GROWINPRO

Growth Welfare Innovation Productivity

Working Paper

The China syndrome revisited: Impact of innovation and globalisation pressures on labor market outcomes in the EU

Jože P. Damijan
University of Ljubljana and University of Leuven

Črt Kostevc
IUniversity of Ljubljana, IER and VIVES, KU Leuven

31/2021 August

This project has received funding from the European Union Horizon 2020 Research and Innovation action under grant agreement No 822781

The China syndrome revisited: Impact of innovation and globalisation pressures on labor market outcomes in the EU [1]

Jože P. Damijan, Črt Kostevc

Task 2.5
Deliverable DE 2.7

Ljubljana, March 2021

[1] The authors acknowledge support of the EU Horizon 2020 grant GROWINPRO GA No. 822781.

The China syndrome revisited: Impact of innovation and globalisation pressures on labor market outcomes in the EU[2]

Jože Damijan[3], Črt Kostevc[4]

Summary

This deliverable is part of the Task 2.5 with an aim to provide an industry study of the impact of globalization and innovation on employment dynamics in the EU member states. It builds on the discussion which factors to led to the decline of manufacturing employment in advanced countries. The discussion was focused on two key variables: impact of globalisation (mainly negative impact of Chinese imports) and impact of technological change (automation and robotisation of production).

This paper contributes to this research by studying the impact of both globalisation and technological change on manufacturing employment in the period between 2008 and 2018 using an extensive industry-level dataset for the EU 28 countries. Our findings robustly suggest that the increasing share of Chinese imports in total extra-EU28 imports has contributed significantly to the declining trend in EU sectors' employment. This could imply either that direct competition of Chinese products has caused a decline in demand for locally manufactured products or that local firms have increasingly shifted production of components or final products abroad, resulting in less demand for local labor. The fact that imports from China were slightly negatively correlated with changes in the share of unskilled labour seems to point to the role of outsourcing. On the other hand, we find little evidence of the impact of technology upgrading on employment growth. 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.

[2] 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

[3] University of Ljubljana and University of Leuven

[4] Corresponding author (crt.kostevc@ef.uni-lj.si), University of Ljubljana, IER and VIVES, KU Leuven

1. Introduction

EU's innovation union initiative (2011) was seen as central to achieving the goals of the Europe 2020 strategy for a smart sustainable and inclusive economy. By improving conditions and access to finance for research and innovation in Europe, the innovation-union initiative was meant to ensure that the R&D investment gap between the US or Japan and Europe would close by 2020. With the stated goal of R&D investment reaching 3% of GDP, it was estimated that 3.7 new jobs could be created by 2020 and EU's annual GDP could increase by 795 billion EUR by 2025 (EC, 2010). While the R&D intensity objective of 3% of GDP was not reached as of 2018 with the EU-28 average only reaching 2.02 per cent of GDP (OECD, 2021), there is some evidence that R&D investments in Europe have in fact helped in generating jobs over the past decades (Bogliacino, Vivareli, 2010; Goos et al., 2010).

Over the last few decades, the diffusion of a "new economy" based on ICT technologies has led to a re-emergence of the classical debate on the possible adverse consequences of innovation on employment. On the one hand, the fear of technological unemployment as a direct consequence of labour-saving innovation has always emerged in ages characterised by radical technological change. On the other, the economic theory pointed out the existence of indirect effects which can counterbalance the reduction in employment with new technologies creating new tasks in which labor has a comparative advantage and offsetting effects of newly created jobs in other sectors in the medium to long term.

While the impact of innovation and R&D spending on productivity is generally seen as positive (see for instance Ortega-Argiléset al., 2010, Hall, 2011), the judgement of the potential effects of innovation on employment has proven more contentious. Generally, product innovation is associated with increased demand for labor, while process innovation can be job destroying (Vivarelli, 2015). Despite ample anecdotal evidence and growing fears of "the age of robots", the evidence on the impact of automation technologies, in particular robotization, on labor-market outcomes remains conflicting. On one hand, Acemoglu and Restrepo (2018) confirm robust negative effects of introduction of industrial robots in the US labor markets with one more robot per thousand employees reducing the employment/population ratio by 0.2 per cent and wages by 0.42 per cent. On the other hand, Klenert at al. (2020) studying the effect of robotization on European labor markets find a significantly positive association between the number of robots in use and overall employment. Similarly, Antón et al. (2020) find that exposure to robots has had a positive effect on employment between 2005 and 2015 and a mildly negative effect prior to 2005. Overall, they find the effect of robotization to be small and ambiguous.

While the jobs of production workers are being disrupted by the rise of industrial robots and other automated machinery, white-collar workers in accounting, sales, logistics, trading, and some managerial occupations are also at risk as tasks they used to perform 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 contributed to wage inequality

and employment polarization (e.g. Goos and Manning 2007; Michaels, Natraj, and Van Reenen 2014).

The blame for stagnant wages, job losses and labor-market polarization is often directed at globalisation, more specifically at competition from low-wage countries through trade, outsourcing as well as labor migration. In the 1990s, most economic literature found globalization (i.e., international trade) had a mild effect on wages and workers' income, suggesting a moderate concern for globalization's losers (see Richardson, 1995). The issue has garnered renewed interest recently for several reasons. Firstly, the magnitude of economic changes at stake have increased as trade has continued to increase along with cross-border capital flows. In particular since the Chinese WTO accession (2001) the share of developing-country imports in developed countries had been increasing rapidly (Crozet, Orefice, 2017). Secondly, academic research on the trade and labor markets had progressed considerably. And thirdly, in a context of global crisis with persistent and oftentimes growing social inequalities, and steady deindustrialization, public opinion in many Western countries is under pressure, providing growing support to populist and/or protectionist parties.

