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Do Schumpeterian Waves of Creative Destruction Lead to Higher Productivity? Panel Data Evidence from Poland*

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Abstract

We look at the determinants and consequences of job reallocation in the 22 2-digit sectors of the manufacturing industry in Poland over the period 1993-1997. Import competition and competitive market structure (weak concentration) are found to lead to more reallocation. Moreover, more reallocation seems to be associated with more productive industries in some specifications. This confirms implications from neo-Schumpeterian growth models: one channel through which competition might positively affect growth is through the reallocation of scarce resources from declining firms to rising ones.

Keywords: Schumpeterian growth, job flows, competition, trade

JEL Codes: F16, J24, J6, O3, P3

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1 Introduction

The continuous and simultaneous rise and decline of firms and sectors is a well documented feature of capitalist economies. Following Schumpeter, it is often referred to as creative destruction. Job creation and job destruction are an immediate manifestation of this process. Determining the factors behind job flows and understanding the consequences of the reallocation process therefore gives a clearer picture of how an economy adapts to a changing environment using information on intra-industry dynamics. This understanding is particularly important in the case of transition countries.

This paper investigates the determinants of sector level job flows in an advanced transition country (Poland) and estimates the consequences of this reallocative process on productivity. As the main determinant of job flows, we consider product market competition, measured by import penetration and concentration.

Under central planning, it is widely accepted that resources were not allocated efficiently: market structures were artificial and industries were sheltered from competition and it was expected that entire industries would collapse after trade liberalisation. Others would expand as new people, new incentives and new technologies would be installed. As a consequence, policy makers believed that this reallocation process would lead to productivity growth as labour would tend to be (re)allocated to a more efficient use[1].

Competition, through trade liberalisation, deregulation of entry or the introduction of competition authority, should foster growth. When inefficient firms are sheltered from competition, they are able to survive and to maintain excess labor. Lack of competition then lowers the rate of job reallocation and impedes necessary restructuring. Competition plays a dual role: it improves incentives to innovate and leads to more productive firms, and it leads to "survival of the fit" as inefficient firms are forced to exit or to get rid of redundant workers. Since innovation introduces new products that replace existing ones, it leads to labor reallocation between firms and between sectors. As a manifestation of the innovation process that is beneficial to growth, these flows should be positively related to the growth rates.

While these arguments are the common belief, empirical analyses of the consequences of competition on job reallocation and growth have been scarce.

[1]For a description of labour flows in transition, see Konings and Faggio (1999), Sorm and Terrell (2000) and Haltiwanger and Vodopivec (2000).

A number of papers has documented the natural evolution of industries and estimated the benefits of turnover on productivity growth (see e.g. Foster, Haltiwanger and Krizan, 1998). However most of them have failed to incorporate the dynamic effect of competition, probably because developed countries did not face dramatic change in trade policy[2].

The non-idiosyncratic determinants of job creation and job destruction are not well understood and this area of research has been relatively underdeveloped. Most studies document the evolution and the cyclicality of these variables but do not link it to sectorial developments. The reason why the question has not thoroughly been examined in the literature rests on the well documented fact that most of the job reallocation process is intra-industry and a very small percentage consists of inter-industry flows. This, according to Davis and Haltiwanger (1999), means that "*job flows are largely driven by plant-level and firm-level heterogeneity in labour demand changes", p.2725.*

However, factors like trade or increased domestic competition should speed up the process of restructuring and job reallocation, especially in the case of transition countries. Even if the restructuring process is mostly within-industry and linked to idiosyncratic factors, more competition is likely to facilitate the learning process about the talent of the manager, and to change the uncertainty factors and the firm learning process about its efficiency. Trade is the most obvious factor that would determine job flows, since import competition serves as an important factor that shapes the structure, conduct and performance of an industry. By the same argument, domestic competitive forces are another channel through which creative destruction is likely to play: lack of competitive environment would allow firms "to enjoy quiet life" and delay the painful restructuring that goes along with the constant updating of the technology.

