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Article

The China syndrome revisited : impact of technological intensity and Chinese import penetration on labor market outcomes in the EU

Ekonomický časopis

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Slovak Academy of Sciences, Bratislava

Reference: Damijan, Jože P./Kostevc, Črt et. al. (2023). The China syndrome revisited : impact of technological intensity and Chinese import penetration on labor market outcomes in the EU. In: Ekonomický časopis 71 (2), S. 119 - 138.
https://www.sav.sk/journals/uploads/0518123402%2023%20Damijan%20+%20SR.pdf.
doi:10.31577/ekoncas.2023.02.02.

This Version is available at:
http://hdl.handle.net/11159/632003

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The China Syndrome Revisited:[1] Impact of Technological Intensity and Chinese Import Penetration on Labor Market Outcomes in the EU[2]

Jože DAMIJAN – Črt KOSTEVC* – Tjaša REDEK***

Abstract

This paper contributes to research on the factors that have led to the decline of manufacturing employment in advanced economies by studying the impact of both import penetration and technological intensity on manufacturing employment between 2008 and 2018 using an extensive industry-level dataset for 28 EU countries. The findings make it clear that the growing share of Chinese imports in total extra-EU-28 imports significantly explains the declining trend in EU sectoral employment. The mentioned trend is shown to be mainly driven by the import penetration of Chinese consumer goods and less by the outsourcing of intermediate products. Yet, little evidence is found of technological intensity having a detrimental impact on sectoral employment outcomes. While the correlation between business expenditure on research and development per employee and employment growth was weakly negative, the share of information and communication technologies assets in total assets was positively correlated with both aggregate employment growth and the share of unskilled workers in the sector.

Keywords: *labor-market outcomes, polarization, technological intensity and import penetration*

JEL Classification: F14, F16, J31, O33

DOI: https://doi.org/10.31577/ekoncas.2023.02.02

Article History: *Received*: September 2022 *Accepted*: April 2023

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[1] The title alludes to the paper by David Autor, David Dorn, and Gordon Hanson: *The China Syndrome. Local Labor Market Effects of Import Competition in the United States*, published in the AER in 2013.

[2] The authors acknowledge the financial support by the European Union's H2020 research and innovation program under GA. No. 822781 – GROWINPRO and Slovenian Research Agency Research Programme J5-4575.

Introduction

In the last few decades, developed-country labor markets may be characterized as middle-wage jobs being replaced by a mix of high- and low-paid jobs. Simultaneously, wages have been shown to be rising faster at the top and bottom of the distribution than in the middle sections (Acemoglu and Autor, 2011). Polarization of the labor market, marked by the diverging fortunes of middle-wage occupations on one hand and high- and low-wage occupations on the other, has been linked to the task content of different occupations (Autor, Levy and Murnane, 2003; Autor, Katz and Kearney, 2006; Goos and Manning, 2007). Workers in the middle of the income distribution tend to be concentrated in occupations that entail many routine tasks.

At the same time, according to the routinization hypothesis (or routine-based technical change), labor-saving technological changes in the form of automation have primarily led to the displacement of jobs whose content is both cognitively and manually quite routine (Cortes, 2016). Parallel to this, foreign outsourcing as a form of trade has become more prominent since the early 1980s upon the rise of South-east Asian nations.[3] Increased vertical specialization is visible in the growing share of trade in intermediate products (Chen and Yi, 2003; Geishecker, 2005; Falk and Wolfmayr, 2005). As technological has progressed, routine occupations have been replaced by standardized production processes outsourced to low-wage destinations. While the impact of trade on polarizing the labor market was initially believed to small, trade theory stated that low-wage countries could be a likely source of disruption of high-wage labor markets (Krugman, 2008).

In the last few decades, the diffusion of a "new economy" based on ICT technologies has re-triggered the classical debate on innovation's possible adverse consequences for employment. On one side, the fear of technological unemployment as a direct outcome of labor-saving innovation has always been present in periods denoted by radical technological change. On the other side, economic theory has pointed to the existence of indirect effects possibly able to counterbalance the loss of employment with new technologies creating new tasks in which labor holds a comparative advantage and offsetting the effects of newly created jobs in other sectors in the medium to long term.

[3] The "China syndrome" describes the increase in import competition that US industries faced after China's entry to the WTO in 2001. Increased imports were not offset by a simultaneous rise in Chinese demand for US exports, which amplified the effect on the US labor market. Similarly rapid growth in the Chinese import share happened in the EU when imports from China grew from 6.4% (2002) to 16.6% (2021) of the total. Europe's trade deficit with China, which was 1.4% of GDP in 2021, has never quite reached US levels (1.7% in 2021).

This paper combines the two strands of literature by exploring the impact of both technological intensity and import competition on European labor markets. This paper contributes to the literature in two ways. First, it is one of very few papers to jointly consider the effects of sectoral technological intensity and import competition on the European labor market. Second, the paper adds with the presented analysis of both aggregate sectoral employment and employment polarization in the EU's labor markets. We show that sectoral labor-market outcomes in Europe are impacted by both technological progress and import competition from China. While strong support for the negative effect of Chinese import penetration on employment growth is found, there is tentative evidence that foreign-firm presence strengthens demand for local labor, whereas R&D investment intensity may weaken it. We proceed as follows. First, the theoretical and empirical background to the underlying causes of labor market outcomes in the EU is presented. The data and methodological issues are described next, followed by the results. The robustness of the results is tested in the penultimate chapter, while the last chapter provides conclusions.

1. Background

1.1. Theory

Several theoretical models have recently attempted to explain labor-market transitions in response to routine-biased technical change (RBTC) and import penetration. Models focusing on the impact of technological change all share an occupational-sorting mechanism whereby workers self-select into occupations based on their comparative advantage (Gibbons et al., 2005; Costinot and Vogel, 2010; Acemoglu and Autor, 2011; Jung and Mercenier, 2014; Cortes, 2016). Capital, in contrast, is assumed to enter the production function as a substitute for labor working in routine tasks and as a complement to workers in nonroutine cognitive tasks. RBTC is modelled as an exogeneous increase in the use of physical capital (caused, for instance, by a fall in ICT asset costs). Such a change induces workers at the bottom of the ability distribution within routine occupations to switch over to nonroutine manual jobs, while those at the top switch to nonroutine cognitive jobs. In addition, the wage premium of routine occupations is expected to fall relative to that of nonroutine occupations (Acemoglu and Author, 2011; Cortes, 2016).