In a seminal paper, Autor et al. (2013) show that rising Chinese imports cause higher unemployment, lower labor force participation and reduced wages in local labor markets that house import-competing manufacturing industries. Author et al. (2013) purport that import competition explains one quarter of the aggregate manufacturing employment decline in the US between 1990 and 2007. Generally, studies on the European labor markets find quantitatively smaller effects of Chinese imports, but they are still found to negatively impact the conditions in the market. Balsvik et al. (2015) find negative employment effects for low-skilled workers in Norway and observe that low-skilled workers tend to be pushed into unemployment or leave the labor force altogether. On the other hand, they find no effect on wages in Norway. They find that import competition from China explains almost 10% of the reduction in the manufacturing employment share from 1996 to 2007 which is half of the effect found by Autor et al. (2013) for the US. Dauth et al. (2014), similarly, find that that increased exposure to imports from China reduces the manufacturing employment share in German local labor markets by about 0.14 percentage points, while a much bigger effect of 1.3 percentage points is 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 has been found to negatively affect less skilled workers in particular (Feenstra and Hanson, 1996), the overall effect has been found to be comparatively small given that with further specialization the firm will become more productive and expand its operations domestically and internationally, leading to positive employment outcomes for all workers (Grossman and Rossi-Hansberg, 2008). Furthemore, studies found that offshoring increases the skilled labor's share of the wage bill in both the offshoring as well as the destination countries. For example, Feenstra and Hanson (1997, 1999) and Hsieh and Woo (2005) show that offshoring may explain a large part (up to 50 per cent) of the increased wage share of skilled

workers in the US, Mexico, and Hong Kong, respectively. Studies looking at European labor markets find similar effects of outsourcing. Becker et al (2013) show that outward FDI increases the skill intensity of German firms, while Castellani et al (2008) using data on Italian firms find that outward FDI has no impact on the skill composition except for FDI towards Central and Eastern European countries. Others show 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).

This paper combines the two strands of literature by exploring the impact of both technological progress and globalisation on European labor markets. We find that sectoral labor-market outcomes in Europe are impacted by globalisation as well as technological progress. Whereby robust 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, while R&D investment intensity may weaken it.

We proceed as follows. Firstly, the theoretical framework is outlined. Next, we describe the data and methodological issues, which is followed by the results. Robustness of the results is tested in the penultimate chapter, while the last chapter offers some conclusions.

2. Data and empirical approach

2.1. Data

The empirical analysis is based on industry-level data for 27 EU countries from 2008 to 2019. Several datasets are combined in the construction of the database. We use Eurostat's data on sectoral (2-digit NACE) employment in 000s of full-time employees and match it with data on employment by European Socio-economic groups at the one-digit aggregation level[5]. To account for the effects of innovation and research and development expenditure we supplement employment data with industry-level information on business R&D spending (BERD) and innovation activity (CIS surveys waves 6, year 2008 to wave 11, year 2018) both from Eurostat.

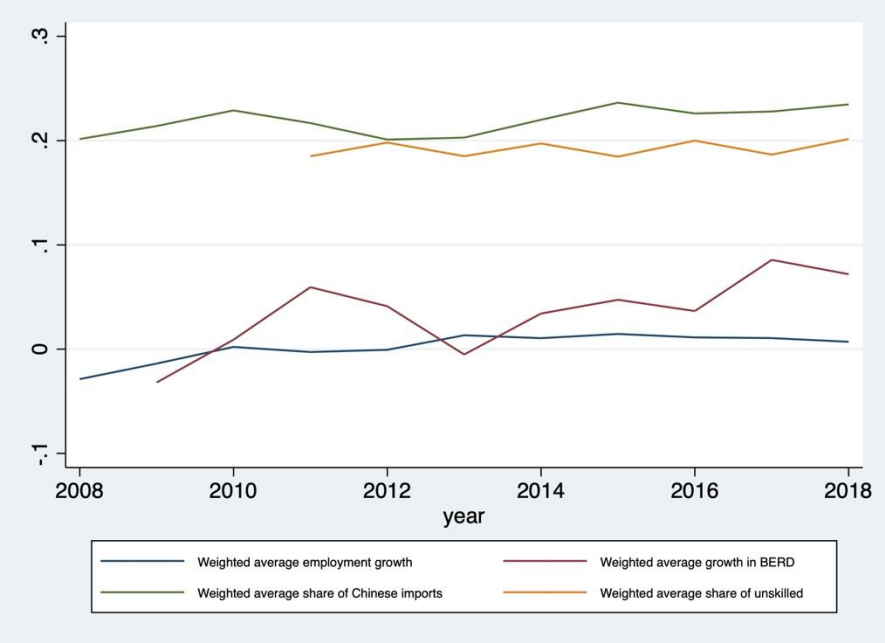
To control for effects of globalisation, we include Eurostat's industry-level information on the share of value added under control of foreign firms and share of employment under foreign-firm control. Data on imports by market of origin and destination is taken from the COMEXT trade database at the two-digit SITC classification. SITC classification at the 2-digit aggregation level is in concordance with 2-digit NACE classification. Trade data is used to calculate import concentration of Chinese and other Asian imports in EU markets by industry and destination

[5] 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".

country. Lastly, we control for gross industry output and value added generated using data from Eurostat.