We find evidence that job flows are positively related to competition variables (there is a positive link with the import penetration ratio and a negative link with the Herfindahl index). More importantly, we show that productivity is positively related to job flows, as an indirect manifestation of increased competition and innovation. Therefore, in line with neo-Schumpeterian growth models, we show that one of the factors through which competition might positively affect growth is through the reallocation of resources from declining firms to rising ones. While the focus in these

[2]Recent exercises have appplied these methods to developing countries (Aw et al., 1997; Levinsohn and Petrin, 1999; Pavcnik, 2002).

papers is usually on the direct mechanism through which the process is functionning (i.e. more innovation), we take an indirect measure that reflects the consequences of this process. Human capital reallocation is associated to firms' rise and decline that leads to layoffs of unskilled labour. More competition should then be associated with more unskilled labour reallocation and more reallocation to more productivity growth.

The paper proceeds as follows. In the next section we describe the models linking competition to reallocation and the empirical implications that we derive from it. Section 3 first details the datasets, then presents results. Section 4 concludes.

2 Models and testable predictions

Globalization has often been blamed as the main source of rising wage inequality and unskilled workers unemployment. Others have argued that biased technological change was the most important source behind these two facts. A few models have pointed out that both explanations might be valid, one factor influencing the other endogenously. Aghion and Howitt (1996) show that competition facilitates the reallocation of skilled labor from declining firms to rising ones. This increases the productivity of researchers and therefore leads to a higher growth rate. A by-product of the process is that the rate at which product lines are abandoned is increased as well, leading to more reallocation of unskilled workers. In Dinopoulos and Segerstrom (1999), trade liberalization leads to a decrease in relative wages of unskilled workers, because it makes R&D more profitable and therefore leads to an increase in innovation. Another interesting feature of their analysis is that there is a endogenous process of skill upgrading: following trade liberalization, more individuals decide to acquire skills. The model does not say much however on turnover and unemployment. Şener (2001) provides an interesting extension by adding a matching technology between workers and firms and a firm replacement mechanism. As in Dinopoulos and Segerstrom, trade liberalization increases the rate of innovation, increases wage inequality and leads to skill upgrading. Additionally, as the leader firm drives the followers out of the market, and as the followers lay off their workers, increased innovation also leads to a faster pace of reallocation and a higher (Schumpeterian) unemployment rate of unskilled workers. Acemoglu (1999) addresses the issue of trade liberalization and its impact on innovation and skill premia (wage

inequality). Trade liberalization induces technical change biased towards skill-intensive technologies, leading to an increase in the skill premium. Finally, Melitz (1999) provides a dynamic industry model where trade leads to the reallocation of resources among heterogeneous firms, and reallocation leads to welfare gains.

The common feature of these models is that trade or more generally competition positively influences the innovation process or the adoption of technology in a Schumpeterian growth model, and increased innovation also affects the reallocation of resources and/or the wage distribution. Some indirect implications can be tested. These relate to the effect of competition on the reallocation of resources and to the effect of this reallocation process on growth.

> **Proposition 1: Competition leads to more job reallocation. The direct mechanism implied by the model is that competition increases the relocation of developers. The indirect mechanism is that old lines are being abandoned earlier and unskilled workers are also relocated.**

The analysis of the sectorial determinants of job flows has been largely overlooked in the literature, probably due to the lack of evidence from earlier studies: Davis et al. (1996), pp.47-49 sorted all 4-digit manufacturing industries by two measures of international trade in 5 categories: very low, moderately low, average, moderately high and very high shares of import over consumption or exports over production. They found no systematic relationship between the magnitude of job flows and exposure to international trade. Similar findings were obtained by Levinsohn (1999) and Faggio (2001) who applied the same classification to Chile and transition countries. However, Baldwin (1991) pp. 139-147 and Warzynski (2002) show evidence of a positive relationship between import penetration and job reallocation in regression analysis. We follow a similar approach in this paper.

> **Proposition 2: Growth is positively correlated with job reallocation. The direct mechanism is that research becomes more productive. The indirect mechanism is that labor is reallocated faster to more productive lines.**

A small literature has analyzed whether job reallocation caused business cycles or the opposite (see e.g. Schuh and Triest, 1998). We propose a

methodology dealing with the potential simultaneity between productivity and job reallocation to investigate the causation. The time dimension of our panel is too short to investigate more precisely the timing of the relationship. In particular, we only have information on the fast recovery period that followed the transitionary recession. What we test is therefore the importance of job reallocation to explain higher productivity on a limited period of time.

