}}{W_{sjt}^{EU27}} \vee s = \{h, m, l\}. \quad (6)$$

The real hourly wages are calculated as labour remuneration divided by hours worked, deflated with the CPI and converted to 2009 USD.[26]

The real convergence literature (Barro and Sala-i-Martin, 2004) provides a basic framework where the growth rates of the variable of interest (here: relative wages) are related to their past realizations and, if beta convergence takes place, the growth rate of the dependent variable is negatively related to its lagged levels. In order to test the absolute convergence hypothesis, the following regression is estimated:

$$\Delta \ln w_{sijt} = \alpha + \beta \ln w_{sijt-1} + u_{ijt} \vee s = \{h, m, l\}, \quad (7)$$

where $\Delta \ln w_{sijt}$ is the first difference of the log wage differential defined in equation (6) and approximates wage growth. The estimated coefficient of the lagged wage differential (β) is the indicator of the convergence process. The speed of convergence is calculated as $\lambda = -ln(1+\beta)$ and its 'half-life,' which indicates the period needed for half of the dispersion to disappear, according to the formula: $t_{1/2} = \frac{ln(0.5)}{ln(1+\beta)}$[27].

Combining (7) with the subtraction of log-linearized versions of eqs. (3) and (4) yields an augmented empirical model of relative (vis-à-vis the EU27 average) wage convergence to be estimated with sector-level data:

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[26] To calculate real hourly wages in one common currency we follow the procedure used by the OECD: first deflating the series with CPI(2009) = 100, and then converting into a common currency using the USD exchange rate from 2009.

[27] Equation (10) can clearly be rewritten in terms of the wage levels:
$\ln w_{sij,t} = \alpha + (1-\beta) \ln w_{sij,t-1} + u_{ij,t}$

$$\Delta \ln w_{sijt} = \alpha + \beta \ln w_{sijt-1} + \gamma_1 \ln(k)_{ijt} + \gamma_2 \ln(lab)_{sijt} + \gamma_3 \ln(out)_{ijt} + D_{ij} + D_t + \varepsilon_{ijt} \quad \vee s = \{h, m, l\} \tag{8}$$

where i denotes home country, j refers to sector, t to time period, s denotes skill group and *out* refers to the whole set of domestic and international outsourcing measures ($DomOut^{N}$, $DomOut^{B}$, $IntOut^{N}$, $IntOut^{B}$) described in Section 2.1. The small letters indicate that all variables are expressed in relation to the EU27 average (log differences), analogously to eq. (6).

Finally, we also consider an augmented specification with an interaction term between offshoring and lagged wages:

$$\begin{aligned}\Delta \ln w_{sijt} &= \alpha + \beta \ln w_{sijt-1} + \gamma_1 \ln(k)_{ijt} + \gamma_2 \ln(lab)_{sijt} + \gamma_3 \ln(out)_{ijt} + \\ &+ \gamma_4 \left(\ln(out)_{ijt} \times \ln w_{sijt-1}\right) + D_{ij} + D_t + \varepsilon_{ijt} \qquad \vee s = \{h, m, l\}\end{aligned} \tag{9}$$

In eq. (9) the impact of offshoring on wages is assessed in two ways: by estimating its long-term impact on the growth of wage differentials (γ_3)[28], i.e. the influence of offshoring on the steady states; and by analyzing the coefficient of the interaction term (γ_4), which measures the effect of offshoring intensity on the persistence parameter - the speed of convergence.[29]

4 Results

4.1. Unconditional vs conditional wage convergence – prima facie evidence

Given that wage differentials in EU27 manufacturing seem to be very persistent (Section 2.2), the next step is to verify whether the process of wage convergence takes place. In Figure 6 we show a comparison between a graphical representation of absolute (unconditional) wage convergence (dashed lines) and partial residuals plots (solid lines) showing the relationship between the independent variable of the convergence model (here: lagged wage levels) and the

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[28] The parameter γ_3 in Eqs. (8) and (9) is obtained as the first partial derivative of Δw_{ijt} with respect to out_{ijt}: $\partial \Delta w_{sijt} / \partial out_{ijt}$.

[29] The formal interpretation of γ_4 in Eq. (9) is the following: it is the second partial derivative of Δw_{ijt} with respect to out_{ijt} and w_{ijt-1} $\partial^2 \Delta w_{sij,t} / \partial out_{ijt} \partial w_{ijt-1}$, so that the speed of convergence is calculated now as $\lambda = -\ln(1 + \beta + \gamma_4 \times \overline{out_{ij}})$.

response variable (here: wage growth), given that other independent variables are also taken into account. As additional covariates, we consider factors present in model (8): the relative capital to labour ratio, the relative supply of each type of labour and (as our main interest is the impact of offshoring practices on wages) the international outsourcing intensity.[30] If absolute wage convergence takes place, then we should obtain a negative relationship between the growth of wages and their lagged levels, corresponding to model (7). However, for all skill categories, this relationship is very weak (Figure 6, dashed lines) and we can surmise that absolute convergence does not take place in our sample of EU countries. On the contrary, conditional convergence is much more pronounced (Figure 6, solid lines).

[30] Here we employ the broad measure of offshoring ($IntOUT^{B}$). However, the figures are very similar when the narrow one ($IntOUT^{N}$) is used and when we consider domestic outsourcing.

