Negative Shocks, Job Creation, and Selection

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Negative Shocks, Job Creation, and Selection

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Contribution to the Project

This research paper investigates (i) the impact of intra-industry competitive selection processes triggered by internationally generated shocks on aggregate employment and productivity, and (ii) the effectiveness of Active Labour Market Policies in countering the employment and welfare effects of a negative shock.

Negative Shocks, Job Creation, and Selection

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Abstract: High inter-country variability characterises the responsiveness of both output to (exogenous) shocks and employment to output contractions. We argue that inter-country differences in firm-size distributions contribute to explaining this variability. Within an open economy model, we show that competitive selection processes are an important channel through which a shock affects aggregate employment. Intra-industry selection is then shown to influence the effectiveness of active labour market policies in countering the employment and welfare effects of a negative shock. We estimate a measure of the shape parameter of firm size distribution and study its effect on the employment-output relationship for a number of OECD countries. Our results confirm the key predictions of the theory.

JEL classification: E22, E64, F12, F41

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1. Introduction

An important stylised fact – confirmed by the Great Recession – concerns the existence of high inter-country variability in the responsiveness of both output to (exogenous) shocks and employment to output contractions. This variability reflects country-specific productivity responses to shocks which, in turn, have been explained with differences in labour market institutions (e.g. employment protection laws that affect lags in laying-off workers in a recession; work-sharing agreements) and/or in aggregate economic structures (e.g., countries specialised in relatively labour intensive sectors experience higher employment responses).

In this paper, we argue that inter-country differences in *intra-industry reallocations and selection* can be an important channel through which a shock affects aggregate outcomes. Specifically, we conjecture that variations across countries in the productivity distribution of firms can contribute to explaining the observed differences in aggregate employment. This channel will then be of relevance in explaining the level and effectiveness of policy interventions aimed at increasing employment and/or offsetting the effects of negative shocks.

In recent years, an extensive body of literature has documented the existence of a significant degree of intra-industry heterogeneity between firms in characteristics, behaviour and performance in international markets.[1] A key stylised fact emerging from this evidence is that there is a positive correlation between firms' performance and their size and productivity – despite the considerable variations observed in the strength of this link across countries and industries as well as over time. Economists have recently started to highlight the impact of intra-industry reallocations on aggregate performance. Di Giovanni and Levchenko (2013) find that the size composition of industries interacts with trade openness in determining aggregate output volatility. Several studies document how misallocations across heterogeneous production units can affect aggregate productivity and the transmission of shocks (e.g., Baily *et al*., 1992; Restuccia and Rogerson, 2010). Of particular interest is that different firms exhibit different cyclical patterns of net job creation (Moscarini and Postel-Vinay, 2012; Elsby and Michaels, 2013). It is therefore plausible to conjecture that intra-industry reallocations are also likely to have some impact on the aggregate employment effects of shocks. A further implication of these studies is that policy-induced distortions can be responsible for the observed inter-country variations in the strength of the inter-firm productivity-size link and for total factor productivity differences (e.g. Bartelsman *et al*., 2013). For instance, Garicano *et al*. (2013) and Gourio and Roys (2013) show that size dependent regulations affect both the firm-size distribution and the extent of industry misallocations.

[1] For recent surveys of the theoretical and empirical literature see, respectively: Melitz and Redding (2012) and Bernard *et al*. (2012).

In the first part of this paper, focusing on a small number of OEDC countries, we provide some evidence of significant inter-country differences in output and employment fluctuations over time, and in the size distribution of firms.

We then proceed to develop a theoretical model that can provide a rationale for these stylised facts. We consider a small open economy producing two goods with labour endogenously supplied by households to study the effects of intra-industry structure on output, employment, and welfare. We also examine how intra-industry reallocations influence the effectiveness of Active Labour Market Policies (ALMP), in the form of employment subsidies, in countering the effects of a shock on employment and welfare. These policies, whose use is widespread across the OECD and has increased during the recent recession, are central to the "European Employment Strategy" to address structural unemployment and to increase labour participation.

We show intra-industry inter-firm heterogeneity and selection to be a channel through which shocks, by affecting average industry productivity, impact on employment and welfare. We find that, in an export-oriented small open economy, a negative demand shock toughens competition for exporters (reducing the extensive margin and increasing the intensive margin of export) but softens it in the domestic market (by reducing the minimum productivity required to survive in the industry). In essence, the shock has an anti-competitive effect that – by reallocating market shares towards less efficient firms – results in a lower average industry productivity, lower employment and lower welfare. However, countries with a 'more efficient distribution of firms' (i.e. with a distribution that is skewed towards higher productivity levels)[2] are shown to weather out the shock better than less efficient ones – and experience a weaker anticompetitive selection effect and smaller aggregate employment and welfare losses.