Models considering the labor-market effects of import penetration, in comparison, hinge on the dichotomy between traded and non-traded goods (Topalova, 2005; 2010; Author, Dorn and Hanson, 2013). While non-traded goods are homogeneous, traded goods are produced in sectors each containing a large number of monopolistically competitive firms that manufacture differentiated product varieties. The productivity growth and falling trade costs of low-cost markets (China) are reflected in given (Western) labor markets in two ways: (i) heightened competition in the goods markets; and (ii) increased export demand from the low-cost markets. Wage and employment outcomes in developed markets are therefore the sum of the impact of the increase in export demand coming from low-cost markets and the drop in demand for developed-market products in all markets in which they compete with low-cost exporters (Author, Dorn and Hanson, 2013). Products reliant on many routine-manual tasks are particularly susceptible to both competition from Chinese imports as well as stages in the production process being outsourced to low-cost production locations like China (Blinder, 2009).

Theoretical contributions on the impact of technological progress and import competition on the job markets in developed economies explore both the effect on the growth of aggregate employment along with different dimensions of polarization between various skill/wage strata. Models typically predict a negative effect of import penetration on aggregate labor growth, whereas both technological improvements and import penetration from low-wage countries tend to boost polarization in the employment share and the wages paid to different skill groups.

1.2. Empirics

Although the impact of innovation and R&D spending on productivity is generally viewed as positive (see, for instance, Ortega-Argilés et al., 2010; Hall, 2011), the assessment of innovation's potential effects on employment has proven more contentious. Product innovation is largely associated with increased demand for labor, yet process innovation can act to destroy jobs (Vivarelli, 2015). Despite ample anecdotal evidence and stronger fears of "the age of robots", the evidence on the impact of automation technologies, especially robotization, on labor-market outcomes remains mixed. Acemoglu and Restrepo (2020) confirm robust negative effects of the introduction of industrial robots in US labor markets with 1 more robot per 1,000 employees reducing the employment/population ratio by 0.2 percent and wages by 0.42 percent.

However, when studying the effect of robotization on European labor markets, Klenert et al. (2020) find a significantly positive association between the number of robots in use and overall employment. Antón et al. (2020) similarly establish that exposure to robots had a positive effect on employment between 2005 and 2015 and a mildly negative effect before 2005. Overall, they find the effect of robotization to be small and ambiguous.

At the same time as the jobs of production workers are being disrupted by the emergence of industrial robots and other automated machinery, white-collar workers in accounting, sales, logistics, trading, and certain managerial occupations are also at risk as the tasks they have hitherto performed are being replaced by specialized software and artificial intelligence. In spite of the later, there is mounting evidence that the automation of a range of low- and medium-skill occupations has exacerbated wage inequality and employment polarization (e.g., Goos and Manning, 2007; Michaels, Natraj and Van Reenen, 2014). More recently, Reljic et al. (2021) explored the job-market impact of ICT intensity and showed that job creation in industries is supported by high digital consumption and reduced by high digital investment. Marek and Moiteaux (2021) studied the effect of a decrease in the share of routine jobs on employment and participation rates, conditionally on the level of the minimum wage, in European local labor markets. Their findings reveal that the polarization process has a negative impact on employment and participation rates in high minimum wage countries only. Domini et al. (2022) investigated the impact of investment in automation and AI-related goods on within-firm wage inequality in France. Investment in automation and AI was shown to impact employee wages with a 3-year delay when workers across the distribution experience a 1% wage increase on average.

The blame for stagnant wages, job losses, and labor-market polarization is often directed at globalization, notably competition from low-wage countries via trade, outsourcing as well as labor migration. In the 1990s, most economic literature determined that globalization (i.e., international trade) had a mild effect on wages and workers' income, suggesting a moderate concern for the losers of globalization (see Richardson, 1995). The issue has garnered renewed interest recently for several reasons. First, the magnitude of the economic changes at stake has gone up as trade has continued to increase along with cross-border capital flows. In particular, ever since China joined the WTO in 2001 the share of developing-country imports in developed countries has been expanding quickly (Crozet and Orefice, 2017). Second, academic research on the trade and labor markets has made considerable progress. Third, in the context of a global crisis with persistent and often rising social inequalities coupled with steady deindustrialization, public opinion in many Western countries is shifting and giving ever more support to populist and/or protectionist parties.

In a seminal paper, Autor et al. (2013) show that rising Chinese imports had caused higher unemployment, lower labor force participation and reduced wages in local labor markets that are home to import-competing manufacturing industries. In explaining the "China syndrome", Author et al. state that Chinese import competition explains one-quarter of the aggregate decline in manufacturing employment in the U.S.A. between 1990 and 2007. Generally, studies on European labor markets find quantitatively smaller effects of Chinese imports, albeit they are still found to negatively impact the market conditions. Balsvik et al. (2015) established negative employment effects for low-skilled workers in Norway and observed that low-skilled workers tend to be pushed into unemployment or leave the labor force altogether. Still, they found no effect on wages in Norway. They showed that import competition from China explains almost 10% of the reduction in the share of manufacturing employment from 1996 to 2007, namely, half the effect found by Autor et al. (2013) for the U.S.A. Dauth et al. (2014) similarly established that increased exposure to imports from China reduces the manufacturing employment share in German local labor markets by about 0.14 of a percentage point, whereas a much bigger effect of 1.3 percentage points was found for Spain by Donoso et al. (2014).

The effects of outsourcing on local employment have also been a hotly debated topic in the recent past. While international sourcing was found to negatively affect less skilled workers in particular (Feenstra and Hanson, 1996), the overall effect has been shown to be comparatively small given that with further specialization the firm will become more productive and be able to expand its operations domestically and internationally, leading to positive employment outcomes for all workers (Grossman and Rossi-Hansberg, 2008). Moreover, studies have revealed that offshoring increases skilled labor's share of the wage bill in both the offshoring and destination countries. For example, Feenstra and Hanson (1996; 1999) and Hsieh and Woo (2005) showed that offshoring can explain a large part (up to 50 percent) of the increased wage share of skilled workers in the U.S.A., Mexico, and Hong Kong, respectively. Studies looking at European labor markets established similar effects of outsourcing. Becker et al. (2013) showed that outward FDI increased the skill intensity of German firms, while using data for Italian firms Castellani et al. (2008) found that outward FDI had no impact on skill composition, except for FDI towards Central and Eastern European countries. Others reveal that offshoring increases the probability of job separation, leading to greater employee insecurity (Geishecker, 2008) with the effect being asymmetric between unskilled and skilled workers (Munch, 2010; Görg and Görlich, 2015).