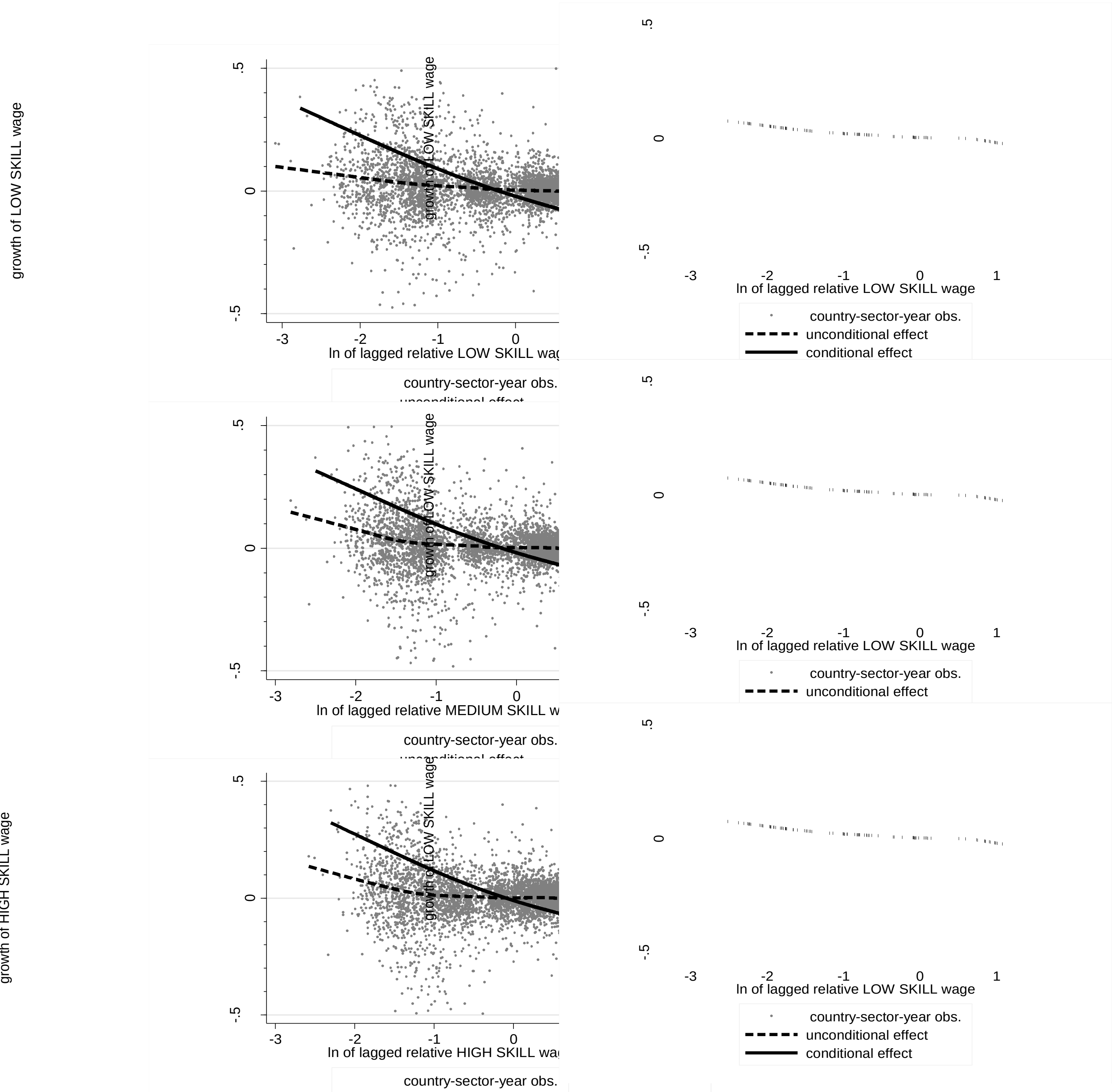

Figure 6. Comparison of absolute (unconditional) and conditional wage convergence patterns, by skill group (manufacturing sectors, EU27, 1995-2009)

Note: the dashed line corresponds to model (7); the solid line refers to partial residuals obtained with model (8) with additional covariates (capital, skill supply, international outsourcing - broad); country, sector and time dummies included in all specifications; all variables in natural logs and with respect to the EU27 average. Regressions weighted by sector size.

4.2. Estimation results

The next tasks are: *(i)* to check the statistical significance of the conditional wage convergence pattern for different types of workers, given the endogeneity in the model; *(ii)* to disentangle the wage growth effects and wage convergence effects, *(iii)* to evaluate the impact of alternative outsourcing types on wage growth and convergence, and assess the magnitude of the effect and its economic significance.

4.2.1 Specification

We are aware that some endogeneity problems may arise with our model. First, due to the inclusion of the lagged wage as an independent variable, either the pooled OLS or the fixed effects will be biased[31]. Additionally, we do not expect wages and capital to be strictly exogenous (Blundell and Bond, 1998). To ensure statistical accuracy, we use the system GMM (two-step) technique from the framework developed by Arellano and Bond (1991), where the endogenous variables are instrumented by their lags. Finally, a two-way relationship between wage growth and offshoring practices is plausible: if we assume that tasks are offshored mainly towards countries with lower wages, then wage growth can discourage the practice of task relocation. To ensure that we measure a causal effect of offshoring on wage growth (and not vice versa), instrumental variable techniques are employed. We build sector-level instruments for trade flows of intermediate goods on the basis of a gravity equation, following the procedure in Di Giovanni and Levchenko (2009), extending Frankel and Romer's (1999) methodology.[32] The values of the

[31] For a formal exposition of the bias, see e.g. Arellano and Bond (1991) or Bond (2002).

[32] In particular we compute: $IntOUT_{ijp,t}=a+\beta_1 lnVA_{ij,t}+ \beta_2 lnVA_{pj,t}+ \beta_3 lnD_{ip}+ \beta_4 Contig_{ip}+ \beta_5 RTA_{ip,t}+ \beta_6 Comcur_{ip}+ \beta_7 Comlang_{ip} + \beta_8 Colony_{ip}+ \varepsilon_{ijp,t}$,where: $IntOUT_{ijp,}$ is bilateral trade of intermediate goods in sector *j*, from country *i* (reporter/origin country) to country *p* (partner/destination country*)*, $lnVA_{ij,t}$ is the log of the reporter's value added, $lnVA_{pj,t}$ is the log of the partner's value added, lnD_{ip} is the log of the distance between *i* and *p*, defined as the distance between the capital cities in the two countries, $Contig_{ip}$ equals 1 if the two countries have a common land border, RTA_{ip} equals 1 if both countries participate in a common regional trade agreement, $Comcur_{ip}$ indicates a dummy variable for whether the reporter and partner have a common currency, $Comlang_{ip}$ indicates a dummy variable for a common official language, and $Colony_{ip}$ equals 1 if the two countries have ever been in a colonial relationship. The above gravity equation is estimated separately for each sector, using the Poisson Pseudo Maximum Likelihood method – PPML (Santos Silva and Tenreyro, 2006) – in order to take into account the information contained in the zero trade observations. Then, the predicted value of industry *j* bilateral trade of intermediate goods from country *i* to each of its partners is obtained ($\widehat{IntOUT}_{ijpt}$). We further sum the predicted values of trade flows across all partner countries *p*=1, …, P to obtain an overall trade flow for each sector analyzed for a given reporter country:

AR(1) and AR(2) correlation and diagnostic tests – the Hansen J-test of joint validity of instruments and the Difference-Hansen tests of the validity of subsets of instruments (i.e. levels, differenced, and standard IV) – show no evidence for misspecification of the estimated model[33]

After a stationarity check[34], we estimate models (7) and (8) for the wages of different skill categories. Table 1 presents the results for low-skilled wages, Table 2 for medium-skilled and Table 3 for high-skilled workers. We start our analysis with the absolute convergence (Column (1) of the respective tables), in which wage growth is regressed on its lagged levels according to Eq. (7). Then we report the estimates of the conditional beta convergence equation (8), when the process is controlled for the impact of the relative capital to labour ratio and the relative supply of each type of labour (Columns (2) of the tables). Finally, Columns (3) to (8) contain analogous results obtained when domestic outsourcing and offshoring intensity (i.e. narrow and broad) are taken into account. In particular, the results in Columns (7) and (8) refer to the autoregressive model (Eq.9) with an observation-dependent autoregressive coefficient and an interaction term, which helps us analyse the effect of *IntOUT* on steady states (and can be interpreted as long-term influence on wage differential growth) as well on speed of convergence. Table 3A in the Appendix presents the summary statistics of all the variables used in the empirical model.