Competitive selection and intra-industry structure are also shown to affect the usefulness of ALMP in countering the employment and welfare effects of a negative shock. Specifically, we assess the effectiveness of employment subsidies in preserving and/or creating employment; we also examine whether targeted policies (to specific types of firms) may be desirable by considering uniform policies (across all firms in the industry), and ones that either target the non-exporter or the exporters only.

In the face of the negative employment effects of the recession, hiring credits (i.e. subsidies to firms that encourage hiring of workers) are perceived as being more effective than worker subsidies (that encourage active labour force participation) in generating employment – see, e.g., Neumark (2011). We find, instead, that worker subsidies are preferable to employment subsidies paid to firms: the 'best' policy entails taxing firms and subsidising workers. This policy mix toughens the selection of exporters (thus reducing the extensive and increasing the intensive margin of export) and increases average industry

[2] The 'efficiency' of the distribution will be discussed later in the analysis.

efficiency, and expands aggregate demand directly by increasing workers' income. Only when the production for domestic sales but not for exports (which is relatively more efficient) is targeted is this result reversed. Furthermore, a uniform policy (that does not discriminate between exports and domestic sales) is dominated, from a welfare point of view, by a policy that targets exports (i.e. the more efficient firms). Thus, the 'best' policy (in terms of employment and welfare) entails picking the winners (i.e. the exporters) by taxing them to sustain aggregate demand and employment via workers subsidies.

A further result of the theoretical analysis is that when ex-ante (i.e. pre-shock) ALMPs are in place, the negative effects of a shock are more enhanced (as it produces stronger anti-competitive effects and reallocations of market shares to less efficient firms). However, after the shock (and before any policy adjustment) employment and welfare are still higher than without ALMPs and the industry is more competitive – with higher intensive margins of export.

Finally, we make an initial attempt at bringing the key testable hypothesis concerning the role of firm heterogeneity that emerges from the theory to the data. To this end, we estimate a parameter representing the firm size distribution and examine its explanatory role within the relationship between aggregate employment and income for a number of OECD countries. Although our data availability does not allow us to study the effects of the shape parameter of the distribution at the country level over time, our pooled analysis confirms that it does matter in determining the effects of output on (un)employment. Specifically, we find that the shape parameter of the distribution has a negative impact on employment: ceteris paribus, the employment level is lower the more skewed is the size distribution of firms towards smaller firms. Furthermore, the fall in employment resulting from an output contraction is smaller the more heterogeneous are firms (i.e. the less skewed is the distribution towards smaller firms). These results are fully consistent with the predictions of our theoretical model.

The rest of the paper is organised as follows. Section 2 provides the important stylised facts that motivate the paper. Section 3 develops the theoretical model. Section 4 tests the importance of the shape parameter of the distribution for the relationship between employment and output. Section 5 concludes the paper.

2. Inter-Country Differences – stylised facts

We begin by documenting the differences in the pattern of real economic activity between the four largest EU countries, France, Germany, Italy and the UK. Let y_{jt} and e_{jt} respectively denote, for country *j* at time *t*, the values of output and employment. We approximate *y* by the logarithm of real GDP. As for *e*, rather than using the actual level of employment, we use the employment rate (i.e. the ratio of employment to labour force) which captures fluctuations in the labour force.[3] This enables us to understand whether a rise in output increases employment relative to the labour force and does therefore lead to a reduction in unemployment. The pattern followed by y_{jt} and e_{jt} in each country is shown in the graphs in Figure 1 which document a considerable inter-country difference in the way the series have been evolving. This difference is further brought to light in Figure 2 where we compare the cyclical and trend components of the series across these countries. For instance, during the recent recession, Germany has experienced a bigger dip in output, but then a faster recovery than the other countries in this sample. Furthermore, fluctuations in employment appear to be less enhanced than those in output across the board – interestingly, as has been discussed in the literature, during the recent recession, Germany has experienced a smaller contraction in employment despite a higher drop in output. In general, it is noticeable that inter-country differences in changes in employment rate are larger than in output.