The basic trends in the dataset are presented in Figure 1. While all four measure appear to have increased during the period of observation, the share of unskilled workers remained virtually unchanged throughout with some fluctuation, while the overall employment growth rate was relatively sluggish. On the other hand, the share of imports from China, already at historically high levels in 2008, continued to grow steadily in particular after 2013. Business expenditure on research and development experienced a strong boost after the collapse related to the global financial crisis.

Figure 1: Trends in key variables; total employment growth, growth in BERD, share of Chinese imports in total extra-EU28 imports and share of unskilled workers in the total labor force (all country-industry pair weighted averages 2008-2018)

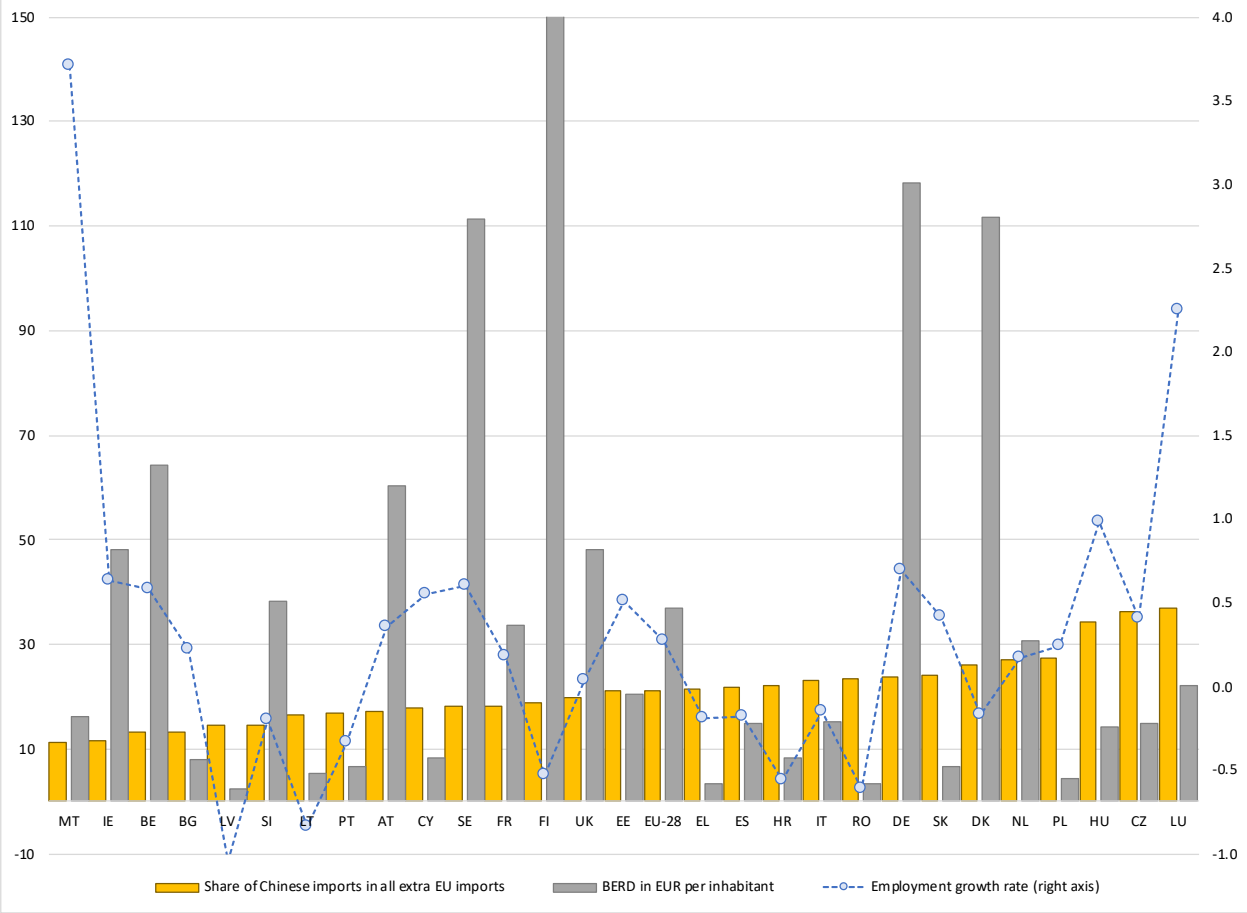


Source: Eurostat, 2021

The basic characteristics of the sample are represented by three key variables of interest in Figure 2: growth rate of total employment, share of Chinese imports in all extra-EU28 imports and BERD expenditure per inhabitant. All variables presented are calculated as weighted averages of industry-country annual observations. 11 of the 28 EU member states experienced negative average growth rates during the period of observation, which is not surprising given that two waves of the global financial crisis (henceforth GFC) strongly impacted many European countries with some sectors,

such as construction, banking and the automotive sector, being particularly affected. The share of extra-EU28 imports coming from China varies greatly across EU member states, due to differing country industry composition as well as different levels of Chinese import penetration. While the average share of imports from China across countries, industries, and time stands at 21.1 per cent, the shares in Czechia and Luxembourg are substantially higher at over 36%, while Malta and Ireland have the lowest shares at around 11 per cent. Even more pronounced are differences in business expenditure on research and development per capita, which range from only 2.3 euro (Latvia) to 191 euro (Finland).