4.2,2 Interpretation of the results

$$\widehat{IntOUT}_{ijt} = \sum_{p=1}^{P} IntOUT_{ijpt}$$

. As an alternative, we sum the predicted trade flows across the EU27 and the NMS12 to obtain an instrument for trade with different partner groups. A similar sector-level instrument for trade has been used in Parteka and Wolszczak-Derlacz (2013).

[33] According to Arrelano and Bond (1991), the GMM estimator requires first-order serial correlation (AR(1) test), but no second-order serial correlation in residuals (AR(2) test). Since the null hypotheses are that there is no first-/ second-order correlation, in the case of AR(1) the null hypothesis should be rejected but not in the case of AR(2). The results from Tables 1, 2 and 3 support the validity of the model specifications. Next, we report the results of the Hansen J test – a standard check for a two-step GMM estimator both considering instrument validity and structural specification (Roodman 2009). Except for the absolute convergence regression (Column 1) we cannot reject the null hypothesis of correct model specification and valid over-identifying restrictions. Additionally, we employ Difference-Hansen tests of the validity of the subsets of instruments. We cannot reject the null hypothesis of exogeneity of system GMM instruments, or validity of the IV instruments.

[34] The convergence hypothesis assumes that wage differences (we use log differentials of domestic wage relative to the EU-27 average) across locations must be stationary. Thus we previously check for unit roots in the panel. We perform the Fisher test for the panel unit root using an augmented Dickey-Fuller test, as it allows for the gaps in the panel (Table 4A in the Appendix). The null hypothesis of the unit root is rejected in all cases at standard levels of confidence.

The hypothesis of absolute convergence is rejected, which is consistent with earlier observations based on the empirical distributions of wage differentials and Figure 6. Only in the case of the wages of low-skilled labour do we obtain a statistically significant and negative beta parameter (Column (1) of Table 1). However, its magnitude is very low and the speed of convergence equals 1%, and consequently it may take more than 60 years for half of the gap in low-skill wages to disappear (a half-life of 64 years)[35].

Consequently, we proceed with the estimation of conditional wage convergence. As reported in Columns (2) for all skills categories, a negative and statistically significant coefficient in front of the lagged wage is obtained in accordance with the conditional convergence hypothesis and in line with Figure 6. If we compare now the speed of convergence and the half-lives, then the highest conditional wage convergence is observed for high-skilled workers. The coefficients associated with additional covariates are mostly significant and as predicted by economic theory (positive in the case of the capital-labour ratio, *k,* and negative in the case of skill-specific supply, *lab*).

Is domestic outsourcing playing a role? A statistically significant and negative effect on wage growth (for all skill categories) is obtained only when *DomOUT* is measured in the broad sense (Columns (4)). Thus the process of task relocation to other sectors within the same country can negatively affect workers when activities are domestically outsourced.

Now we turn to our main variable of interest: international outsourcing (*IntOUT*)[36], measured in the narrow sense (results in Column (5)) and in the broad sense (results in Column (6)), and

[35] The relatively small coefficients on the lagged wage variables indicate that the series are highly persistent so that their own lagged levels are weak instruments for subsequent changes. This is confirmed by the Hansen J diagnostic test. As noted by Roodman (2009), the Hansen J test of over-identifying restriction in the case of non-rejection of the null hypothesis can not only indicate weak instruments but also some misspecification e.g. omitting important explanatory variables.

[36] We did not include the variables of domestic outsourcing and offshoring in one regression due to possible collinearity problems. The coefficient of correlation between domestic outsourcing and offshoring equals 0.76 and 0.81 respectively for the narrow and broad measures. Similarly, we cannot account for the overall degree of openness of a given sector (*imp/VA* or *exp/VA*) as these measures are highly correlated with the outsourcing ones (correlation coefficient in the range between 0.81 to 0.92 for import/export penetration and narrow/broad ofsshoring penetration, respectively). Nevertheless, the results of the regression simultaneously incorporating domestic and international outsourcing as well as controlling for industry import/export penetration are available upon request.

always instrumented. There are some differences in the impact of international outsourcing on the wages of workers according to skill level. A negative and statistically significant parameter associated with international outsourcing (both narrow and broad measures) was only obtained for the wage growth of low- and medium-skilled workers. This would be consistent with the concept that offshoring practices hurt workers with lower skill levels (Wood, 1995; Feenstra and Hanson, 1999; Geishecker and Görg , 2008; Hummels et al., 2011). However, we will show that this negative impact is negligible.

The results obtained with the interaction term (note its statistically insignificant coefficient in Columns 7 and 8) indicate that international outsourcing (both narrow and broad) appears to negatively affect the steady state of each industry's wage differentials (as in the equation without the interaction term) but does not influence the speed of adjustment. This holds for the wages of low- and medium-skilled workers (Table 1 and Table 2) and means that even if offshoring affects the wage growth of less skilled workers, it does not affect the wage convergence process. Moreover, international outsourcing affects neither wage growth nor wage convergence in the case of high-skilled labour (Column 7 and 8 of Table 3).

4.2.3 Economic significance

So far we have concentrated on the statistical interpretation of the results obtained, indicating some negative effect of international outsourcing on the wage growth of domestic workers with education below university level. However, it is crucial to check the magnitude of the coefficients estimated to obtain an idea of their economic significance.[37] We will focus on offshoring and the politically relevant and widely debatable link between task relocation abroad and the domestic wages of medium- and low-skilled workers.

Our interpretation is based on the statistically significant results from Tables 1 and 2. The coefficient estimates for narrow offshoring indicate that the 10% increase it shows is associated

[37] Geishecker and Görg (2008) provide an exercise of this sort analyzing the case of German workers. They estimate that increased international outsourcing between 1991 and 2000 accounts for an hourly wage reduction (for the low-skilled) of €0.57 and €0.86 for narrow and broad outsourcing respectively.

with a wage growth drop of around 0.5 % for low- and medium-skilled labour (point estimates from Columns 5 of Tables 1 and 2), and for broad offshoring of 0.96% and 0.75% for low- and medium-skilled workers respectively (Columns 6 of Tables 1 and 2). The question arises of whether this change in wage levels is economically significant.

For an illustration, we calculate the cumulative marginal effects. These are based on the change observed in offshoring intensity, combined with a point estimate of the offshoring coefficients from the wage growth equation and the average wage for each skill category in 1995. Overall, between 1995 and 2009 narrowly-defined relative[38] offshoring intensity increased by 32% (for broad offshoring the increase was about 22%). We can easily calculate that due to this rise in offshoring intensity the relative average wages of low-skilled workers decreased only by 1.8% and 2.4% between 1995 and 2009 (for narrow and broad offshoring respectively - see Figure 7). If we express these percentages in relation to the EU27 average for 1995[39] they amount to total drops in hourly wages of only 0.32 and 0.42 USD in fourteen years. Matching this with the average annual hours worked (e.g. 2000 hours per year), this would imply a total loss of between 640 and 840 USD per worker.