We use two methods to quantify the differences in the series across countries. First, we estimate their AR(p) representations which we report in Table 1, confirming that although both Δe_{jt} and Δy_{jt} are stationary, they exhibit rather different characteristics in terms of their cyclicality, persistence and volatility. In Figure 3, we compare the AR residuals (representing the innovations to Δe_{jt} and Δy_{jt}) of France, Italy and the UK with their German equivalent. These indicate that Germany's Δe_{it} innovations (Δy_{jt} innovations) have been less (more) volatile relative to the rest. Second, we use the structural vector autoregressive representations of $\left(\Delta e_{jt}, \Delta y_{jt}\right)$ and the autoregressive distributed lag model – relating Δe_{jt} to its own lags and to Δy_{jt-s} – to estimate the impulse response of Δe_{jt} to exogenous shocks and its dynamic multipliers with respect to a change in Δy_{jt} (see Appendix 1 for detail). Figure 4 shows these, further highlighting the differences in the way employment responds to exogenous shocks, and to changes in output. Again, Germany's case is noticeable with a smaller immediate impact which declines monotonically and steadily. The UK also exhibits a similar pattern but its immediate impact is more enhanced. Italy's employment, on the other hand, shows a volatile response to shocks. Such inter-country differences in the response of employment reflect differences in productivity responses and have been ascribed to the way labour market institutions (e.g.: employment protection laws that affect lags in laying-off workers in a recession, or work-sharing agreements), and/or differences in aggregate economic structures (with countries specialised in relatively labour intensive sectors experiencing higher employment responses) vary across countries.

[3] Given that we focus on welfare, using the logarithm of total employment (employees + self-employed) for *e* can be misleading in that the underlying policies do not necessarily target the absolute level of employment and are primarily concerned with the proportion of participating labour force that is employed so as to reduce the unemployment rate $u = 1 - e$.

In this paper we conjecture that one of the reasons for the variations in the response of employment lies in *intra-industry reallocations and selection*. In particular, we wish to examine whether the distribution of firms in a country can explain the way its aggregate employment reacts to exogenous shock and/or changes in its output. There is ample evidence in the literature on the existence of considerable variations across countries of firms' size distribution, where firms' size is found to be correlated positively with their performance. Given the difficulties involved in obtaining accurate measures of productivity to approximate performance, we follow others (see, e.g., Moscarini and Postel-Vinay, 2012) and use employment as a measure of firm-level performance and size. Figure 5 plots the cumulative distribution of firm-level employment for the four EU countries considered above, showing that considerable differences exist between their firm size distributions, with the UK and Germany having a larger proportion of bigger firms than France and Italy.

Following the convention in the literature, in our theoretical analysis detailed in the next section, we shall approximate the probability density function of firms' size by a Pareto distribution and use the corresponding shape parameter to characterise differences in distribution when investigating the role played by this channel in transmitting the impact of policies.

3. Theoretical Analysis

We consider a small open economy consisting of two sectors, one imperfectly and one perfectly competitive, respectively producing a horizontally differentiated and a homogeneous commodity.[4]

The homogeneous good is freely traded with the rest of the world. All varieties of the differentiated commodity are exported but none is imported. The small open economy (SOE) assumption requires the export revenue for the differentiated commodity to be treated as exogenous (i.e. total expenditure by the rest of the world on the good is inelastic and exogenously given).[5] Labour, the only factor used in production, is internationally immobile but perfectly mobile between the two sectors. Labour supply is endogenous. Thus, although employment effects do not result from a labour market distortion in this model, this assumption enables us to capture the endogeneity of the level of economic activity and to study the aggregate employment effects of exogenous and policy shocks. A government implements active labour market policies, in the form of an employment subsidy, which can

[4] The model is based on Molana and Montagna (2013) who examine the effects of ALMPs on competitive selection in different trade and policy configurations. The SOE setting is adopted in this paper as it allows for an easy characterisation of exogenous (aggregate demand) shocks via demand for exports.

[5] In the traditional perfect competition literature, the SOE assumption implies that the country has a perfectly elastic demand for its exports at a constant price. As is standard in models of monopolistic competition, in this paper, the country is 'small' in the sense that it cannot affect the total aggregate expenditure for the differentiated good it exports (see, for instance, Flam and Helpman, 1987; Demidova and Rodiguez-Clare, 2013). Clearly, due to the monopoly power that each firm has in its market niche, the quantity of output sold by each firm in foreign market will be a function of its price.

be used to offset the negative impact of a fall in export demand facing the imperfectly competitive sector. The government ensures that the subsidy bill is met by the (general) tax revenue and uses tax and subsidies as instruments to achieve its policy target – e.g. to keep aggregate employment at the pre-shock level, or to maximise welfare.