Figure 2: Weighted average values for EU28 member states 2008-2018



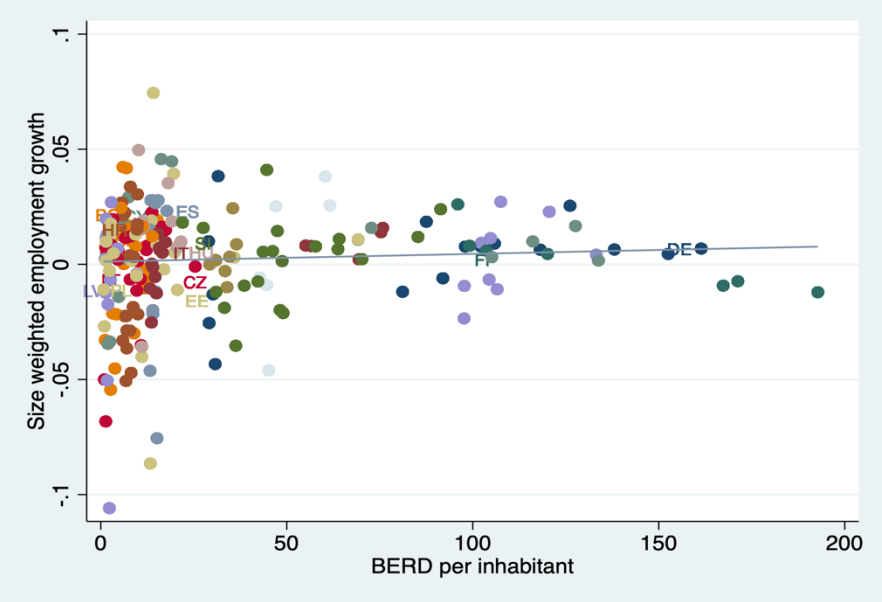
Note: Annual data on industry employment growth is weighted by employment in an industry of a particular country and year, share of Chinese imports of all extra-EU28 imports is weighted by all extra-EU28 imports in the industry-country-year triplet and BERD expenditure per inhabitant in EUR is weighted by total BERD spending in the relevant industry-country-year triplet.
Source: Eurostat, 2021

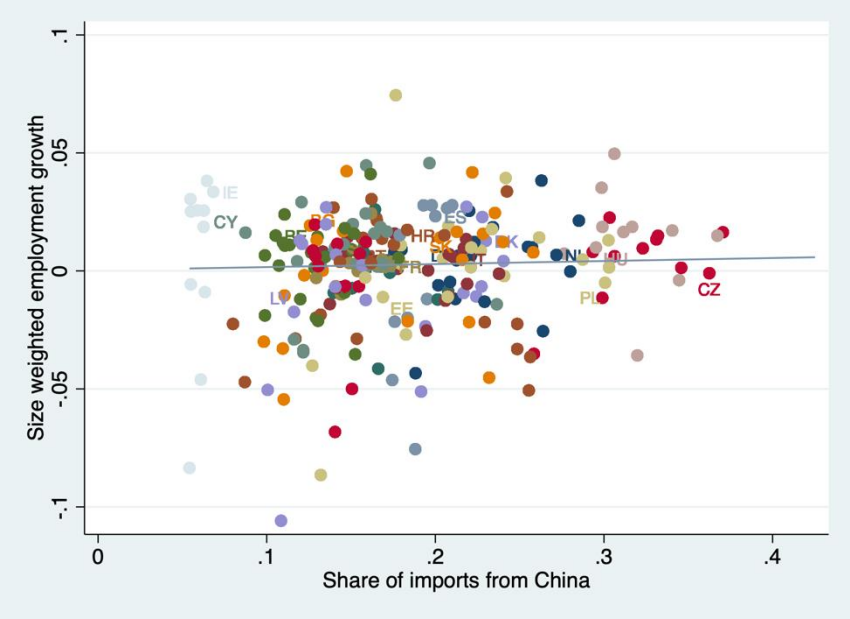
Figure 2 reveals no obvious relationships between the three variables for specific countries. Some countries experienced sluggish labor-market performance, while import penetration by Chinese

firms was low, while others did the opposite. Likewise, higher BERD to inhabitant ratios did not define labor market performance of countries.

In order to get a first glimpse at the correlation between key variables Figures 3 and 4 present scatter plots of employment growth versus innovative activity (BERD per person) and impact of globalisation (share of Chinese imports in total extra-EU28 imports) (Figure 3) and correlation between share of unskilled workers and BERD or penetration of Chinese imports (Figure 4). Country-year pairs depicted in the figures represent weighted average values across industries. Country-year average employment growth rate is weighed by total sectoral employment, BERD per person is weighed by sectoral output share and the share of Chinese imports in total extra-EU28 imports by total sectoral extra-EU28 imports.