The same exercise can be performed for medium-skilled workers (Figure 8). The point estimates indicate that in the period 1995-2009 a rise in narrow and broad offshoring of 10% is associated with drops in relative wages of 0.5% and 0.75%, respectively. This accounts for a reduction in relative wages of only 1.8% (equivalent to 0.38 USD over 14 years). We can conclude that the reduction in wages of less-skilled European workers due to offshoring is indeed economically (and socially) insignificant.

[38] Note that all our specifications take into account developments relative to the EU27 average.
[39] In 1995, the EU27 average low-skilled wage equalled 17.7 USD.

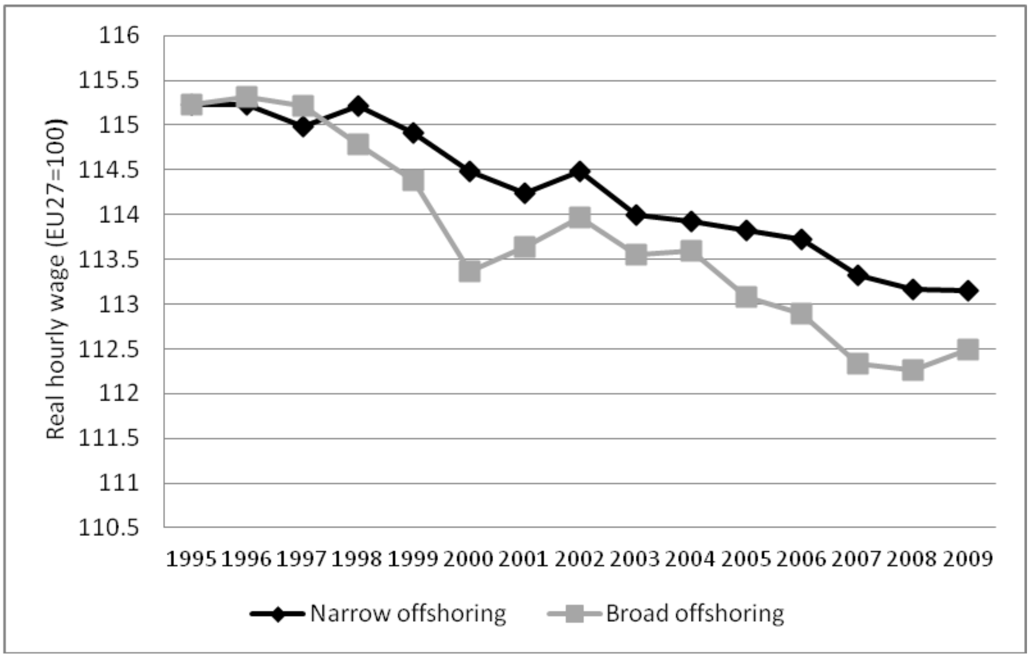

Figure 7. Cumulated marginal effects of offshoring on relative wages (EU27 =100) for domestic low-skilled labour.

Notes: cumulated marginal effects based on point estimates from Table 1; relative wages are weighted averages across 13 manufacturing sectors and EU27 countries; weights correspond to sector size (employment).

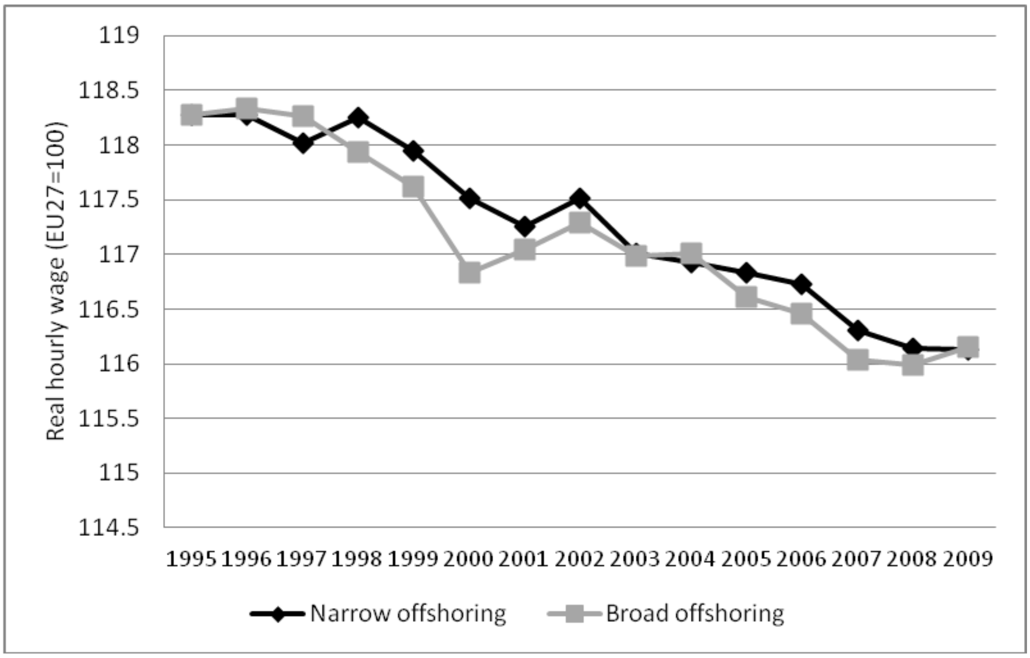

Figure 8. Cumulated marginal effects of offshoring on relative wages (EU27 =100) for domestic medium-skilled labour.

Notes: cumulated marginal effects based on point estimates from Table 2; relative wages are weighted averages across 13 manufacturing sectors and EU27 countries; weights correspond to sector size (employment).