In the spirit of our paper, Breemersch et al. (2019) explored the effects of offshoring, technology, and Chinese import competition on labor-market polarization in European countries. Concerning European manufacturing industries, they found that ICT adoption explains one-third of within-industry polarization, while the contribution made by Chinese net import competition was much smaller.

2. Data and Empirical Approach

2.1. Data

The empirical analysis is based on industry-level data for 27 EU countries between 2008 and 2019. Several datasets were combined to construct the database. Eurostat data on sectoral (2-digit NACE) employment in thousands of full-time employees were matched with data on employment by European socio-economic groups on the one-digit aggregation level.[4] To account for the effects of innovation and research and development expenditure, employment data were supplemented with industry-level information on business R&D spending (BERD) and innovation activity (CIS surveys waves 6 in 2008 to wave 11 in 2018), both from Eurostat. EU Klems data (Bontadini et al., 2023) were used for information regarding the share of ICT capital. To control for other effects of globalization, Eurostat industry-level information on the share of value added under the control of foreign firms and the share of employment under foreign-firm control was also added. Data on imports by market of origin and destination were taken from the COMEXT trade database for the two-digit SITC classification. The SITC classification on the 2-digit aggregation level is in harmony with the 2-digit NACE classification. Trade data were used to calculate the import concentration of Chinese and other Asian imports in EU markets by industry and destination country. Data on the proportion of intermediate goods imports came from the OECD (Bilateral Trade Database by Industry and End-Use, BTDIxE). Finally, we controlled for gross industry output and value added generated using Eurostat data.

The basic trends in the dataset are presented in Figure 1. While all four measures appear to have increased during the observation period, the share of unskilled workers remained virtually the same throughout, with some fluctuation, while the overall employment growth rate was relatively sluggish. In comparison, the share of imports from China, already at historically high levels in 2008, continued to grow steadily, notably after 2013. Business expenditure on research and development experienced a gradual revival after the collapse associated with the global financial crisis.

The basic characteristics of the sample are presented in Table A1 (in the Appendix) through three key variables of interest: growth rate of total employment, share of Chinese imports in all extra-EU-28 imports, and BERD expenditure per inhabitant. All variables presented were calculated as weighted averages of

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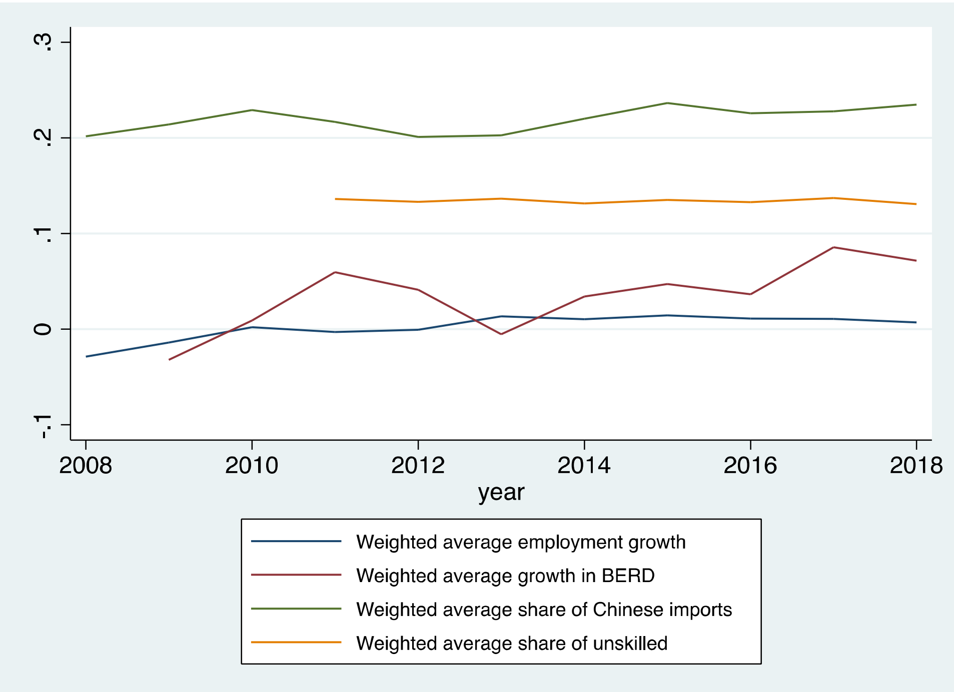
[4] The socio-economic groups included are (0) "Persons in the labour force whose occupation or status in employment is not known"; (1) "Managers"; (2) "Professionals"; (3) "Technicians and associate professional employees"; (4) "Small entrepreneurs"; (5) "Clerks and skilled service employees"; (6) "Skilled industrial employees-not specified"; (7) "Lower status employees".

industry-country annual observations. Eleven of the 28 EU member states experienced negative average growth rates in the period under observation, which is unsurprising given that two waves of the global financial crisis (henceforth GFC) strongly impacted many European countries with some sectors like construction, banking and the automotive sector being particularly affected. The share of extra-EU-28 imports coming from China varies greatly across the EU member states due to countries' differing industry compositions along with different levels of Chinese import penetration. While the average share of imports from China across countries, industries, and time stands at 21.1 percent, the shares in Czechia and Luxembourg are substantially higher at over 36 percent, while Malta and Ireland have the lowest shares at around 11 percent. Even more pronounced are the differences in business expenditure on research and development per inhabitant, which range from just EUR 2.3 (Latvia) to EUR 191 (Finland).