3.1. Consumers and firms

On the demand side, the representative consumer maximises a utility function defined over the two consumption goods and labour supply,

$$u=\left(\frac{a}{1-\beta}\right)^{1-\beta}\left(\frac{y}{\beta}\right)^{\beta}-\frac{\theta h^{1+\delta}}{1+\delta},\quad 0<\beta<1,\quad \delta>0,\ \theta\geq 0, \tag{1}$$

subject to the time and budget constraints,

$$h+\ell=1, \tag{2}$$

$$P_A a+P_D y=\left(1-t\right)\left(wh-\tau\right), \tag{3}$$

where the total time endowment is normalised to unity, *h* and ℓ are time spent at work and leisure respectively, *a* and P_A are the quantity and the price of the homogenous commodity, *y* and P_D are the quantity and price of the differentiated good, *w* is the wage rate and *t* and τ are the income tax rate and the lump-sum tax, respectively.[6] We define the consumer price index by $P=P_A^{1-\beta}P_D^{\beta}$ and use the homogenous commodity as the numeraire. Since this commodity is freely (and costlessly) traded internationally, the law of one price holds and $P_A=P_A^*$; hereon, we use an asterisk to denote the value of a variable in the rest of the world and normalise $P_A=P_A^*=1$.

Denoting by *N* the number of consumers, the aggregate labour supply function and the demand functions for the two goods are, respectively,

$$\begin{aligned} L &\equiv Nh=N\left(\frac{\left(1-t\right)w}{\theta P}\right)^{1/\delta}, \\ A &\equiv Na=\frac{\left(1-\beta\right)\left(1-t\right)\left(wL-N\tau\right)}{P_A}, \\ D &\equiv Ny=\frac{\beta\left(1-t\right)\left(wL-N\tau\right)}{P_D}. \end{aligned} \tag{4}$$

D is assumed to be a CES bundle of differentiated varieties with 'dual' price index P_D, respectively given by

[6] This setting enables us to choose one or both taxations methods. Using a lump-sum tax is usually considered to involve less distortion (in that it does not affect the relative prices), unless the proportional tax can be argued to correct an existing distortion. In what follows we shall concentrate on the proportional income tax case, and only briefly refer to the results based on using the lump-sum taxation.

$$D=\left(\int_{i\in M} x(i)^{1-1/\sigma}di\right)^{\frac{1}{1-1/\sigma}} \quad \text{and} \quad P_D=\left(\int_{i\in M} p(i)^{1-\sigma}di\right)^{\frac{1}{1-\sigma}}, \qquad (5)$$

where *i* and *M* denote a variety and the set of varieties and *p* and *x* are the price and quantity of a variety. The demand for each variety is then

$$x(i)=D\left(\frac{p(i)}{P_D}\right)^{-\sigma}, \qquad i\in M. \qquad (6)$$

A subset $M^*\subseteq M$ of the differentiated goods is also marketed abroad and attracts a fixed proportion β^* of foreign nominal income I^*, hence $\int_{i\in M^*} p^*(i)x^*(i)di=\beta^*I^*$ where x^* is the quantity demanded of a variety by consumers abroad and p^* is the corresponding variety price. Let P_D^* and D^* be the corresponding aggregate price and quantity indices such that $P_D^*D^*=\beta^*I^*$. Assuming, for simplicity, that consumers abroad have the same elasticity of substitution between any two varieties as that of domestic consumers, P_D^* and p^* and D^* and x^* are related as in (5) and the demand for each variety can be written as

$$x^*(i)=D^*\left(\frac{p^*(i)}{P_D^*}\right)^{-\sigma}, \quad i\in M^* \qquad (7)$$

The homogenous good is produced under perfectly competitive conditions using a constant returns to scale technology with unit labour requirement, $L_A=A^s$ where L_A and A^s denote the labour demand by this sector and the supply of the good, respectively. The constant returns to scale technology, the zero-profit condition and free mobility of labour across the two sectors imply the equality between the wage rate and the price of the homogeneous good, hence $w=P_A=1$.

In the differentiated good sector, each firm produces one variety of the good using a linear technology with increasing returns to scale. Labour is the only input and the labour requirements, to produce and market the quantities *x* and x^* of a variety in domestic and foreign markets, are respectively, $l(\varphi)=\alpha+\frac{x(\varphi)}{\varphi}$ and $l^*(\varphi)=\alpha^*+\frac{x^*(\varphi)}{\varphi}$ where we have dropped the variety indicator *i* and distinguished the firm by its productivity parameter $\varphi\in[1,\infty)$. $1/\varphi$ is a firm's marginal labour requirement and α and α^* are its fixed labour requirement for the domestic and export productions respectively.[7] To capture the fact that exporting is costlier than domestic sales, it is assumed that $\alpha^*>\alpha>0$. Imposing *w*=1, a