Table 1. Estimation results of wage convergence model (manufacturing sectors, EU27, 1995-2009) - LOW-SKILLED wages, dependent variable: wage growth $\Delta \ln(w_{ij,t})$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(w_{ij,t-1})$	-0.0108***	-0.0990***	-0.1068***	-0.1526***	-0.0924***	-0.0988***	-0.0959***	-0.0961***
	[0.0034]	[0.0210]	[0.0248]	[0.0272]	[0.0222]	[0.0215]	[0.0206]	[0.0210]
$\ln(k_{ij,t})$		0.0922***	0.1015***	0.1498***	0.0800***	0.0853***	0.0709***	0.0805***
		[0.0231]	[0.0277]	[0.0271]	[0.0256]	[0.0203]	[0.0209]	[0.0198]
$\ln(lab_{ij,t})$		-0.0038	-0.0028	-0.0004	-0.0130**	-0.0221***	-0.0122***	-0.0182***
		[0.0028]	[0.0036]	[0.0032]	[0.0062]	[0.0059]	[0.0046]	[0.0055]
$\ln(dom\_out^{N}_{ij,t})$			-0.0058					
			[0.0084]					
$\ln(dom\_out^{B}_{ij,t})$				-0.1034***				
				[0.0258]				
$\ln(int\_out^{N}_{ij,t})$					-0.0463**		-0.0527***	
					[0.0197]		[0.0190]	
$\ln(int\_out^{B}_{ij,t})$						-0.0961***		-0.0801***
						[0.0281]		[0.0281]
$\ln(int\_out^{N}_{ij,t}) \times \ln(w_{ij,t-1})$							-0.0106	
							[0.0126]	
$ln(Int\_out^{B}_{ij,t}) \times ln(w_{ij,t-1})$								0.0098
								[0.0187]
Observations	4845	4456	4434	4456	4456	4456	4456	4456
Groups	350	350	349	350	350	350	350	350
Instruments	104	195	285	285	286	286	287	287
Diagnostics								
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.195	0.351	0.333	0.351	0.334	0.247	0.317	0.256
Hansen J-test of over-identifying restrictions	0.000	0.000	0.092	0.077	0.089	0.114	0.085	0.112
Difference-Hansen tests (p value)								
GMM differenced-instruments	0.000	0.045	0.014	0.012	0.056	0.027	0.053	0.025
System GMM instruments	0.725	0.999	0.996	0.993	0.638	0.979	0.631	0.984
GMM instruments without IV	0.000	0.000	0.074	0.062	0.081	0.075	0.102	0.077
IV instruments	0.191	0.052	0.609	0.601	0.481	0.811	0.245	0.759

Notes: All variables expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to the sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. In specifications (5), (6), (7) and (8) the instruments for offshoring penetration are based on the gravity equation described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous). Difference-Hansen tests: H_0 GMM differenced instruments are exogenous; H_0 System GMM instruments are exogenous and they increase the Hansen-J test result; H_0 GMM instruments without IV instruments are exogenous; H_0 Standard IV instruments are exogenous and they increase the Hansen-J test result. All computation done using the xtabond2 command in STATA SE.

Source: author's calculations

Table 2. Estimation results of wage convergence model (manufacturing sectors, EU27, 1995-2009) - MEDIUM SKILLED wages, dependent variable: wage growth $\Delta \ln(w_{ij,t})$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(w_{ij,t-1})$	-0.0084	-0.0569***	-0.0690***	-0.1265***	-0.0873***	-0.1121***	-0.1077***	-0.1156***
	[0.0053]	[0.0207]	[0.0207]	[0.0284]	[0.0181]	[0.0253]	[0.0236]	[0.0262]
$\ln(k_{ij,t})$		0.0518***	0.0634***	0.1227***	0.0742***	0.0972***	0.0794***	0.1005***
		[0.0182]	[0.0192]	[0.0251]	[0.0179]	[0.0214]	[0.0180]	[0.0220]
$\ln(lab_{ij,t})$		-0.0050**	-0.0058**	-0.003	-0.0101***	-0.0164***	-0.0109***	-0.0143***
		[0.0019]	[0.0024]	[0.0023]	[0.0027]	[0.0039]	[0.0035]	[0.0045]
$\ln(dom\_out^{N}_{ij,t})$			0.0012					
			[0.0054]					
$\ln(dom\_out^{B}_{ij,t})$				-0.1169***				
				[0.0262]				
$\ln(int\_out^{N}_{ij,t})$					-0.0458***		-0.0594***	
					[0.0114]		[0.0187]	
$\ln(int\_out^{B}_{ij,t})$						-0.0753***		-0.0696***
						[0.0192]		[0.0217]
$\ln(int\_out^{N}_{ij,t})\times\ln(w_{ij,t-1})$							-0.0173	
							[0.0196]	
$\ln(Int\_out^{B}_{ij,t})\times \ln(w_{ij,t-1})$								0.0122
								[0.0209]
Observations	4845	4456	4434	4456	4456	4456	4456	4456
Groups	350	350	349	350	350	350	350	350
Instruments	104	195	285	285	286	286	287	287
Diagnostics								
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.064	0.081	0.11	0.081	0.089	0.088	0.085	0.09
Hansen J-test of overidentifying restrictions	0.000	0.120	0.115	0.132	0.182	0.135	0.17	0.145
Difference-Hansen tests (p value)								
GMM differenced-instruments	0.000	0.035	0.027	0.018	0.027	0.038	0.025	0.035
System GMM instruments	0.104	0.778	0.839	0.731	0.981	0.84	0.991	0.876
GMM instruments without IV	0.000	0.006	0.068	0.056	0.057	0.098	0.051	0.09
IV instruments	0.039	0.01	0.401	0.177	0.97	0.341	0.993	0.421

Notes: All variables expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. In specifications (5), (6), (7) and (8) the instruments for offshoring penetration are based on the gravity equation as described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous). Difference-Hansen tests: H_0 GMM differenced instruments are exogenous; H_0 System GMM instruments are exogenous and they increase the Hansen-J test result; H_0 GMM instruments without IV instruments are exogenous; H_0 Standard IV instruments are exogenous and they increase the Hansen-J test result. All computation done using the xtabond2 command in STATA SE.
Source: author's calculation

Table 3. Estimation results of wage convergence model (manufacturing sectors, EU27, 1995-2009) - HIGH SKILLED wages, dependent variable: wage growth $\Delta \ln(w_{ij,t})$

	(1)	(2)	(3)	(4)	(5)	(66)	(7)	(8)
$\ln(w_{ij,t-1})$	-0.0067	-0.1053***	-0.1084***	-0.1906***	-0.0901***	-0.1058***	-0.0919***	-0.0924***
	[0.0056]	[0.0300]	[0.0275]	[0.0318]	[0.0258]	[0.0294]	[0.0295]	[0.0350]
$\ln(k_{ij,t})$		0.0800***	0.0843***	0.1584***	0.0672***	0.0796***	0.0678***	0.0756***
		[0.0217]	[0.0184]	[0.0261]	[0.0188]	[0.0233]	[0.0194]	[0.0250]
$\ln(lab_{ij,t})$		0.0028	0.003	0.0055*	0.0007	0.0001	0.0028	0.0027
		[0.0033]	[0.0038]	[0.0033]	[0.0035]	[0.0046]	[0.0034]	[0.0044]
$\ln(dom\_out^{N}_{ij,t})$			-0.002					
			[0.0071]					
$\ln(dom\_out^{B}_{ij,t})$				-0.1485***				
				[0.0229]				
$\ln(int\_out^{N}_{ij,t})$					-0.0101		-0.0059	
					[0.0129]		[0.0159]	
$\ln(int\_out^{B}_{ij,t})$						-0.0184		-0.0032
						[0.0208]		[0.0229]
$\ln(int\_out^{N}_{ij,t})\times\ln(w_{ij,t-1})$							0.0076	
							[0.0173]	
$\ln(Int\_out^{B}_{ij,t})\times \ln(w_{ij,t-1})$								0.0268
								[0.0205]
Observations	4845	4456	4434	4456	4456	4456	4456	4456
Groups	350	350	349	350	350	350	350	350
Instruments	104	195	285	285	286	286	287	287
Diagnostics								
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.100	0.108	0.140	0.099	0.109	0.108	0.110	0.110
Hansen J-test of overidentifying restrictions	0.000	0.004	0.142	0.154	0.194	0.086	0.174	0.104
Difference-Hansen tests (p value)								
GMM differenced-instruments	0.000	0.010	0.019	0.031	0.09	0.024	0.081	0.025
System GMM instruments	0.075	0.828	0.995	0.995	0.879	0.942	0.863	0.997
GMM instruments without IV	0.000	0.008	0.12	0.163	0.213	0.143	0.192	0.127
IV instruments	0.012	0.086	0.585	0.344	0.31	0.081	0.304	0.497