Figure 1
Trends in Key Variables: Total Employment Growth, Growth in Business Expenditure on Research and Development (BERD), Share of Chinese Imports in Total Extra-EU-28 Imports and Share of Unskilled Workers in the Total Labor Force (All country-industry pair weighted averages 2008 – 2018)

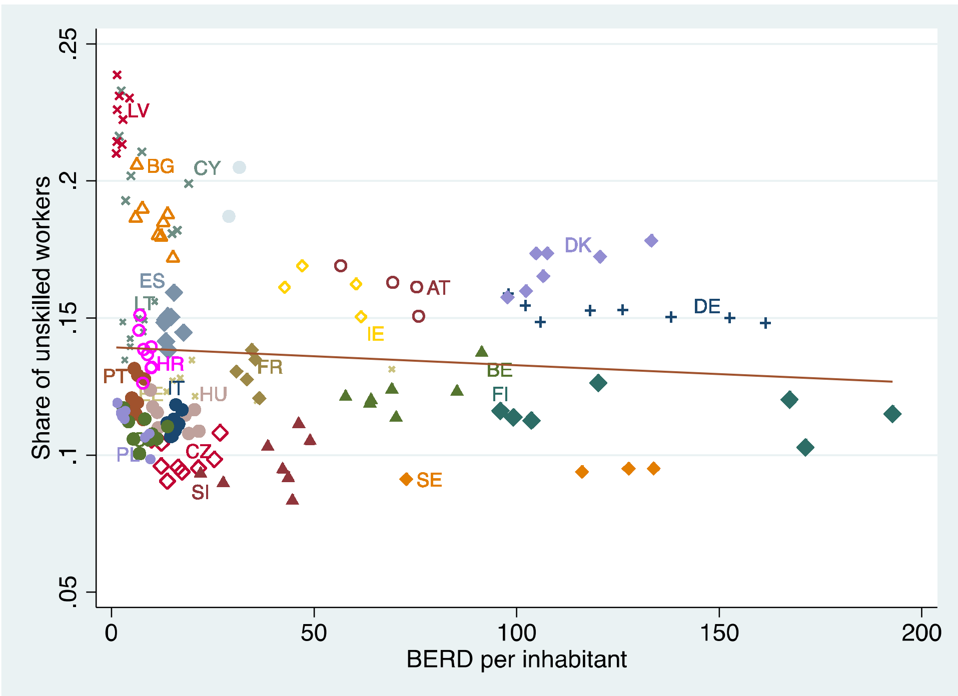


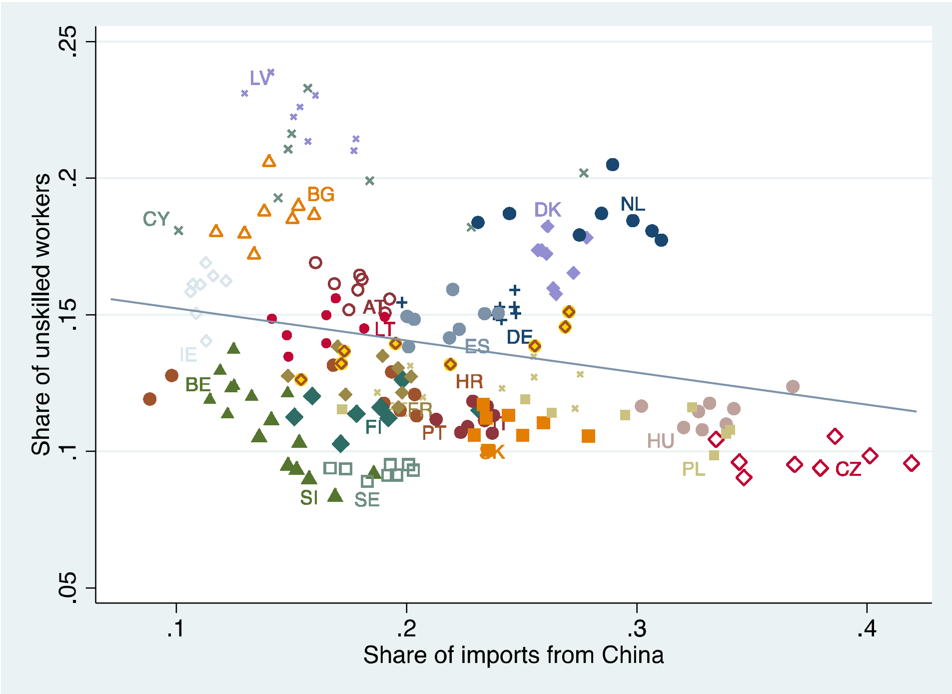
Source: Eurostat, 2021.

Table A1 reveals no obvious relationships between the three variables for specific countries. Some countries experienced a sluggish labor-market performance while import penetration by Chinese firms was low, yet others did the opposite. Likewise, higher BERD to inhabitant ratios did not define the labor market performance of countries.

In order to help observe the correlation between key variables, Figure 2 presents scatterplots of the share of unskilled workers versus innovative activity (BERD per inhabitant) and the impact of import penetration (share of Chinese imports in total extra-EU-28 imports). Country-year pairs depicted in the figures represent weighted average values across industries. The country-year average share of unskilled workers is weighted by total employment, BERD per inhabitant is weighted by sectoral output share, and the share of Chinese imports in total extra-EU-28 imports by total sectoral extra-EU-28 imports.

Figure 2
Correlation between the Share of Unskilled Workers and Business Research and Development Spending (BERD) Per Inhabitant (panel 2a),
and the Share of Imports from China (panel 2b)





Note: Country-year average share of unskilled workers is weighted by total employment, BERD per inhabitant is weighted by sectoral output share, and the share of Chinese imports in total extra-EU-28 imports by total sectoral extra-EU-28 imports.

Source: Eurostat, 2021.

A clear picture emerges from the figures, with a pronounced negative trend shown in the data. Both the correlation between the share of unskilled workers in the total workforce and BERD spending per person as well as the correlation of the share of unskilled workers with the share of imports from China are distinctly negative. While there remains considerable unexplained variability mainly between countries, the two linear trends reveal there might be an underlying relationship worth exploring further.

2.2. Empirical Approach

Our approach to decomposing the effects of technological change and globalization on labor-market outcomes rests on regressing sectoral employment growth on a set of standard labor-market determinants and key indicators of innovation activity and globalization. Among others, a similar approach was taken by Autor and Dorn (2013), Keller and Utar (2016), and Breemersch et al. (2019). The proposed empirical model is:

$$\Delta emp_{ijt} = \alpha + \beta_1 tech_{ijt} + \beta_2 import\_pen_{ijt} + \beta_3 control_{ijt} + \\ +\gamma_4 \sum_{t=1}^{T-1} D_t + \gamma_5 \sum_{i=1}^{I-1} D_i + \gamma_6 \sum_{j=1}^{J-1} D_t + \varepsilon_{ijt} \tag{1}$$

where

Δemp_{ijt} is the change in total employment in sector *i* of country *j* at time *t*. We also used changes in the share of unskilled labor as an alternative measure of the conditions in the labor market.[5] $tech_{ijt}$ is the measure of technological intensity in sector *i* of country *j* at time *t*. While the CIS dataset provides information on firm innovation activity, the sectoral and country coverage is patchy and information on innovative activity is provided in a 2-year window only. This leads to some indeterminacy as to the precise timing of an innovation. To mitigate these issues, we chose to rely mostly on business expenditure on research and development (BERD) measured as industry-level expenditure in millions of euros relative to the total number of employees in the relevant industry. Very similar reasoning and choice of determinants was used in Breemersch et al. (2019).[6] We also controlled for technological intensity with the country-industry-year share of ICT capital in total gross fixed capital formation.[7] Use of this variable aligns our study with those of Goos et al. (2016), Breemersch et al. (2019), Maarek and Moiteaux (2021), and Reljic et al. (2021), who employed similar controls for sectoral technological intensity in their specifications.