[7] Note that in the existing setup where the country exports but does not import the differentiated good, the ice-berg transport cost that is commonly used in the literature will be simply equivalent to a proportional reduction in productivity of exporting firms for their export relative to their production for domestic market, and therefore will not add much; for this reason it has been disregarded here.

firm's profits from domestic and export sales are, respectively, $\pi(\varphi) = p(\varphi)x(\varphi) - (1-s)l(\varphi)$ and $\pi^*(\varphi) = p^*(\varphi)x^*(\varphi) - (1-s^*)l^*(\varphi)$ where $s \in [0,1)$ and $s^* \in [0,1)$ are the wage subsidy rates that firms receive from the government for their domestic and export operations. For any given subsidy rate, the firm chooses its price to maximise profits subject to its technology and demand but ignoring the effect of its action on the industry price index. This yields the familiar markup rules

$$p(\varphi) = \frac{\sigma(1-s)}{(\sigma-1)\varphi} \text{ and } p^*(\varphi) = \frac{\sigma(1-s^*)}{(\sigma-1)\varphi}. \quad (8)$$

For later use, we note that using (8) the equilibrium profits from domestic and foreign sales can be written as $\pi(\varphi) = r(\varphi)/\sigma - (1-s)\alpha$ and $\pi^*(\varphi) = r^*(\varphi)/\sigma - (1-s^*)\alpha^*$ where $r = px$ and $r^* = p^*x^*$ are the firm's revenues.

Following Montagna (1995) and Melitz (2003) we assume that, before they can set up and start producing, a large pool F of identical potential entrants make an initial 'entry investment' which amounts to paying a fixed entry sunk cost f measured in terms of the numeraire good. This investment enables entrants to draw their technology, as embodied in the specific value of the productivity parameter φ. The draw is from a common population with a known p.d.f. $g(\varphi)$ defined over support $[1,\infty)$ with a continuous cumulative distribution $G(\varphi)$. A firm's survival in the domestic market and whether or not it can also export will depend on the magnitude of its $\varphi \in [1,\infty)$ in relation to two thresholds φ_c and φ_c^* which satisfy $\pi(\varphi_c) = 0$ and $\pi^*(\varphi_c^*) = 0$ respectively, with $1 < \varphi_c < \varphi_c^*$ (which hold under conditions specified below): firms with $\varphi \in [\varphi_c^*, \infty)$ will succeed in serving both domestic and foreign markets while those with $\varphi \in [\varphi_c, \varphi_c^*)$ can serve the domestic market only; firms with $\varphi \in [1, \varphi_c)$ will not enter since they would make a loss, while all firms with $\varphi \in (\varphi_c, \infty)$ make positive profits. Prior to entry, therefore, it is known that a fraction $G(\varphi_c)$ of F will fail to enter and that, of the fraction $M \equiv (1 - G(\varphi_c))F$ that succeed, a mass $M^d \equiv (G(\varphi_c^*) - G(\varphi_c))F$ only serve the domestic market while a mass $M^* \equiv (1 - G(\varphi_c^*))F$ of firms are sufficiently efficient to also export. Thus, ex-post, M and M^* are the mass of varieties available to domestic and foreign consumers respectively, with $M = M^d \cup M^*$, $M^d \cap M^* = 0$. We can therefore redefine the p.d.f of the surviving (incumbent) firms over $\varphi \in [\varphi_c, \infty)$ by $\mu(\varphi) = \dfrac{g(\varphi)}{1 - G(\varphi_c)}$ and the p.d.f of the exporting firms over $\varphi \in [\varphi_c^*, \infty)$ by $\mu^*(\varphi) = \frac{g(\varphi)}{1 - G(\varphi_c^*)}$. Following Melitz (2003), measures of aggregate productivity of the surviving and exporting firms can then be written as weighted averages of the productivity levels φ that satisfy respectively $\varphi \in [\varphi_c, \infty)$ and $\varphi \in [\varphi_c^*, \infty)$ to obtain[8]

$$\tilde{\varphi} = \left(\int_{\varphi_c}^{\infty} \varphi^{\sigma-1} \mu(\varphi) d\varphi \right)^{\frac{1}{\sigma-1}} \quad \text{and} \quad \tilde{\varphi}^* = \left(\int_{\varphi_c^*}^{\infty} \varphi^{\sigma-1} \mu(\varphi) d\varphi \right)^{\frac{1}{\sigma-1}}. \qquad (9)$$

All aggregate variables can then be written in terms of $\tilde{\varphi}$ or $\tilde{\varphi}^*$ which are independent of M and M^*: $D = M^{\sigma/(\sigma-1)} x(\tilde{\varphi})$; $P_D = M^{1/(1-\sigma)} p(\tilde{\varphi})$; $R = P_D D = Mr(\tilde{\varphi})$; $\Pi = M\pi(\tilde{\varphi})$; $L_D = Ml(\tilde{\varphi})$; $D^* = M^{*\sigma/(\sigma-1)} x^*(\tilde{\varphi}^*)$; $P_D^* = M^{*1/(1-\sigma)} p^*(\tilde{\varphi}^*)$; $R^* = P_D^* D^* = M^* r^*(\tilde{\varphi}^*)$; $\Pi^* = M^* \pi^*(\tilde{\varphi}^*)$; and $L_D^* = M^* l^*(\tilde{\varphi}^*)$.