3 Data and results

3.1 Data

Our dataset provides information about 2495 Polish firms. We only consider firms in the manufacturing sector in the period 1993-1997. The variables in which we are particularly interested are employment and sales. Sales are deflated using 2-digit producer price index. Firm level labor productivity is created by dividing real sales by the level of employment. An index of sector level labor productivity $PROD_{jt}$ is then defined as the size-weighted average in industry j in time t.

To be included in our dataset[3] firms must comply with at least one of the following size criteria:

- minimum operating revenue of 8 million USD
- minimum total assets of 16 million USD
- minimum number of employees of 100

Therefore this includes only big firms and we miss out most of the dynamic *de novo* small and medium enterprises. However these firms represent a large percentage of total industry employment and most likely the bulk of sector level job flows.

We complete the previous information set with concentration, trade and production data at the industry level provided by the national statistical office. We use the Herfindahl index as a measure of domestic product market competition. To assess the importance of imports compared to domestic production we compute the import over sales ratio (MS). We also compute an index to measure the export intensity (EI), defined as exports divided by sales.

[3]The sample is extracted from the Amadeus CD-rom compiled by Bureau Van Dijk

3.2 Determinants of job reallocation: the effect of competition

Using the firm-level dataset, we compute the rates of job creation (POS), job destruction (NEG), gross job reallocation ($GROSS$), net job reallocation (NET) and excess job reallocation ($EXCESS$) by sector and by year, as defined in the literature (Davis and Haltiwanger, 1990, 1992, 1999).

We then create a sector-level balanced panel (22 industries over 4 years) by linking the job flows variables to the trade and competition variables. We regress these five variables on various factors we believe are determinant in explaining the job reallocation process:

$$
\begin{aligned}
POS_{jt} &= POS\left(MS_{jt}, EI_{jt}, HERF_{jt}, year\right) \\
NEG_{jt} &= NEG\left(MS_{jt}, EI_{jt}, HERF_{jt}, year\right) \\
GROSS_{jt} &= GROSS\left(MS_{jt}, EI_{j,t}, HERF_{jt}, year\right) \\
NET_{jt} &= NET\left(MS_{jt}, EI_{jt}, HERF_{jt}, year\right) \\
EXCESS_{jt} &= EXCESS\left(MS_{jt}, EI_{jt}, HERF_{jt}, year\right)
\end{aligned}
$$

where j is an industry index and t is a time index.

We are especially interested in three types of industry-level variables. First, trade factors are likely to affect job flows. High import share (MS) should lead to major restructuring as firms exposed to foreign competition will be put under pressure to become more efficient. Export intensity (EI) might force firms to adopt better technologies to remain competitive on a global scale and lead to labour readjustments. Second, the degree of domestic concentration should be a significant variable to explain job flows. We take the Herfindahl index ($HERF$). Third, macroeconomic shocks are controlled for by adding year dummies. Table 1 presents the results. The appendix provides panel data regressions.

The results confirm most of our a priori assumptions. First, the coefficient of the share of import in domestic sale is positive and significant in the first four specifications, what appears to indicate that high import shares

lead to high job flows. However, the positive effect of MS on POS is not robust in the panel specification. It is logical that import competition has a destructive rather than constructive effect. This explains that the effect of MS on NET is negative and significant. However, import share is not significant in the $EXCESS$ equation, as the coefficient of $GROSS$ and NET cancel each other. Second, the export intensity variable has no significant effect in all specifications, although in the fixed effects specification, EI has a negative and significant effect on NEG and $GROSS$. Firms present in export-intensive industries are less likely to destroy jobs. Third, the Herfindahl index is negative and significant in the first three specifications: this leads us to believe that high concentration allows firms to operate inefficiently and that competition forces restructuring. However, this result is not robust in our panel data regressions.

3.3 Determinants of industry productivity and consequences of job reallocation

We then regress an index of industry productivity on our job reallocation variables and on the trade and competition variables. We focus our attention on two measures: $GROSS$ and $EXCESS$.