Figure 3: Correlation between industry employment growth and BERD per person (panel 3a) and share of imports from China (panel 3b)



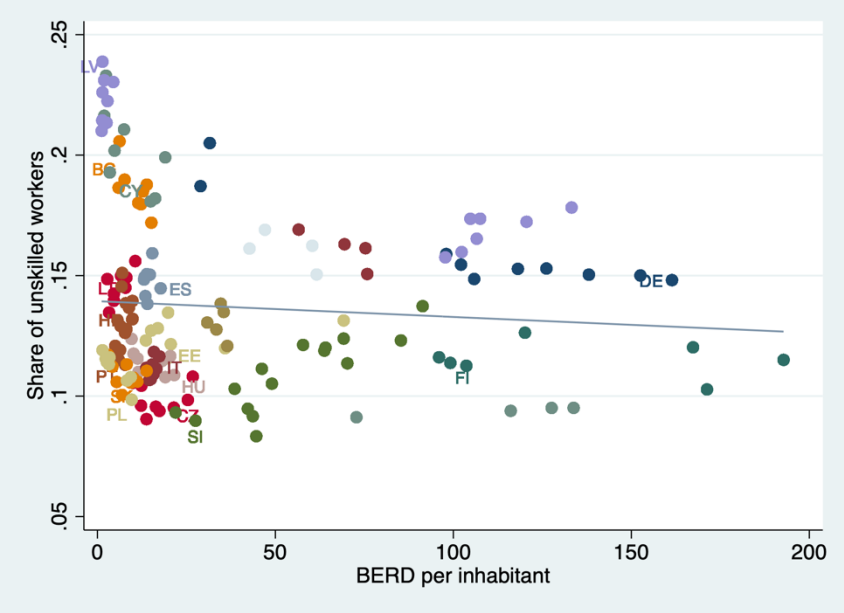


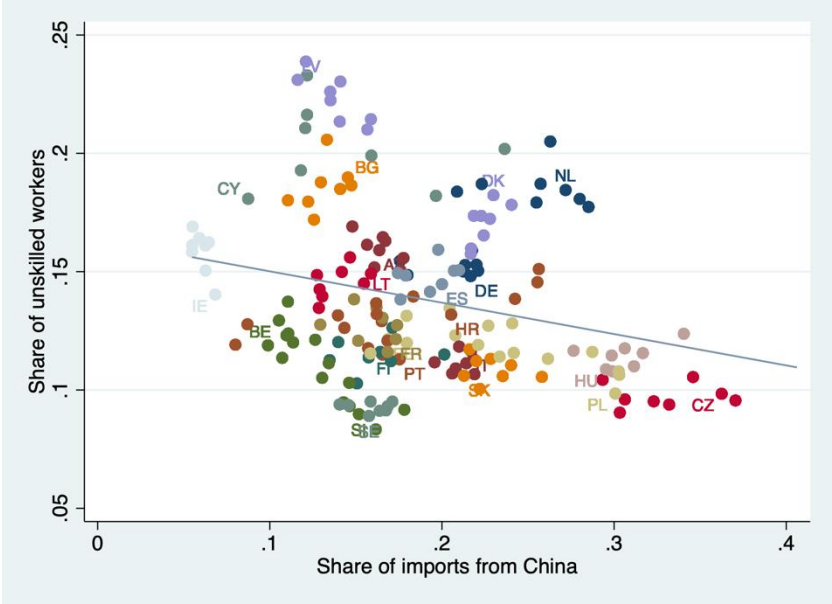
Source: Eurostat, 2021

Both the Chinese import penetration and RD investment appear to be (weakly) positively correlated with average annual employment growth. Noticeably, there is substantial dispersion across time and in particular between countries in case of BERD per inhabitant and Chinese import penetration.

Figure 4, on the other hand, depicts the correlation between weighted average shares of unskilled workers across country-year pairs and RD expenditure or Chinese import penetration. Here a clearer picture emerges with a more pronounced negative trend emerging in the data. While there is still considerable unexplained variability, the two trends clearly indicate a negative correlation between the share of unskilled workers and BERD or share of Chinese imports.

Figure 4: Correlation between 4b)





Source: Eurostat, 2021

2.2. Empirical approach

Our approach to decomposing the effects of technological change and globalisation 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 globalisation. The proposed empirical model is:

$$\Delta emp_{ijt} = \alpha + \beta_1 innov_{ijt} + \beta_2 global_{ijt} + \beta_3 control_{ijt} + \gamma_4 \sum_{t=1}^{T-1} D_t + \gamma_4 \sum_{i=1}^{I-1} D_i + \gamma_4 \sum_{j=1}^{J-1} D_t + \varepsilon_{ijt} \quad (1)$$

where Δemp_{ijt} is the change in total employment in sector *i* of country *j* at time *t*. Alternatively, we also use changes in the share of unskilled labor as an additional measure of the conditions in the labor market. $innov_{ijt}$ is the measure of innovation activity 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 only provided in two-year windows. This leads to some indeterminacy as to the exact timing of innovation. To mitigate these issues, we choose to rely mostly on business expenditure on research and development (BERD) measured as industry-level expenditure in millions of euro relative to the total number of employees in the relevant industry.

$global_{ijt}$ is a measure of an industry *i*'s exposure to globalisation at time *t* in country *j*. To capture the exposure to globalisation we use the share an industry's imports from China relative to all extra EU-28 imports or share of an industry's imports from developing Asia[6] in total extra EU-28 imports and the share of employment in foreign enterprises in sector *i* of country *j* at time *t* or share of value added generated by foreign-owned enterprises in the sector. $control_{ijt}$ represents additional control variables, such as 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. In an alternate specification we also employ a dynamic specification by including a lagged level of employment in sector *i* of country *j* at time *t* as an additional explanatory variable.