Notes: All variables expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. In specifications (5), (6), (7) and (8) the instruments for offshoring penetration are based on the gravity equation as described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous). Difference-Hansen tests: H_0 GMM differenced instruments are exogenous; H_0 System GMM instruments are exogenous and they increase the Hansen-J test result; H_0 GMM instruments without IV instruments are exogenous; H_0 Standard IV instruments are exogenous and they increase the Hansen-J test result. All computation done using the xtabond2 command in STATA SE.
Source: author's calculations

4.3. Robustness checks

The robustness of the estimation results is assessed in several ways.[40] First, we augment the regression with additional covariates that might impact on wage growth but that have been omitted from the analysis so far. We argue that the sector-country and time dummies have picked up any unmeasurable specific effects but labour market conditions (measured by unemployment rate, migration flows and the labour market institution characteristics) can have an exceptional influence on wages.

Due to data constraints, all the additional covariates are sector invariant (country specific).[41] The results referring to the low skilled, are reported in Table 5A in the Appendix. Unemployment has the expected negative effect on wage growth[42] (and also for medium- and high-skilled labour – results not provided due to space constraints). The next control, migration[43], is insignificant for low-skilled labour in none of the specifications but in the case of medium- and high-skilled workers there is a negative (and statistically significant) association between migration intensity and domestic wage growth, which can be a sign that native workers and migrants can substitute each other. Finally, we control for the role of labour market institutions[44] in wage-setting mechanisms. An increase in regulatory restrictions lowers the growth of wages for low-skilled and medium-skilled workers only. Importantly, even after adding labour market control variables, the offshoring coefficients remain similar to the baseline results.

The factor that may affect the results is the time period over which the regressions are estimated. We estimate the regression for subsamples for 1995-2002 and 2003-2009. In Table 6A in the Appendix we report the results, which replicate those from Columns (5) and (6) of Tables

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[40] To save space, the detailed results referred to in this section are available from the author upon request.
[41] Due to data unavailability, the estimations involving additional covariates of labour market condition are performed for a sub-sample of 18 countries (no data on migration for: BGR, CYP, EST, LTU, LVA, MLT, POL, ROM, SVN; no data on the employment protection index for: BGR, CYP, LTU, LVA, MLT, ROM.
[42] Data on unemployment comes from the World Bank.
[43] Migration measure as change in the migration stock – source OECD.
[44] We utilise indicators of employment protection measuring the procedures and costs involved in dismissing individuals or groups of workers ($Employ\_protec_{j,t}$) from the OECD, ranging from 0 (lowest restrictions) to 6 (highest restrictions)

1, 2 and 3, confirming the robustness of our benchmark findings: a negative parameter for international outsourcing in the case of the wages of low- and medium-skilled workers.

We also consider an alternative to our global measure of offshoring (based on trade in intermediate goods with all world partners). We calculate two restricted measures of *IntOUT* taking into account only the European dimension of offshoring practices with respect to flows from the EU27 and NMS12 (also adjusting the gravity-based instruments). The results of these estimations are very close to those obtained with global trade measures (see Table 7A in the Appendix).

The next robustness check concerns the way we calculate wages. Instead of utilizing nominal exchange rates we convert wages using PPPs. The results consistently confirm a negative impact of offshoring on low- and medium-wage growth regardless of the method of conversion utilized. The only difference concerns the lagged dependent variable, the magnitude of which is now greater (in absolute terms), indicating a higher speed of wage convergence when purchasing power is taken into account.

In terms of the robustness of the estimation method, we additionally follow the suggestion by Bond (2002) to examine the dynamic GMM validity by (apart from using standard diagnostic tests) checking if the estimated coefficient on the lagged dependent variable lies between the ones obtained from OLS and FE estimates. This condition is confirmed (i.e. for wages of low-skilled workers in the specification with international outsourcing, the values of the lagged wages are: OLS= - 0.063, GMM =-0.099, FE= - 0.40).

We conclude the robustness checks by exploring cross-industry heterogeneity (the results are in Table 8A in the Appendix, where Column (1) presents a baseline specification as in Column (6) of Tables 1, 2 and 3.). First, we augment the baseline specification with sector dummies (additional to country-sector and year dummies) – Column (2) in Table 8A. Second, we re-estimate specification (9) sequentially excluding industries one by one (to check that the results are not driven by any specific sector). In Column (3) the mean coefficient for this sequential sector elimination is presented. The values of the coefficients lie close to the baseline specification. This suggests that parameter heterogeneity is not a source of substantial bias in the coefficients estimated.

Finally, it should be stated that the magnitude of the parameters for offshoring obtained during these alternative specifications does not differ dramatically from that obtained in the previous section. The conclusion that a reduction in relative wages due to international outsourcing is economically insignificant is sustained.

5 Conclusions

This paper has contributed to the literature on real convergence and the implications of economic integration for labour markets by investigating the effects of offshoring on wage growth and wage equalization in Europe. To the best of our knowledge, this is the first paper to provide empirical evidence on this topic in such a wide context (a sample of 13 manufacturing sectors in the EU27 countries, including both old and new member states, in the period 1995-2009). Importantly, with the use of recent data (coming from the WIOD project) and in line with recent literature that introduces worker heterogeneity into models of international trade, we have been able to discriminate between heterogeneous wage effects for different categories of workers (low, medium and high skill).

The main focus has been on the labour market outcomes of vertical integration, so we have augmented a model of conditional wage convergence through the inclusion of precise sector-specific broad and narrow outsourcing/offshoring indices based on input-output data (also from the WIOD). Two-way relations between trade variables (outsourcing) and wages have additionally been addressed through the use of a gravity-grounded sector-level instrument.

Our results confirm that despite a considerable rise in trade integration, which is also visible in cross-border flows of intermediates, there is no evidence supporting unconditional skill-specific wage convergence in the EU27. Both descriptive evidence and the results obtained from estimated regression models show that wage differentials in the EU27 prove to be highly persistent. However, in a conditional setting, (slow) wage equalisation may take place.

We have also made an additional effort to complement the estimates of the statistical significance (fairly standard in an empirical analysis) of the impact of outsourcing with estimates of its economic significance. The regression results indicate that offshoring (like broad domestic outsourcing) negatively affects wage growth (but has no impact on the process of wage equalization in EU sectors). This negative impact of international outsourcing on wage growth is not homogeneous across the various categories of labour: only medium- and low-skilled workers in domestic sectors are involved. However, we argue that the magnitude of this effect (calculated in terms of real wage change) is very small and low/medium skilled workers cannot therefore be perceived as losers from the integration process.