As suggested by Davis and Haltiwanger (1999), $GROSS$ is a "*useful way to summarize the heterogeneity of employment changes across business units*", as "*it entails the reshuffling of job opportunities across locations*". $EXCESS$ "*represents that part of job reallocation over and above the amount required to accomodate net employment change*" and is therefore another (more appropriate) index of simultaneous job creation and job destruction.

$$PROD_{jt} = \beta_0 + \beta_1 GROSS_{jt} \beta +_2 MS_{jt} + \beta_3 EI_{jt} + \beta_4 HERF_{jt} + \varepsilon_{jt}$$

$$PROD_{jt} = \beta'_0 + \beta'_1 EXCESS_{jt} + \beta'_2 MS_{jt} + \beta'_3 EI_{jt} + \beta'_4 HERF_{jt} + \varepsilon'_{jt}$$

Recent papers have outlined the importance of competition for providing the right incentives for firms to become more productive. Others have also noticed that exporting firms were more productive than non exporting firms due to some learning by exporting or self selection effect. Finally, through the job reallocation variables we control for the reallocative aspect of competition.

Table 1: determinants of sector level job flows

	$GROSS$	POS	NEG	NET	$EXCESS$
MS	0.016*** (9.79)	0.002* (1.86)	0.014*** (9.75)	-0.012*** (-5.75)	0.002 (1.32)
EI	-0.01 (-0.67)	-0.015 (-1.46)	0.005 (0.43)	-0.02 (-1.15)	-0.01 (-0.65)
$HERF$	-0.14*** (-2.86)	-0.069* (-1.90)	-0.076* (-1.73)	0.007 (0.11)	-0.10** (-2.05)
year dummies	YES	YES	YES	YES	YES
constant	0.086*** (6.59)	0.036*** (3.91)	0.049*** (4.36)	-0.013 (-0.79)	0.049*** (3.84)
Adj.R^2	0.57	0.10	0.56	0.32	0.15

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; t-stat in parentheses

In tables 2 and 3, we propose the results of three different estimation methods. Tables 2a and 3a provide the OLS estimates. However, we should not trust these results because of a potential simultaneity bias between productivity and the job reallocation variables. We therefore instrument job reallocation in two different ways:

As a first strategy, we use the analysis of the previous subsection and instrument job flows variables with the trade and concentration variables. In that case, we need at least one additional variable (instrument) in the job flow equation. Results with the share of public firms in total sales used as instrument are found in tables 2b and 3b. There are a few problems associated with this method: first, our trade and competition variables could also be considered as endogenous. Second, it is probably too strong to assume that the error term of the productivity equation will not be correlated with our proposed instruments.

We deal with these issues in tables 2c and 3c. We instrument the reallocation variables and the other industry level variables by applying the GMM method à la Arellano and Bond (1991), imposing as a moment condition that:

$$\begin{aligned} E\left(FLOW_{j(t-2-n)}\varepsilon_{jt}\right) &= 0, n = 0, 1 \\ E\left(MS_{j(t-2-n)}\varepsilon_{jt}\right) &= 0, n = 0, 1 \\ E\left(EI_{j(t-2-n)}\varepsilon_{jt}\right) &= 0, n = 0, 1 \\ E\left(HERF_{j(t-2-n)}\varepsilon_{jt}\right) &= 0, n = 0, 1 \end{aligned}$$

where $FLOW = \{GROSS, EXCESS\}$

This method considers that all our right hand side variables are potentially endogenous and therefore need to be instrumented.

In tables 2a and 3a, the results from the OLS specification indicate that the $EXCESS$ variable is not significant and that gross job reallocation is negatively and significantly related to industry productivity. The Herfindahl is positively and significantly related to industry productivity and so is import penetration ratio. In both cases the random effects specification is validated by an Hausman specification test.