$import\_pen_{ijt}$ is a measure of an industry *i*'s exposure to import penetration at time *t* in country *j*. To capture the exposure to import penetration from low-cost locations, we used the share of an industry's imports from China relative to all extra-EU-28 imports or the share of an industry's imports from developing Asia[8] in total extra-EU-28 imports and the share of employment in foreign enterprises in sector *i* of country *j* at time *t*. In addition, we included information on the share of intermediate imports from China to capture potential production-network participation or outsourcing. Different variations of the "imports-from-China"

[5] A number of studies use industry employment growth as the primary dependent variable (see, for instance, Falk and Wolfmayr, 2008). Industry share of unskilled labor is used by Autor et al. (2013) and Breemersch et al. (2019), among others.

[6] Klette and Forre (1998) and Bogliacino et al. (2012) both used R&D expenditure to proxy for innovation. Interestingly, Bogliacino et al. also found that R&D as a proxy for innovation not only mattered for firms in manufacturing industries, but also for firms active in services industries.

[7] Calculated as the share of computing equipment, communication equipment, and computer software and databases in total assets. The original data is in millions of EUR and 2015 reference prices.

[8] We include China, Indonesia, Vietnam, India, the Philippines, Malaysia, Bangladesh, Thailand, and Pakistan as developing Asia.

variable were used by Autor et al. (2013), Balsvik et al. (2015), and Breemersch et al. (2019), amongst others.

$control_{ijt}$ represents additional control variables such as the total output of industry *i* of country *j* at time *t* to account for the level of activity in an industry, value added per employee in the industry-country-year triplet to account for the level of productivity, labor costs per employee to account for factor cost, and investment per employee to account for contemporaneous investment intensity in the sector.[9] Finally, we also included the share of value added generated by foreign-owned enterprises and share of foreign-firm employment in the sector.

Given that Europe was hit particularly hard by the global financial crisis, we additionally introduced a crisis indicator variable that takes the value "1" in 2009 and 2012, the 2 years in which economic activity in Europe saw a significant contraction, and "0" otherwise. Lastly, ε_{ijt} is the error term.

Following Autor et al. (2013), our baseline specification was estimated with ordinary least squares (OLS) with a full set of country, industry, and time effects. We also introduced time-industry and time-country interaction terms as a robustness check. In order to control for endogeneity issues, while estimating we considered the empirical model with the system generalized method of moments (sys-GMM) following the approach outlined in Blundell and Bond (1998).

3. Results

Benchmark estimates of (1) regarding the change in total sectoral employment are presented in Table 1. Column 1 presents baseline estimates with the full range of country, industry, and time fixed effects, while columns 2 and 3 show estimates with interaction industry-time (2) and industry-time, country-time (3) fixed effects.

The results indicate that both business expenditure on research and development (BERD) and Chinese import share are negatively correlated with changes in total industry employment once size, capital intensity, and labor costs are accounted for. The correlation of the change in employment with foreign firm value added is negative yet insignificant, while the share of foreign employment is only statistically significant when country-time interaction terms are included. The crisis effect is statistically significant unless country-time fixed effects are added (columns 1 and 2), and insignificant otherwise (column 3).

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[9] A similar set of labor-demand controls was used by Blanco et al. (2021).

T a b l e 1

Benchmark OLS Estimates of (1)

(Dependent variable: Change in total employment between *t* and *t* + 1)

	(1)	**(2)**	**(3)**
Ln(turnover)$_{ijt}$	–0.042*** (0.003)	–0.037*** (0.003)	–0.032*** (0.003)
Investment per employee$_{ijt}$	–0.000 (0.000)	–0.001 (0.000)	–0.001** (0.000)
Personnel cost per emp$_{ijt}$	0.002*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
RD expenditure per emp$_{ijt}$	–0.000 (0.000)	–0.000 (0.000)	–0.001** (0.000)
ICT share	0.166*** (0.059)	0.116** (0.056)	0.096* (0.053)
Chinese import share$_{ijt}$	–0.065*** (0.017)	–0.045*** (0.017)	–0.029* (0.016)
Share of foreign VA$_{ijt}$	–0.000 (0.000)	–0.000 (0.000)	–0.000 (0.000)
Share of foreign emp$_{ijt}$	0.001 (0.001)	0.001 (0.001)	0.004*** (0.001)
Crisis dummy	0.004*** (0.001)	0.004*** (0.001)	0.000 (0.001)
Constant	–0.014 (0.011)	–0.078** (0.038)	–0.014 (0.047)
Time dummy	YES	YES	YES
Country dummies	YES	YES	YES
Industry dummies	YES	YES	YES
Time x industry dummies		YES	YES
Time x country dummies			YES
Observations	4,692	4,692	4,692
R-squared	0.113	0.228	0.314

Note: Standardized beta coefficients. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Own calculations based on dataset.

In order to analyze the relative importance of specific determinants on sectoral changes in total employment, all coefficients in Table 1 are presented as standardized beta coefficients of equation 1. These standardized coefficients show a change in the dependent variable correlated with one standard deviation change in the explanatory variables. Having a standardized unit of measurement allows a determination of the relative importance of factors contributing to the changes in sectoral employment. Comparing the beta standardized coefficients reveals that the strongest correlation with changes in sectoral employment comes from the sectoral share of ICT assets in total assets. The coefficients ranging from 0.096 to 0.116 implies that a one-standard-deviation change in the share of ICT assets is correlated with an approximately a 0.1-standard-deviation increase in sectoral employment. This appears to contradict the idea of labor-displacing technology negatively impacting Europe's labor markets. On the other hand, a one-standard-deviation increase in the share of imports from China in total extra EU-28 imports is correlated with a 0.065-standard deviation decrease in sectoral employment. The effect of BERD (*RD expenditure per emp$_{ijt}$*) is almost negligible as a one-standard-deviation rise in R&D spending per employee only lowers sectoral employment by up to 0.001 of a standard deviation.