In order to obtain explicit solutions, we adopt a Pareto distribution and let

$$G(\varphi) = 1 - \varphi^{-\gamma} \quad \text{and} \quad g(\varphi) = \gamma \varphi^{-(1+\gamma)}, \quad \varphi \in [1, \infty), \qquad (10)$$

where the shape parameter γ provides an inverse measure of dispersion: the higher is γ the more homogeneous are the firms.[9] To obtain meaningful results we impose $\gamma > \sigma - 1$. Using (10) and (9) imply $\tilde{\varphi}^{\sigma-1} = \left(\frac{\gamma}{1+\gamma-\sigma} \right) \varphi_c^{\sigma-1}$ and $\tilde{\varphi}^{*\sigma-1} = \left(\frac{\gamma}{1+\gamma-\sigma} \right) \varphi_c^{*\sigma-1}$. We can also use $M \equiv (1 - G(\varphi_c))F$ and $M^* \equiv (1 - G(\varphi_c^*))F$ to obtain $\frac{M}{M^*} = \left(\frac{\varphi_c^*}{\varphi_c} \right)^{\gamma}$. Finally, note that a sufficient condition for $\varphi_c < \varphi_c^*$ is $\alpha^* \geq (1-s)\alpha / (1-s^*)$ and $\beta I > \beta^* I^*$ since $r^*(\varphi_c^*) / r(\varphi_c) = (1-s^*)\alpha^* / (1-s)\alpha$ always holds.[10]

3.2. The general equilibrium

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[8] To see this, define $\tilde{\varphi} = \left(\int_{\varphi} \varphi^{-1} (x(\varphi)/x(\tilde{\varphi})) \mu(\varphi) d\varphi \right)^{-1}$ and note that the weight $x(\varphi)/x(\tilde{\varphi})$ is given by $(\varphi/\tilde{\varphi})^{\sigma}$ which can be substituted back in the definition of $\tilde{\varphi}$ to obtain (9).

[9] In the Pareto distribution, both mean and variance are negatively related to the shape parameter γ. Thus, the smaller is γ, the higher is the average firm efficiency and the higher is the productivity dispersion (i.e. the lower is the density of firms at lower productivity levels). It is in this sense that we argue that the value of γ captures the efficiency of the distribution: a "more efficient distribution of firms" is one with a higher average productivity and a higher dispersion – i.e. one with a smaller γ.

[10] $I = (1-t)(L - N\tau)$ is domestic aggregate disposable income of consumers and $\beta I > \beta^* I^*$ requires the domestic demand for the differentiated good to exceed the foreign demand, but the extent of this is dampened by $\alpha^* \geq (1-s)\alpha / (1-s^*)$.

In general equilibrium, the entry process continues until the expected *net* profit of entry is driven to zero,

$$M\pi\left(\tilde{\varphi}\right)+M^{*}\pi^{*}\left(\tilde{\varphi}^{*}\right)-Ff=0, \tag{11}$$

and marginal firms' zero profit condition require $\pi\left(\varphi_c\right)=r\left(\varphi_c\right)/\sigma-\left(1-s\right)\alpha=0$ and $\pi^{*}\left(\varphi_c\right)=r^{*}\left(\varphi_c\right)/\sigma-\left(1-s^{*}\right)\alpha^{*}=0$.