Table 2a: determinants of industry productivity: effect of $GROSS$

Dep.var.: $PROD$	OLS	RE	FE
$GROSS$	-2.67** (1.30)	-2.77** (1.18)	-2.27** (1.10)
$HERF$	1.68*** (0.62)	1.767** (0.83)	-1.86 (1.93)
MS	0.18*** (0.03)	0.133*** (0.03)	-0.026 (0.059)
EI	0.16 (0.17)	0.074 (0.24)	0.80 (0.75)
year dummies	YES	YES	YES
constant	0.95*** (0.19)	1.076*** (0.211)	1.48*** (0.36)
Adj. R^2	0.50	-	-
R^2 within	-	0.20	0.33
R^2 between	-	0.67	0.13
R^2 overall	-	0.50	0.02

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

Table 3a: determinants of industry productivity: effect on $EXCESS$

Dep.var.: $PROD$	OLS	RE	FE
$EXCESS$	0.44 (1.35)	-0.71 (1.20)	-2.15** (1.06)
$HERF$	2.11*** (0.62)	2.12** (0.84)	-1.96 (1.94)
MS	0.14*** (0.02)	0.086*** (0.023)	-0.086* (0.051)
EI	0.19 (0.17)	0.11 (0.25)	1.023 (0.737)
year dummies	YES	YES	YES
constant	0.70*** (0.17)	0.87*** (0.20)	1.35 (0.338)
Adj. R^2	0.47	-	-
R^2 within	-	0.15	0.33
R^2 between	-	0.65	0.19
R^2 overall	-	0.47	0.06

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

In tables 2b and 3b, we instrument job flows using the specifications of the previous subsection, we find that our estimates of the job flows coefficients are positive. This would suggest that the reallocative effect of trade and competition is important, and that correcting for simultaneity bias is a necessary precaution. OLS and IV results differ significantly, as indicated by the Hausman specification test, which would suggest to favor the IV results.

Table 2b: determinants of industry productivity: effect of $GROSS$

Dep.var.: $PROD$	2SLS	G2SLS
$GROSS$	6.64** (3.18)	6.02** (2.80)
$HERF$	3.00*** (0.90)	2.99*** (1.05)
MS	0.03 (0.06)	0.004 (0.05)
EI	0.24 (0.22)	0.20 (0.28)
year dummies	NO	NO
constant	0.28 (0.37)	0.40 (0.36)
Adj. R^2	0.15	-
R^2 within	-	0.02
R^2 between	-	0.57
R^2 overall	-	0.23

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

Table 3b: determinants of industry productivity: effect on $EXCESS$

Dep.var.: $PROD$	2SLS	G2SLS
$EXCESS$	7.08** (3.00)	6.67** (2.85)
$HERF$	2.75*** (0.77)	2.70*** (0.93)
MS	0.13*** (0.02)	0.10*** (0.03)
EI	0.24 (0.21)	0.20 (0.26)
year dummies	NO	NO
constant	0.47* (0.27)	0.53** (0.28)
Adj. R^2	0.28	-
R^2 within	-	0.03
R^2 between	-	0.73
R^2 overall	-	0.33

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

However, using GMM instruments (tables 2c and 3c), the results differ again in a striking way, suggesting that the trade and domestic competition variables are also partially endogenous. Imports and exports might be driven by the productivity of the industry, and firm productivity would be a determinant of market structure, as is often argued.

If we consider this specification as the most rigorous in terms of econometrics, then job flows are not affecting industry productivity and trade variables are always positively related to industry productivity. This could mean that import discipline and learning by exporting leads to better incentives and more productivity. The most convincing explanation for these results is that we only capture the direct link from trade to growth in our specification. Domestic concentration has a positive but not significant effect on industry productivity in the two specifications after controlling for potential simultaneity, suggesting the emergence of market forces shaping market structure.