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Appendix

Table 1A. List of countries (EU27)

Country code	Country_name
AUT	Austria
BEL	Belgium
BGR	Bulgaria
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
DNK	Denmark
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HUN	Hungary
IRL	Ireland
ITA	Italy
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MLT	Malta
NLD	Netherlands
POL	Poland
PRT	Portugal
ROM	Romania
SVK	Slovak Republic
SVN	Slovenia
SWE	Sweden

Table 2A. List of manufacturing sectors

Sector code	Description
15t16	Food , Beverages And Tobacco
17t18	Textiles And Textile Products
19	Leather, Leather And Footwear
20	Wood and Products of Wood and Cork
21t22	Pulp, Paper, Printing And Publishing
24	Chemicals and Chemical Products
25	Rubber And Plastics
26	Other Non-Metallic Mineral Products
27t28	Basic Metals And Fabricated Metal
29	Machinery not elsewhere classified
30t33	Electrical And Optical Equipment
34t35	Transport Equipment
36t37	Manufacturing not elsewhere classified; Recycling

Table 3A. Summary statistics of variables used in the empirical model

Variable	Obs	Mean	Std. Dev.	Min	Max
$\Delta\ln(w^{L}_{ij,t-1})$	4845	0.005	0.094	-1.279	1.291
$\Delta\ln(w^{M}_{ij,t-1})$	4845	0.007	0.094	-1.222	1.268
$\Delta\ln(w^{H}_{ij,t-1})$	4845	0.003	0.097	-1.191	1.274
$\ln(k)_{ij,t}$	4807	-0.188	0.913	-3.883	1.878
$ln(lab_{LSij,t})$	5196	0.463	1.183	-6.617	2.301
$ln(lab_{MSij,t})$	5196	0.537	1.147	-8.124	2.195
$ln(lab_{HSij,t})$	5196	0.483	1.235	-8.009	2.330
$ln(dom\_out^{N}_{ij,t})$	5171	0.023	0.917	-16.703	2.658
$ln(dom\_out^{B}_{ij,t})$	5196	0.085	0.284	-2.217	1.184
$ln(Int\_out^{N}_{ij,t})$	5196	-0.499	0.550	-7.176	2.033
$ln(Int\_out^{B}_{ij,})$	5196	-0.426	0.416	-1.839	1.661

Note: All variables expressed in relation to the EU27average. Observations weighted across 13 manufacturing sectors in EU27 countries according to the sector size (total hours worked by persons engaged).
Source: own calculation.

Table 4A Fisher panel unit root test

	Based on augmented Dickey-Fuller tests	
	χ2 (p-value) without trend	χ2 (p-value) with trend
$\ln(w^{L}_{ij,t-1})$	1284.1 (0.000)	1758.8 (0.000)
$\ln(w^{M}_{ij,t-1})$	1260.4 (0.000)	1482.8 (0.000)
$\ln(w^{H}_{ij,t-1})$	1045.2 (0.000)	1290.9 (0.000)
$ln(lab_{LSij,t})$	1467.8 (0.000)	1598.7 (0.000)
$ln(lab_{MSij,t})$	1096.7 (0.000)	1193.2 (0.000)
$ln(lab_{HSij,t})$	907.5 (0.000)	1092.0 (0.000)
$\ln(k)_{ij,t}$	1037.2 (0.000)	1075.6 (0.000)
$ln(dom\_out^{N}_{ij,t})$	1024.3 (0.000)	1225.6 (0.000)
$ln(dom\_out^{B}_{ij,t})$	1002.6 (0.000)	1154.2 (0.000)
$ln(Int\_out^{N}_{ij,t})$	1180.2 (0.000)	1141.9 (0.000)
$ln(Int\_out^{B}_{ij,})$	1121.7 (0.000)	1139.9 (0.000)

Notes: All variables expressed in relation to the EU27average. Due to the limited time period, the number of lags was restricted to 1.
Source: own calculation.

Table 5A. Estimation results of wage convergence model (manufacturing sectors, EU27, 1995-2009) - low skilled wages, additional covariates: unemployment rate (UN), migration (Mig) and employment protection index (Empl_protec).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(w_{ij,t-1})$	-0.0143***	-0.1210***	-0.1114***	-0.0863***	-0.0990***	-0.1332***	-0.1028***	-0.1316***
	[0.0030]	[0.0257]	[0.0230]	[0.0180]	[0.0213]	[0.0220]	[0.0216]	[0.0212]
$\ln(k)_{ij,t}$		0.1254***	0.1204***	0.0846***	0.0930***	0.1240***	0.0839***	0.1104***
		[0.0273]	[0.0240]	[0.0182]	[0.0217]	[0.0221]	[0.0227]	[0.0217]
$\ln(lab_{ij,t})$		-0.0046	-0.0080**	-0.0044*	-0.0094***	-0.0177***	-0.0069**	-0.0139***
		[0.0030]	[0.0037]	[0.0027]	[0.0030]	[0.0040]	[0.0028]	[0.0041]
$UN_{i,t}$	-0.0289***	-0.0358***	-0.0390***	-0.0368***	-0.0377***	-0.0437***	-0.0367***	-0.0447***
	[0.0052]	[0.0080]	[0.0080]	[0.0065]	[0.0071]	[0.0071]	[0.0063]	[0.0071]
$Mig_{i,t}$	0.0071	0.0089	0.0122	0.0087	0.0061	0.0093	0.001	0.0048
	[0.0094]	[0.0107]	[0.0103]	[0.0103]	[0.0100]	[0.0093]	[0.0100]	[0.0094]
$Empl\_protec_{i,t}$	-0.0002	-0.0182**	-0.0195**	-0.0133**	-0.0088	-0.0004	-0.0069	0.0026
	[0.0028]	[0.0088]	[0.0080]	[0.0064]	[0.0062]	[0.0073]	[0.0061]	[0.0080]
$\ln(Dom\_Out^{N}_{ij,t})$			0.0093					
			[0.0064]					
$\ln(Dom\_Out^{B}_{ij,t})$				0.0155				
				[0.0162]				
$\ln(Int\_Out^{N}_{ij,t})$					-0.0257**		-0.0289**	
					[0.0119]		[0.0113]	
$\ln(Int\_Out^{B}_{ij,t})$						-0.0687***		-0.0642***
						[0.0169]		[0.0169]
$\ln(Int\_Out^{N}_{ij,t})\times\ln(w_{ij,t-1})$							0.0127	
							[0.0112]	
$\ln(Int\_Out^{B}_{ij,t})\times \ln(w_{ij,t-1})$								-0.005
								[0.0194]
Observations	2560	2417	2412	2417	2417	2417	2417	2417
Groups	220	220	219	220	220	220	220	220
Instruments	107	171	248	248	249	249	250	250
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.451	0.385	0.354	0.379	0.404	0.466	0.385	0.476
Hansen J-test of overidentifying restrictions	0.003	0.041	0.91	0.922	0.905	0.89	0.906	0.886