The labour market equilibrium condition, balanced government budget constraint (equating the subsidy bill with tax revenue) and the trade balance, which should hold in equilibrium, are

$$L_A+L_D+L_D^{*}=L, \tag{12}$$

$$sL_D+s^{*}L_D^{*}=t\left(L-N\tau\right)+N\tau, \tag{13}$$

$$A+Ff-A^{s}=\beta^{*}I^{*}. \tag{14}$$

In addition, the demand and supply for the homogenous good are $A=\left(1-\beta\right)\left(1-t\right)\left(L-N\tau\right)$ and $A^{s}=L_A$[11], and the market clearing conditions for the differentiated good are given, at the firm level, by $x\left(\tilde{\varphi}\right)=\left(\tilde{\varphi}/\varphi_c\right)^{\sigma}\alpha\left(\sigma-1\right)\varphi_c$ and $x^{*}\left(\tilde{\varphi}^{*}\right)=\left(\tilde{\varphi}^{*}/\varphi_c^{*}\right)^{\sigma}\alpha^{*}\left(\sigma-1\right)\varphi_c^{*}$, which at the aggregate level will require $Mr\left(\tilde{\varphi}\right)=\beta\left(1-t\right)\left(L-N\tau\right)$ and $M^{*}r^{*}\left(\tilde{\varphi}^{*}\right)=\beta^{*}I^{*}$. Finally, we note that since all markets clear, (12) and (14) can be obtained from each other and only one of them can be used in deriving the solution.

3.3. *Policy analysis*

In this section we study the effects of an exogenous (international) aggregate demand shock on the equilibrium of the model. Although the model can be characterised analytically, given the complexity of the algebra involved, we resort to numerical solutions to analyse the effects of external shocks and policy and in comparing different equilibria. Our calibration parameters are consistent with those widely used in the literature for this type of model.[12]

As a benchmark, it is useful to consider the case in which the government is not active, for which we set $s=s^{*}=t=\tau=0$. This will enable us to isolate the effects of the size of the shape parameter of the productivity distribution on the impact of a negative shock.

In what follows, welfare is measured by the indirect utility obtained by substituting (4) into the utility function in (1). For τ=0, this is given by

$$u=\frac{\theta\delta}{1+\delta}h^{\delta+1}, \tag{15}$$

[11] Equation (14) can also be interpreted as the market clearing condition for the homogenous good since it equates the value of exports with the value of domestic excess demand for the differentiated good.

[12] See e.g. Felbermayr *et al*. (2011).

which is monotonically increasing in labour supply *h*.

The first two columns of Table 2 give the equilibrium solutions for two values of γ. As is clear from the table, in the no-policy equilibrium, a reduction in γ (that results in an increase in firm heterogeneity, with the distribution becoming less 'skewed' towards low productivity levels) will increase both domestic and export productivity cut-offs, i.e. $(\partial\varphi_c/\partial\gamma) < 0$ and $(\partial\varphi_c^*/\partial\gamma) < 0$: thus, a country with a more efficient productivity distribution of firms will be characterised by a higher minimum productivity to survive in both the domestic and export markets. This essentially amounts to a toughening of market competition that results in a smaller mass of surviving firms and exporters, despite a larger number of firms attempting entry. However, the higher average industry efficiency is accompanied by a larger average size of both domestic-only and exporting firms, a lower price index (despite the smaller total mass of firms), and a higher welfare. Aggregate employment is also higher. Thus, a country with a higher degree of firm heterogeneity (in which there is a lower density of smaller, less efficient firms) will be characterised by a higher level of economic activity, with a smaller intensive (and a higher extensive) margin of export.

The third and fourth columns of Table 2 report equilibrium values after a negative export demand shock. As can be seen from the table, for a given value of γ, a negative aggregate demand shock reduces employment, real wages and welfare and reallocates market shares towards less efficient firms – with a fall in the total mass of firms being accompanied by an increase in the mass of domestic firms and a reduction in the extensive (and an increase in the intensive) margin of exports; these effects result from an increase in the export productivity cut-off and a reduction in the domestic cut-off. Thus, a negative shock in this model effectively has *anti-competitive* effects that translate into a lower average industry productivity. The last two columns of Table 2 show, however, that in a country with a higher degree of firm heterogeneity (i.e. with a lower value of the shape parameter γ) a negative shock will have less severe effects in terms of aggregate employment and welfare reduction. Effectively, in a more 'efficient' country, industries are better placed to 'weather out' the effects of a shock – experiencing weaker anti-competitive effects, with a smaller fall in the extensive (and a greater increase in the intensive) margin of exports, and a smaller reduction in average industry efficiency.

Thus, this analysis suggests that (intra-industry) competitive selection is a channel for the transmission of shocks, through which they affect aggregate industry productivity, aggregate employment and welfare. In particular, in an *export-oriented* small open economy, a negative shock has a selection-toughening effect on exporters, a selection-softening effect on less efficient firms, and an overall *anti-competitive effect* on average productivity. However, more efficient countries (characterised by a higher degree of heterogeneity among firms, i.e. a smaller shape parameter of their productivity distribution), manage to *weather* *out* the shock better and experience *weaker* anticompetitive selection effects, with a resulting smaller negative effect on employment and welfare.