Table 2c: determinants of industry productivity: effect of $GROSS$ (GMM estimates)

Dep.var.: $PROD$	
$GROSS$	-4.52 (4.15)
$HERF$	0.61 (0.59)
MS	0.35*** (0.03)
EI	0.29** (0.11)
year dummies	YES
constant	1.32** (0.38)
Sargan, d.f.	6.35, 8
p-value	0.608

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

Table 3c: determinants of industry productivity: effect of $EXCESS$ (GMM estimates)

Dep.var.: $PROD$	
$EXCESS$	-0.72 (2.81)
$HERF$	0.99 (0.78)
MS	0.32*** (0.01)
EI	0.37*** (0.12)
year dummies	YES
constant	0.84*** (0.24)
Sargan, d.f.	6.80,8
p-value	0.558

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

4 Conclusion

This paper analysed the causes and consequences of job reallocation in Poland over the period 1993-1997. Import competition and domestic competition were shown to influence considerably the extent of job reallocation. Moreover, job reallocation under some conditions appeared to be positively related to productivity growth. This confirms predictions of neo-Schumpeterian models: one of the channels through which competition could positively influence growth is by accelerating the reallocation of scarce human capital, and therefore the rise and decline of firms. We stressed in the paper that this exercise could be considered as an **indirect** test. A more interesting exercise would be to analyse the direct mechanism, i.e. the effect of competition on innovation. This is unfortunately not possible with our dataset.

Another interesting extension would be to analyse more in details the social consequences of this large reallocation process, for example by linking it to labour force surveys analyses. While most of the papers focus on efficiency other factors are obviously being considered by organised lobbies like trade unions and by governments. Individuals with outdated skills would find it difficult to find another job if they are fired following restructuring. These issues are left for future research.

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Appendix: panel data estimates

Table A1: determinants of POS (fixed and random effects regressions)

Dep.var.: POS	Fixed effects	**Random effects**
MS	0.0002 (0.004)	0.001 (0.001)
$HERF$	0.167 (0.146)	-0.046 (0.047)
EI	-0.029 (0.055)	-0.015 (0.013)
Year dummies	YES	YES
R^2 within	0.22	0.15
R^2 between	0.03	0.15
R^2 overall	0.003	0.14

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

We can not reject the hypothesis that the coefficients are the same, and therefore we favour the random effects specification.

Table A2: determinants of NEG (fixed and random effects regressions)

Dep.var.: NEG	**Fixed effects**	Random effects
MS	0.027*** (0.005)	0.015*** (0.001)
$HERF$	-0.13 (0.19)	-0.086* (0.05)
EI	-0.13* (0.07)	0.004 (0.014)
Year dummies	YES	YES
R^2 within	0.62	0.59
R^2 between	0.38	0.69
R^2 overall	0.37	0.59

Note: *,**,*** denotes respectively statistical significance at the 10%, 5% and 1% level; standard errors in parentheses

We can reject the hypothesis that the coefficients are the same, and therefore we favour the fixed effects specification.

Table A3: determinants of $GROSS$ (fixed and random effects regressions)

Dep.var.: $GROSS$	**Fixed effects**	Random effects
MS	0.027*** (0.006)	0.016*** (0.001)
$HERF$	0.034 (0.227)	-0.146** (0.06)
EI	-0.164* (0.086)	-0.011 (0.017)
Year dummies	YES	YES
R^2 within	0.52	0.49
R^2 between	0.30	0.72
R^2 overall	0.30	0.60

We can reject the hypothesis that the coefficients are the same, and therefore we favour the fixed effects specification.

Table A4: determinants of $EXCESS$ (fixed and random effects regressions)

Dep.var.: $EXCESS$	Fixed effects	**Random effects**
MS	0.001 (0.006)	0.002 (0.002)
$HERF$	-0.014 (0.235)	-0.102* (0.05)
EI	-0.068 (0.089)	-0.009 (0.014)
Year dummies	YES	YES
R^2 within	0.24	0.19
R^2 between	0.01	0.30
R^2 overall	0.06	0.21

We can not reject the hypothesis that the coefficients are the same, and therefore we favour the random effects specification.

Table A5: determinants of NET (fixed and random effects regressions)

Dep.var.: NET	**Fixed effects**	Random effects
MS	-0.026*** (0.006)	-0.014*** (0.002)
$HERF$	0.30 (0.25)	0.042 (0.077)
EI	0.105 (0.094)	-0.018 (0.022)
Year dummies	YES	YES
R^2 within	0.55	0.51
R^2 between	0.12	0.29
R^2 overall	0.23	0.36

We can reject the hypothesis that the coefficients are the same, and therefore we favour the fixed effects specification.

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