Notes: All variables are expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. In specifications (5), (6), (7) and (8) the instruments for international outsourcing penetration are based on the gravity equation as described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous). Difference-Hansen tests: H_0 GMM differenced instruments are exogenous; H_0 System GMM instruments are exogenous and they increase the result of the Hansen-J test; H_0 GMM instruments without IV instruments are exogenous; H_0 Standard IV instruments are exogenous and they increase the result of the Hansen-J test. All computation done using the xtabond2 command in STATA SE. Source: author's calculations

Table 6A. The determinants of wage growth – time subsamples: 1995-2002 and 2003-2009

	Low skilled		Medium skilled		High skilled	
	(1) (1995-2002)	(2) (2003-2009)	(3) (1995-2002)	(4) (2003-2009)	(5) (1995-2002)	(6) (2003-2009)
$\ln(w_{ij,t-1})$	-0.1536***	-0.1824***	-0.1366**	-0.1583***	-0.1521**	-0.0269
	[0.0486]	[0.0299]	[0.0537]	[0.0358]	[0.0699]	[0.0308]
$\ln(k)_{ij,t}$	0.1511***	0.1592***	0.1206**	0.1365***	0.1185**	0.0104
	[0.0497]	[0.0298]	[0.0502]	[0.0337]	[0.0589]	[0.0247]
$\ln(lab_{ij,t})$	-0.0324***	-0.0256***	-0.0069	-0.0235***	-0.0014	-0.0123***
	[0.0102]	[0.0082]	[0.0054]	[0.0072]	[0.0076]	[0.0046]
$\ln(Int\_Out^{B}_{ij,t})$	-0.1281***	-0.1390***	-0.0535*	-0.1057***	-0.0413	-0.0349*
	[0.0457]	[0.0379]	[0.0294]	[0.0357]	[0.0394]	[0.0195]
Observations	2397	2059	2397	2059	2397	2059
Groups	350	350	350	350	350	350
Instruments	63	213	63	213	63	213
Diagnostics						
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.167	0.017	0.203	0.001	0.217	0.008
Hansen J-test of overidentifying restrictions	0.000	0.065	0.000	0.074	0.00	0.034
Difference-Hansen tests (p value)						
GMM differenced-instruments	0.000	0.021	0.000	0.043	0.000	0.03
System GMM instruments	0.244	0.955	0.53	0.734	0.323	0.422
GMM instruments without IV	0.00	0.06	0.00	0.07	0.000	0.033
IV instruments	0.87	0.513	0.52	0.481	0.714	0.416

Notes: All variables are expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. International outsourcing penetration is instrumented based on the gravity equation as described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous). Difference-Hansen tests: H_0 GMM differenced instruments are exogenous; H_0 System GMM instruments are exogenous and they increase the result of the Hansen-J test; H_0 GMM instruments without IV instruments are exogenous; H_0 Standard IV instruments are exogenous and they increase the result of the Hansen-J test. All computation done using the xtabond2 command in STATA SE 9.0.
Source: author's calculations.

Table 7A The determinants of wage growth – different trade partners: EU27 and NMS12, broad measure of offshoring

	Low skilled		Medium skilled		High skilled	
	EU27	NMS12	EU27	NMS12	EU27	NMS12
$\ln(w_{ij,t-1})$	-0.1196***	-0.1060***	-0.1267***	-0.0764***	-0.1171***	-0.0914***
	[0.0260]	[0.0180]	[0.0261]	[0.0272]	[0.0301]	[0.0273]
$\ln(k)_{ij,t}$	0.0992***	0.0818***	0.1055***	0.0552***	0.0883***	0.0708***
	[0.0239]	[0.0173]	[0.0221]	[0.0199]	[0.0240]	[0.0191]
$\ln(lab_{ij,t})$	-0.0292***	-0.0114***	-0.0174***	-0.0028	-0.0027	0.0044
	[0.0061]	[0.0027]	[0.0037]	[0.0026]	[0.0049]	[0.0033]
$\ln(Int\_Out_{ij,t})$	-0.1217***	-0.0292***	-0.0814***	-0.0152**	-0.0324	0.0103
	[0.0264]	[0.0076]	[0.0177]	[0.0066]	[0.0201]	[0.0067]
Observations	4456	4456	4456	4456	4456	4456
Groups	350	350	350	350	350	350
Instruments	286	286	286	286	286	286
Diagnostics						
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.263	0.34	0.091	0.082	0.11	0.105
Hansen J-test of overidentifying restrictions	0.173	0.105	0.099	0.076	0.128	0.123

Notes: All variables are expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Country/industry fixed effects and year dummies are included in all regressions. Variables: $\ln(w_{ij,t-1})$, $\ln(k)_{ij,t}$, are treated as endogenous and instrumented by their lags. International outsourcing penetration is instrumented based on the gravity equation as described in the main text. The figures reported for the Arellano-Bond test for AR(1) and AR(2) are the p-values. The Hansen J-test of over-identifying restrictions corresponds to the H_0. The model specification is correct and all over-identifying restrictions (all over-identified instruments) are correct (exogenous).

Table 8A The determinants of wage growth - cross-industry heterogeneity, broad measure of offshoring

	Low skilled			Medium skilled			High skilled		
	(1) (pooled)	(2) (pooled)	(3) (mean)	(4) (pooled)	(5) (pooled)	(6) (mean)	(7) (pooled)	82) (pooled)	(9) (mean)
$\ln(w_{ij,t-1})$	-0.0988***	-0.1031***	-0.099	-0.1084***	-0.1084***	-0.112	-0.1058***	-0.0929***	-0.106
$\ln(k)_{ij,t}$	0.0853***	0.0917***	0.085	0.0941***	0.0941***	0.097	0.0796***	0.0664***	0.08
$\ln(lab_{ij,t})$	-0.0221***	-0.0207***	-0.022	-0.0153***	-0.0153***	-0.016	0.0001	0.002	0
$\ln(Int\_Out_{ij,t})$	-0.0961***	-0.0885***	-0.096	-0.0708***	-0.0708***	-0.075	-0.0184	-0.0091	-0.018
Instrumental variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country/sector effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sector effect	NO	YES	-	NO	YES	-	NO	YES	-

Notes: All variables are expressed in relation to the EU27 mean. All estimations are two-step system GMM, with the weights corresponding to sector size (total hours worked by persons engaged). Constants not reported. Robust standard errors in parentheses. Statistically significant at ***1, ** 5, * 10 percent level. Variables: $\ln(w_{ij,t-1})$, $\ln(k/l)_{ij,t}$, are treated as endogenous and instrumented by their lags. International outsourcing penetration is instrumented based on the gravity equation as described in the main text.