Next, we explore the effects globalization and innovation activity on labor-market polarization using the share of unskilled labor (European socio-economic groups category "lower-level employees" share in total employment in a sector) as the dependent variable. The results of (1) estimated on the share of unskilled labor are presented in Table 2.

T a b l e 2

OLS Estimates of (1)

(Dependent variable: Change in the share of unskilled workers between *t* and *t* + 1)

	(1)	**(2)**	**(3)**
Ln(turnover)$_{ijt}$	–0.0814 (0.0537)	–0.0940* (0.0517)	–0.1910** (0.0826)
Investment per employee$_{ijt}$	–0.0065 (0.0060)	–0.0059 (0.0059)	–0.0063 (0.0098)
Personnel cost per emp$_{ijt}$	–0.0107* (0.0065)	–0.0148** (0.0062)	–0.0074** (0.0036)
RD expenditure per emp$_{ijt}$	–0.0024 (0.0049)	–0.0016 (0.0047)	–0.0041 (0.0077)
ICT share	0.0010 (0.0009)	0.0005 (0.0009)	0.0012 (0.0014)
Chinese import share$_{ijt}$	–0.0012*** (0.0003)	–0.0016*** (0.0003)	–0.0011** (0.0004)
Share of foreign VA$_{ijt}$	0.0008*** (0.0001)	0.0033*** (0.0001)	0.0004*** (0.0001)
Share of foreign emp$_{ijt}$	0.0022*** (0.0004)	0.0016*** (0.0002)	0.0009 (0.0006)
Crisis dummy	–0.0336*** (0.0037)	0.1010*** (0.0042)	–0.0272* (0.0152)
Constant	0.0814 (0.0537)	0.0940* (0.0517)	–0.1910** (0.0826)
Time dummy	YES	YES	YES
Country dummies	YES	YES	YES
Industry dummies	YES	YES	YES
Time x industry dummies		YES	YES
Time x country dummies			YES
Observations	4,158	4,158	4,158
R-squared	0.906	0.955	0.967

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Own calculations based on dataset.

The estimates presented in Table 2 reveal that the share of Chinese imports in total extra-EU imports is negatively correlated with the growth in the proportion of unskilled workers while, on the other hand, the correlation of foreign-firm presence, both through value added and employment, becomes statistically significant and positive. These two controls for technological intensity (share of ICT, R&D expenditure per employee) are no longer significantly correlated with the dependent variable.

3.1. Robustness Check

To test the robustness of the above results, we explored several changes to the estimated model. We first replaced the share of China in extra-EU-28 imports with the share of developing Asian economies (excluding China) in total extra-EU-28 imports (column 1). This permitted us to explore whether the negative correlation observed in the benchmark estimates was part of a broader effect of import penetration from low-cost source countries or one specific to China.

Second, we looked at whether the effect Chinese import penetration is associated with imports of intermediate products (rather than consumer or capital products) by including the share of intermediates in total Chinese imports (column 2).

T a b l e 3

Robustness Check

(Dependent variable: Change in total employment between *t* and *t* + 1)

	(1)	**(2)**	**(3)**
Ln(turnover)$_{ijt}$	–0.009*** (0.003)	–0.037*** (0.003)	–0.0113* (0.0064)
Investment per employee$_{ijt}$	–0.002*** (0.000)	–0.000 (0.000)	–0.0020*** (0.0006)
Personnel cost per emp$_{ijt}$	0.001*** (0.000)	0.003*** (0.000)	0.0017** (0.0008)
RD expenditure per emp$_{ijt}$	–0.000 (0.000)	–0.000 (0.000)	–0.0003 (0.0007)
ICT share	0.010 (0.037)	0.145** (0.056)	0.0190 (0.1637)
Share of foreign VA$_{ijt}$	–0.001 (0.001)	0.006*** (0.001)	0.0019* (0.0010)
Share of foreign emp$_{ijt}$	0.000 (0.001)	0.002* (0.001)	–0.0012** (0.0005)
Crisis dummy	0.044 (0.037)	0.060* (0.035)	–0.0066 (0.0090)
Asia import share$_{ijt}$	0.029* (0.017)		
Chinese import share$_{ijt}$		–0.048*** (0.017)	–0.0405* (0.0225)
Share of intermediate imports		0.000	
China		(0.000)	
Constant	0.080 (0.060)	0.015 (0.055)	0.0335 (0.0553)
Observations	4,692	4,692	1,327
R-squared	0.338	0.369	
Number of panels			355
AR(1)			–5.14***
AR(2)			–0.16
Hansen chi2(261)			197.84

Note: Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Own calculations based on dataset.

Finally, we present system GMM estimates (Blundel and Bond, 1998) to account for the endogeneity of turnover, investment, personnel costs, and R&D expenditure (column 3). All available lagged levels and differences were used as instruments for the endogenous variables, while the share of foreign firms (by value added and employment), the crisis indicator, and the fixed effects were considered to be exogenous.

The robustness tests fully confirmed the original estimates as the share of Chinese imports of an industry remains a key predictor of industry labor-market outcomes in the EU. The effect does not generalize to a broader group of developing Asian countries, a group that includes Indonesia, Vietnam, India, the Philippines, Malaysia, Bangladesh, Thailand, and Pakistan. In fact, the correlation between the import penetration of other South-east Asian countries and sectoral employment growth was positive, even if only weakly statistically significant. The effect of including the share of intermediate goods in Chinese imports is quantitatively negligible because it is not only virtually non-correlated with employment growth but also does not impact the estimate of overall Chinese import penetration. While the effect of R&D expenditure remains weakly negative, and is imprecisely estimated, the correlation with the ICT share remains broadly positive, albeit it is only significant in the second specification.

Finally, the system GMM estimates confirmed both the sign and size of the effect of Chinese import penetration on sectoral employment growth.

Conclusion

Along with the sluggish post-crisis recovery in Europe, the labor markets in Europe have long been seen as a cause for concern by policymakers and researchers alike. Generally considered to be less flexible and responsive than labor markets in the U.S.A. or Asia, they were hit especially hard by the global financial crisis alongside being affected by technological progress and globalization. Although the effects of different manifestations of globalization and technological unemployment have for a long time been viewed as the primary dangers for developed-country labor markets, any definitive evidence on either has proven elusive.