In all specifications we control for country, industry and time effects and also introduce time-industry and time-country interaction terms as a robustness check. Given that Europe was particularly hard hit by the global financial crisis, we additionally introduce a crisis indicator variable which takes on value "1" in years 2009 and 2012, the two years where there was a significant contraction of economic activity in Europe, and "0" otherwise. Lastly, ε_{ijt} is the error term.

3. Results

3.1. Base results

Benchmark estimates of model (1) on 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

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

fixed effects, while columns 2 and 3 show estimates with interaction industry-time (2) and industry-time, country-time (3) fixed effects. Lastly, column 4 presents weighted least squares results with the full set of interaction terms with industry total employment levels serving as weights.

Table 1: Benchmark OLS estimates of (1) [Dependent variable: Change in total employment between t and t+1]

	(1)	(2)	(3)	(4)
$Ln(turnover)_{ijt}$	-0.036***	-0.035***	-0.032***	-0.008***
	(0.003)	(0.003)	(0.003)	(0.002)
$Investment\ per\ employee_{ijt}$	-0.001	-0.000	-0.001**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
$Personnel\ cost\ per\ emp_{ijt}$	0.002***	0.002***	0.003***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$RD\ expenditure\ per\ emp_{ijt}$	-0.001**	-0.001**	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Chinese\ import\ share_{ijt}$	-0.069***	-0.054***	-0.046***	-0.040***
	(0.014)	(0.014)	(0.014)	(0.009)
$Share\ of\ foreign\ VA_{ijt}$	0.004***	0.004***	0.009***	-0.001*
	(0.001)	(0.001)	(0.003)	(0.000)
$Share\ of\ foreign\ emp_{ijt}$	0.004***	0.004***	0.013	0.001
	(0.001)	(0.001)	(0.012)	(0.001)
Crisis dummy	-0.014	-0.071*	0.186	-0.038
	(0.010)	(0.039)	(0.171)	(0.025)
Constant	0.027	0.046	-0.300	0.054*
	(0.044)	(0.045)	(0.363)	(0.029)
Time dummy	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
Time x industry dummies		YES	YES	YES
Time x country dummies			YES	YES
With employment weights				YES
Observations	9,643	9,643	9,643	9,643
R-squared	0.087	0.137	0.212	0.221

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

Results indicate that both 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 presence is generally positive and significant, apart from the WLS results (column 4) where the correlation with the share of foreign value added turns negative significant, while the share of foreign employment is not statistically significant when country-time interaction terms are included. The crisis effect is only statistically significant in case when industry-time fixed effects are added (2) and insignificant otherwise.

In order to analyse the relative importance of specific determinants on sectoral changes in total employment, we present standardized beta coefficients of (1) with a full set of fixed effect and interaction fixed effects in Table 2. The standardized coefficients presented below show a change in the dependent variable correlated with one standard deviation changes in the explanatory variables. Having a standardized unit of measurement allows us to determine the relative importance of factors contributing to the changes in sectoral employment.

Table 2: Beta standardized coefficient estimates of (1) with a full set of fixed effects

	(1)
$Ln(turnover)_{ijt}$	-0.032***
	(0.003)
$Investment\ per\ employee_{ijt}$	-0.001**
	(0.000)
$Personnel\ cost\ per\ emp_{ijt}$	0.003***
	(0.000)
$RD\ expenditure\ per\ emp_{ijt}$	-0.001***
	(0.000)
$Chinese\ import\ share_{ijt}$	-0.046***
	(0.014)
$Share\ of\ foreign\ VA_{ijt}$	0.009***
	(0.003)
$Share\ of\ foreign\ emp_{ijt}$	0.013
	(0.012)
Crisis dummy	0.186
	(0.171)
Constant	-0.300
	(0.363)
Time dummy	YES
Country dummies	YES
Industry dummies	YES
Time x industry dummies	YES
Time x country dummies	YES
Observations	9,643
R-squared	0.212

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

Comparing the beta standardized coefficients reveals that the share of imports from China has the largest impact on changes in sectoral employment with one standard deviation increase in the share of imports from China in total extra EU28 imports is correlated with a 0.046 standard deviation decrease in sectoral employment. The second largest correlation is found for sectoral size (log total turnover) where one standard deviation increase in the size of the sector reduces the employment growth rate by 0.032 standard deviation. While the effect of foreign-generated value added is positive, it is also comparatively small as a one deviation increase in the share of value added of

foreign-owned firms only contributes to 0.009 standard deviations increase in the growth of employment. The effect of BERD is even smaller than that with only 0.001 standard deviations decrease in the employment growth rate. Overall, the effect of innovation as measured by R&D spending is dwarfed by the effect of globalisation in the form of Chinese import penetration.

Next, we explore the effects globalisation and innovation activity on labor-market polarisation by using the share of unskilled labor (European socio-economic groups category "lower-level employees" share in total employment in a sector). The results of model (1) estimated on the share of unskilled labor are presented in Table 3.