This paper focused on EU labor markets in the period of great upheaval between 2008 and 2018. We analyzed the impact of both Chinese import penetration and technological intensity on sectoral labor market outcomes during this period using an extensive industry-level dataset for 28 member states. Our findings suggest that the share of Chinese imports in total extra-EU-28 imports has played a major part in determining the condition of the EU's labor markets. Even after sector, country, and time fixed effects as well as sector and country specific trends were explicitly controlled for, the size of the industry and the share of Chinese imports remain the key predictors of labor-market outcomes. This could mean either that direct competition with locally made products caused a fall in demand or that local firms increasing the outsourced production of components or final products to China, triggering lower demand for local labor. Albeit not conclusively, the estimates regarding the impact of intermediate goods imports from China indicate that the impact primarily comes from direct competition in the segment of final (consumer) goods. Sectoral foreign direct investment, measured as either a share of value added generated or share of employment, appears to have had a positive effect on the overall demand for labor.

However, evidence of technological unemployment remains mixed. While the correlation between business expenditure on research and development per employee and employment growth was significantly negative in some specifications, this result was not robust to changes in specification.[10] Evidence on the effect of technological intensity, as measured by the sectoral share of ICT assets in total assets is, in comparison, that it generally correlates positively with sectoral employment growth even though the estimates are mostly not robust to specification changes. Overall, unlike the evidence on Chinese import penetration, the data do not seem to support a strong negative impact of technological intensity on sectoral employment growth in the European labor markets.

In order to fully understand the impacts of technological intensity and product-market competition from low-cost locations, notably the effect of Chinese imports on the European labor markets, further exploration is needed. More detailed data are required not only to fully understand the channels via which Chinese imports in particular are putting pressure on the EU's labor markets, but also to determine the long-run impact of technological intensity and labor-saving innovation on the aggregate and within-sector employment dynamics. Only once a detailed picture of the causes of the lackluster labor dynamics emerges will it become possible to tailor policy measures to combat technological and globalization-induced unemployment.

References

ACEMOGLU, D. – AUTOR, D. (2011): Skills, Tasks and Technologies: Implications for Employment and Earnings. In: ASHENFELTER, O. and CARD, D. (ed.): Handbook of Labor Economics. Amsterdam: Elsevier, Vol. 4B, pp. 1043 – 1171.

[10] Further, changing the measure of innovative activity or using additional lags of R&D investment per employee did not improve the significance of the correlation.

ACEMOGLU, D. – RESTREPO, P. (2020): Robots and Jobs: Evidence from US Labor Markets. Journal of Political Economy, *128,* No. 6, pp. 2188 – 2244.

AUTOR, D. H. – DORN, D. – HANSON, G. H. (2013): The China Syndrome: Local Labor Market Effects of Import Competition in the United States. American Economic Review, *103,* pp. 2121 – 2168.

AUTOR, D. H. – KATZ, L. F. – KEARNEY, M. S. (2006): The Polarization of the US Labor Market. American Economic Review, *96*, No. 2, pp. 189 – 194.

AUTOR, D. H. – LEVY, F. – MURNANE, R. J. (2003): The Skill Content of Recent Technological Change: An Empirical Exploration. Quarterly Journal of Economics, *118*, No. 4, pp. 1279 – 1333.

ANTÓN, J. – KLENERT, D. – FERNÁNDEZ-MACÍAS, E. – URZÌ BRANCATI, M. C. – ALAVERAS, G. (2020): The Labour Market Impact of Robotisation in Europe. Seville: European Commission, JRC121388.

BALSVIK, R. – JENSEN, S. – SALVANES, K. G. (2015): Made in China, Sold in Norway: Local Labor Market Effects of an Import Shock. Journal of Public Economics, *127*, pp. 137 – 144.

BECKER, S. O. – EKHOLM, K. – MUENDLER, M. A. (2013): Offshoring and the Onshore Composition of Tasks and Skills. Journal of International Economics, *90*, No. 1, pp. 91 – 106.

BLANCO, A. – BORLAND, J. – COELLI, M. – MACCARRONE, J. (2021): The Impact of Growth in Manufactured Imports from China on Employment in Australia. Econ Rec, *97*, pp. 243 – 266.

BLINDER, A. (2009): How Many US Jobs Might be Offshorable? World Economics, *10*, No. 2, pp. 41 – 78.

BLUNDELL, R. – BOND, S. (1998): Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, *87*, pp. 115 – 143.

BREEMERSCH, K. – DAMIJAN, J. P. – KONINGS, J. (2019): What Drives Labor Market Polarization in Advanced Countries? The Role of China and Technology. Industrial and Corporate Change, *28*, No. 1, pp. 51 – 77.

BOGLIACINO, F. – PIVA, M. – VIVARELLI, M. (2012): R&D and Employment: An Application of the LSDVC Estimator Using European Microdata. Economics Letters, *116*, No. 1, pp. 56 – 59.

BONTADINI, F. C. – CORRADO, J. – HASKEL, M. I. – JONA-LASINIO, C. (2023): EUKLEMS & INTANProd: Industry Productivity Accounts with Intangibles. Sources of Growth and Productivity Trends: Methods and Main Measurement Challenges. Roma: Luiss Lab of European Economics.

CHEN, H. – YI, K.-M. (2003): Trends in Vertical Specialisation and International Trade, Manuscript. New York, NY: Federal Reserve Bank of New York, September.

CORTES, G. M. (2016): Where Have the Middle-Wage Workers Gone? A Study of Polarization Using Panel Data. Journal of Labor Economics, *34*, No. 1, pp. 63 – 105.

COSTINOT, A. – VOGEL, J. (2010): Matching and Inequality in the World Economy. Journal of Political Economy, *118*, No. 4, pp. 747 – 786.

CROZET, M. – OREFICE, G. (2017): Trade and Labor Market: What Do We Know? [CEPII Policy Brief 2017-15.] Paris: CEPII Research Center.

DAUTH, W. – FINDEISEN, S. – SUEDEKUM, J. (2014): The Rise of the East and the Far East: German Labor Markets and Trade Integration. Journal of the European Economic Association, *12*, No. 6, pp. 1643 – 1675.

DOMINI, G. M. – GRAZZI, D. M. – TREIBICH, T. (2022): For Whom the Bell Tolls: The Firm-Level Effects of Automation on Wage and Gender Inequality. Research Policy, *51*, No. 7, pp. 1 – 30.

DONOSO, V. – MARTIN, V. – MINONDO, A. (2014): Do Differences in the Exposure to Chinese Imports Lead to Differences in Local Labour Market Out-Comes? An Analysis for Spanish Provinces. Regional Studies, pp. 1 – 19.

FALK, M. – WOLFMAYR, Y. (2005): Employment Effects of Trade in Intermediate Inputs with the EU Member States and Asia. Aussenwirtschaft, *60*, No. IV, pp. 441 – 461.

FEENSTRA, R. C. – HANSON, G. H. (1996): Globalization, Outsourcing, and Wage Inequality. American Economic Review, American Economic Association, *86*, No. 2, pp. 240 – 245.

FEENSTRA, R. C. – HANSON, G. H. (1999): The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979 – 1990. Quarterly Journal of Economics, *114*, No. 3, pp. 907 – 940.

GEISHECKER, I. (2005): Does Outsourcing to Central and Eastern Europe Really Threaten Manual Workers' Jobs in Germany? [Paper Presented at the Euroframe Conference, Vienna 2005.]

GEISHECKER, I. (2008): The Impact of International Outsourcing on Individual Employment Security: A Micro-Level Analysis. Labour Economics, *15*, No. 3, pp. 291 – 314.

GIBBONS, R. – KATZ, L. F. – LEMIEUX, T. – PARENT, D. (2005): Comparative Advantage, Learning, and Sectoral Wage Determination. Journal of Labor Economics, *23*, No. 4, pp. 681 – 724.

GOOS, M. – KONINGS, J. – RADEMAKERS, E. (2016): Future of Work in the Digital Age: Evidence from OECD Countries. [Flexibility@work2016.] Randstad, KU Leuven and Utrecht University.

GOOS, M. – MANNING, A. (2007): Lousy and Lovely Jobs: The Rising Polarization of Work in Britain. The Review of Economics and Statistics, *89*, No. 1, pp. 118 – 133.

GÖRG, H. – GÖRLICH, D. (2015): Offshoring, Wages and Job Security of Temporary Workers. Review of World Economy, *151*, No. 3, pp. 533 – 554.

GROSSMAN, G. M. – ROSSI-HANSBERG, E. (2008): Trading Tasks: A Simple Theory of Offshoring. American Economic Review*, 98*, No. 5, pp. 1978 – 1997.

HALL, B. H. (2011): Innovation and Productivity. [No. w17178.] National Bureau of Economic Research.

HSIEH, CH.-T. – WOO, K. T. (2005): The Impact of Outsourcing to China on Hong Kong's Labor Market. American Economic Review, *95*, No. 5, pp. 1673 – 1687.

JUNG, J. – MERCENIER, J. (2014): Routinization-biased Technical Change and Globalization: Understanding Labor Market Polarization. Economic Inquiry, *52*, No. 4, pp. 1446 – 1465.

KELLER, W. – UTAR, H. (2016): International Trade and Job Polarization: Evidence at the Worker-Level. [No. w22315.] National Bureau of Economic Research.

KLENERT, D. – FERNÁNDEZ-MACÍAS, E. – ANTÓN, J. (2020): Do Robots Really Destroy Jobs? Evidence from Europe. Seville: European Commission, JRC118393.

KRUGMAN, P. R. (2008): Trade and Wages, Reconsidered. Brookings Papers on Economic Activity, No. 1, pp. 103 – 138.

MAAREK, P. – MOITEAUX, E. (2021): Polarization, Employment and the Minimum Wage: Evidence from European Local Labor Markets. Labour Economics, *73*, No. C.

MUNCH, J. R. (2010): Whose Job Goes Abroad? International Outsourcing and Individual Job Separations. Scandinavian Journal of Economics, *112*, No. 2, pp. 339 – 360.

TOPALOVA, P. (2005): Trade Liberalization, Poverty, and Inequality: Evidence from Indian Districts. [National Bureau of Economic Research Working Paper 11614.]

TOPALOVA, P. (2010): Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India. American Economic Journal: Applied Economics, *2*, No. 4, pp. 1 – 41.

OECD (2021): Gross Domestic Spending on R&D (indicator). [Accessed on 07 March 2021.] DOI: 10.1787/d8b068b4-en.

ORTEGA-ARGILÉS, R. – PIVA, M. – POTTERS, L. – VIVARELLI, M. (2010): Is Corporate R&D Investment in High-Tech Sectors more Effective? Contemporary Economic Policy, *28*, No. 3, pp. 353 – 365.

RELJIC, J. – EVANGELISTA, R. – PIANTA, M. (2021): Digital Technologies, Employment, and Skills. Industrial and Corporate Change, pp. 1 – 22. DOI: 10.1093/icc/dtab059.

RICHARDSON, J. D. (1995): Income Inequality and Trade: How to Think, what to Conclude. Journal of Economic Perspectives, *9*, No. 3, pp. 33 – 55.

VIVARELLI, M. (2015): Innovation and Employment. [IZA World of Labor, 154.] DOI: 10.15185/izawol.154.

Appendix

Table A1

Weighted Average Values of Employment Growth Rate, Share of Chinese Imports in Total Extra-EU Imports and Business Expenditure on Research and Development (BERD) for EU-28 Member States 2008 – 2018

Country	Employment growth rate (in %)	Share of Chinese imports in all extra EU imports (in %)	BERD in EUR per inhabitant
AT	0.35	17.15	60.37
BE	0.58	13.29	64.38
BG	0.22	13.34	8.09
CY	0.55	17.82	8.16
CZ	0.41	36.22	14.90
DE	0.69	23.67	118.19
DK	–0.17	26.04	111.53
EE	0.51	21.01	20.38
EL	–0.19	21.56	3.44
ES	–0.18	21.93	14.96
FI	–0.53	18.76	190.99
FR	0.18	18.31	33.54
HR	–0.56	22.18	8.17
HU	0.98	34.15	14.18
IE	0.63	11.52	48.07
IT	–0.15	23.07	15.35
LT	–0.84	16.51	5.23
LU	2.25	36.80	22.17
LV	–1.05	14.41	2.31
MT	3.71	11.15	16.07
NL	0.17	26.94	30.65
PL	0.24	27.47	4.43
PT	–0.34	16.91	6.71
RO	–0.61	23.41	3.26
SE	0.60	18.21	111.42
SI	–0.20	14.64	38.20
SK	0.42	24.07	6.72
UK	0.04	19.83	48.03
Simple average	0.27	21.09	36.78

Note: Annual data on industry employment growth is weighted by employment in an industry of a particular country and year, the share of Chinese imports of all extra-EU-28 imports is weighted by all extra-EU-28 imports in the industry-country-year triplet, and BERD expenditure per inhabitant in EUR is weighted by total BERD spending in the relevant industry-country-year triplet.

Source: Eurostat, 2021.