Table 3: OLS estimates of (1) [Dependent variable: Change in share of unskilled workers between t and t+1]

	(1)	(2)
	benchmark	standardized beta coeff
$Ln(turnover)_{ijt}$	-0.0002***	-0.0002***
	(0.0001)	(0.0001)
$Investment\ per\ employee_{ijt}$	0.0000	0.0000
	(0.0000)	(0.0000)
$Personnel\ cost\ per\ emp_{ijt}$	0.0000	0.0000
	(0.0000)	(0.0000)
$RD\ expenditure\ per\ emp_{ijt}$	0.0000	0.0000
	(0.0000)	(0.0000)
$Chinese\ import\ share_{ijt}$	-0.0006*	-0.0006*
	(0.0003)	(0.0003)
$Share\ of\ foreign\ VA_{ijt}$	0.0036***	0.0022***
	(0.0008)	(0.0001)
$Share\ of\ foreign\ emp_{ijt}$	0.0032***	0.0103***
	(0.0008)	(0.0003)
Crisis dummy	0.0624	0.0623
	(0.0411)	(0.0412)
Constant	-0.1701***	-0.2709***
	(0.0388)	(0.0070)
Time dummy	YES	YES
Country dummies	YES	YES
Industry dummies	YES	YES
Time x industry dummies	YES	YES
Time x country dummies	YES	YES
Observations	7,671	7,671
R-squared	0.9119	0.9119

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

Estimates presented in Table 3 reveal that Chinese imports had a weakly significant negative effect on the growth of the proportion of unskilled workers. On the other hand, effects of foreign-owned firms, both through value added and employment, appear to be considerably stronger and positive.

The only other significant correlation is the negative correlation with log turnover implying that larger sectors had slower growth in the share of unskilled workers.

3.2. Robustness check

In order to test the robustness of the above results, we explore several changes to the estimated model. Firstly, we use CIS information on the relative share of firms which innovated in a given industry to replace BERD per employee as an indicator of innovative activity in an industry-country-time triplet. Secondly, we replace the share of China in extra-EU28 imports with the share of developing Asian economies in the total extra-EU28 imports. Lastly, we present system GMM estimates (Blundel, Bond, 1998) to account for endogeneity of turnover, investment, personnel costs and RD expenditure. 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 dummy and the fixed effects were considered exogenous.

Table 4: Robustness check [Dependent variable: Change in total employment between t and t+1]

	(1)	(2)	(3)	(4)
$Ln(turnover)_{ijt}$	-0.016***	-0.026***	-0.033***	-0.0133**
	(0.003)	(0.003)	(0.003)	(0.0064)
$Investment\ per\ employee_{ijt}$	-0.002***	0.000	0.000	-0.0008
	(0.000)	(0.000)	(0.000)	(0.0006)
$Personnel\ cost\ per\ emp_{ijt}$	0.001***	0.002***	0.003***	0.0009
	(0.000)	(0.000)	(0.000)	(0.0007)
$Chinese\ import\ share_{ijt}$		-0.026*	-0.046***	-0.0403**
		(0.015)	(0.015)	(0.0199)
$Share\ of\ foreign\ VA_{ijt}$	-0.001	0.002*	0.010***	0.0013**
	(0.004)	(0.001)	(0.003)	(0.0005)
$Share\ of\ foreign\ emp_{ijt}$	0.011	-0.001	0.008	-0.0013**
	(0.016)	(0.001)	(0.012)	(0.0005)
Crisis dummy	0.057		0.032	-0.0266***
	(0.064)		(0.160)	(0.0086)
$RD\ expenditure\ per\ emp_{ijt}$	-0.000*		0.001	0.0014
	(0.000)		(0.001)	(0.0010)
$Asia\ import\ share_{ijt}$	0.003			
	(0.018)			
$Share\ of\ employment\ of\ innovators_{ijt}$		-0.000		
		(0.004)		
$RD\ expenditure\ per\ emp_{ijt-1}$			-0.003	
			(0.002)	
$RD\ expenditure\ per\ emp_{ijt-2}$			0.001	
			(0.002)	

Constant	-0.106	0.103*		0.0883**
	(0.458)	(0.062)		(0.0399)
Observations	5,003	8,406	8,548	2,329
R-squared	0.363	0.217	0.209	
Number of panel				355
AR(1)				-6.63***
AR(2)				-0.50
Hansen chi2(263)				290.67

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

Table 4 presents the results of the robustness test. The first column reports estimates of (1) with the share of imports from developing Asian countries in total extra EU28 imports in place of the share of imports from China. The second column shows estimates of (1) with the share of employment in innovative firms replacing investment in R&D as a measure of innovative activity in an industry. The third column introduces two additional lags of the BERD per employee into the estimation in order to control for the possible lag between RD investment, innovation and its ultimate effect on the labor market. The last column reports sys-GMM estimates.

Robustness tests fully confirm the original estimates as the share of Chinese imports of an industry remains the 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 which includes Indonesia, Vietnam, India, Philippines, Malaysia, Bangladesh, Thailand and Pakistan in addition to China. While the share of employment by innovative enterprises or additional lags of RD investment are not significantly correlated with the change in employment levels of an industry, the share of Chinese imports remains a significant contributor to the sluggish labor-market performance in Europe.

4. Conclusions

Along with the sluggish post crisis recovery in Europe, the European labor markets have long been seen as a cause for concern by policy makers and researchers alike. Generally considered to be less flexible and responsive than the labor markets in US or Asia, they have been particularly hard hit by the global financial crisis in addition to being affected by technological progress and globalisation. The effects of different manifestations of globalisation and technological unemployment have long been seen as the primary dangers to developed-country labor markets, but definitive evidence on either has proven elusive.

This paper focuses on the EU labor markets in a period of great upheaval between 2008 and 2018. We analyse the impact of both globalisation and technological change on the labor market outcomes in this period using an extensive industry-level dataset for the 28 member states. Our findings suggest that the share of Chinese imports in total extra-EU28 imports played a major part

in determining the state of the EU's labor markets. This could imply either that direct competition with locally made products caused a fall in demand or that local firms increasing outsourced production of components or final products to China causing decreased demand for local labor. The fact that imports from China were mildly negatively correlated with changes in the share of unskilled workers appears to point to the role played by outsourcing. 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 Chinese import share remain key predictors of labor-market outcomes. Sectoral foreign direct investment, measured either as share of value added generated or share of employment, appear to have had a positive effect on the overall demand for labor.

On the other hand, evidence of technological unemployment remains weak. 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. Furthermore, changing the measure of innovative activity or using additional lags of the R&D investment per employee did not improve the significance of the correlation.

In order to fully understand the impacts of technological progress and globalisation, in particular the effect of Chinese imports on the European labor market, further exploration is needed. Only once a detailed picture of the causes of the lacklustre labor dynamics is known, will it be possible to tailor policy measures to combat technological and globalisation induced unemployment.

5. References

Acemoglu, D., & Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. American Economic Review, 108(6), 1488-1542.

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(): 2121–2168.

Antón, J., Klenert, D., Fernández-Macías, E., Urzì Brancati, M. C., Alaveras, G., The labour market impact of robotisation in Europe, Seville: European Commission, 2020, JRC121388.

Balsvik R., Sissel Jensen, Kjell G. Salvanes, 2015: Made in China, sold in Norway: Local labor market effects of an import shock, Journal of Public Economics, Volume 127, p 137-144,

Becker, S.O., Ekholm, K., and Muendler, M.--A., 2013. Offshoring and the onshore composition of tasks and skills. Journal of International Economics, 90 (1): 91–106.

Blundell, R., and S. Bond. 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87: 115-43.

Bogliacino, F., & Vivarelli, M. (2010). The job creation effect of R&D expenditures. IZA Discussion Paper No. 4728.

Castellani, D., Mariotti, I., & Piscitello, L. (2008). The impact of outward investments on parent company's employment and skill composition: Evidence from the Italian case. Structural change and economic dynamics, 19(1), 81-94.

Crozet M. & Gianluca Orefice, 2017. "Trade and Labor Market: What Do We Know?," CEPII Policy Brief 2017-15, CEPII research center.

Dauth, W., S. Findeisen and J. Suedekum (2014). “The rise of the east and the far east: German labor markets and trade integration.” Journal of the European Economic Association

Donoso, V., V. Martın and A. Minondo (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.

EC memo, 2010: Turning Europe into a true Innovation Union. Brussels, MEMO/10/473

Feenstra, Robert C & Hanson, Gordon H, 1996. "Globalization, Outsourcing, and Wage Inequality," American Economic Review, American Economic Association, vol. 86(2), pages 240-245, May.

Feenstra, R.C., and 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(3): 907--940.

Geishecker, I., 2008. The impact of international outsourcing on individual employment security: A micro--level analysis. Labour Economics, 15(3): 291–314.

Goos, M., & Manning, A. (2007). Lousy and lovely jobs: The rising polarization of work in Britain. The review of economics and statistics, 89(1), 118-133.

Goos, M., Manning, A., & Salomons, A. (2010). Explaining job polarization in Europe: The roles of technology, globalization and institutions (No. dp1026). Centre for Economic Performance, LSE.

Görg, H., and Görlich, D., 2015. Offshoring, wages and job security of temporary workers. Review of World Economy, 151 (3): 533–554.

Grossman, Gene M., and Esteban Rossi-Hansberg. *2008.* "Trading Tasks: A Simple Theory of Offshoring." American Economic Review, 98 (5): 1978-97.

Hall, B.H., 2011. *Innovation and productivity* (No. w17178). National bureau of economic research.

Hsieh, Chang-Tai, and Keong T. Woo. 2005. "The Impact of Outsourcing to China on Hong Kong's Labor Market." American Economic Review, 95 (5): 1673-1687.

Klenert, D., Fernández-Macías, E., Antón, J., 2020. Do robots really destroy jobs? Evidence from Europe, Seville: European Commission, 2020, JRC118393.

Michaels, G., Natraj, A., & Van Reenen, J. (2014). Has ICT polarized skill demand? Evidence from eleven countries over twenty-five years. Review of Economics and Statistics, 96(1), 60-77.

Munch, J.R., 2010. Whose job goes abroad? International outsourcing and individual job separations. Scandinavian Journal of Economics, 112(2): 339–360.

OECD (2021), Gross domestic spending on R&D (indicator). doi: 10.1787/d8b068b4-en (Accessed on 07 March 2021).

Ortega-Argilés R., Piva, M., Potters, L. and Vivarelli, M. (2010): Is Corporate R&D Investment in High-Tech Sectors more Effective?, Contemporary Economic Policy

Richardson J. D. (1995), “Income Inequality and Trade: How to Think, what to Conclude”, Journal of Economic Perspectives, vol. 9(3), pp.33-55.

Vivarelli, M. (2015): Innovation and employment. IZA World of Labor, 154 doi: 10.15185/izawol.154