In recent years, welfare state reforms have tended to be directed away from traditional redistribution systems towards the 'social investment model' associated with 'flexicurity' and Active Labour Market Programmes (ALMP). ALMP are being increasingly used by many OECD countries to reduce structural unemployment as well as to offset the impact of negative shocks[13], even though a significant disparity on spending exists across countries (Kluve, 2010). These programmes consist of policies aimed at reducing search frictions (e.g. public employment services), increasing employability (e.g. training schemes), or at direct job creation. The latter include direct employment programmes in the public sectors, but also measures directed at either private employers or workers that seek to influence hiring and labour force participation. We wish to examine how the use of ALMP influences the aggregate outcomes in response to a shock via their effects on competitive selection in this model. In particular, we shall focus on private sector incentive schemes, in the form of wage subsidies to firms, and consider a policy in which the subsidies are chosen so as to keep the level of employment at the pre-shock levels (what we term '*employment protection*' policy); we then compare this policy scenario to an *optimal* policy, in which the government chooses (*uniform* and *targeted*) subsidies to firms (in the post-shock equilibrium) that maximise welfare.

We first consider the effects of a uniform subsidy, financed via proportional income taxation, given to all firms in response to a negative shock for both their domestic and export production (i.e. $s_i = s_i^* = s \quad \forall i$): hence, the policy is implemented on the post-shock equilibrium given in column III of Table 2. The results, for the ad-hoc and optimal policy respectively, are reported in the first two columns of Table 3. For a given γ, both the policy aimed at restoring employment to pre-shock levels and the optimal policy consist of *negative subsidies* and *negative taxes* – i.e. the policy response to a shock entails *taxing firms* and *subsidising workers*. Doing so increases aggregate employment and welfare relative to the post-shock equilibrium. Underpinning these results is the fact that taxing firms and subsidising workers has a *pro-competitive effect* on industry and an *expansionary aggregate demand effect*. The former occurs because, by taxing firms, the government triggers a process of competitive selection that reallocates market shares from low to high productivity firms – and that translates, with both policies, in higher domestic and export productivity cut-offs. The direct transfer to workers, in turn, produces an increase in labour supply and in aggregate demand that contributes to the increase in employment, with both domestic-only and

[13] See Andersen and Svarer (2012) for a discussion of the Danish case. The 2013 EU Annual Growth survey, available at http://ec.europa.eu/europe2020/making-it-happen/annual-growth-surveys/index_en.htm encourages the member states to step up ALMP, paying specific attention to maintaining and even reinforcing their coverage and effectiveness. The implementation of such policies to create employment also heavily featured in the ILO-IMF 2010 conference in Oslo on "The Challenges of Growth, Employment and Social Cohesion".

exporting firms increasing in size. The effects of the intervention are qualitatively the same for both ad-hoc and optimal policies. The latter, however, is more *interventionist* and has stronger (positive) effects on welfare and aggregate employment – which increase even above their pre-shock levels, as can be seen by comparing column II of Table 3 with column I of Table 2.[14]

During the recent 'financial' crisis there have been calls for targeting particular firm types – such as for example small firms and/or exporters.[15] Table 3 also reports the results of a *targeted* policy response to the shock based on: (i) subsidising all firms' domestic production only (columns III and IV), and (ii) subsidising production for exports only (columns V and VI).[16]

It is clear from columns III and IV in Table 3 that case (i) alters the nature of the policy as it involves subsidising the firms and taxing the workers. Comparison of this case with the post-shock equilibrium in column III of Table 2, reveals that subsidising domestic production only (and hence the relative less efficient firms) reduces the average industry efficiency (by reducing both domestic and export productivity cut-offs) but results in higher employment and welfare. As with the uniform policy, even in this case the optimal policy is more *interventionist* and has stronger positive welfare and employment effects, leading to an improvement on both fronts even relative to the pre-shock equilibrium. Comparison with the effects of a uniform policy in columns I and II of Table 3, however, shows that the non-discriminatory policy in response to a shock is more expansionary and leads to higher welfare. The reason for this is that subsidisation of relatively weaker firms has an anti-competitive effect (by softening selection) – as reflected in the lower productivity cut-offs.

Instead, in case (ii), the *pick-the-winner* policy targeted to exporters only involves, as with the uniform policy, taxing firms and subsidising workers. This can be seen from columns V and VI of Table 3.

To summarise, both uniform and export-targeting policies entail taxing firms and subsidising workers. Only when targeting all firms' domestic production (and hence the relatively less efficient firms) does the policy require a positive subsidy to firms. Taxing firms and subsidising workers' income increases welfare and employment relative to the post-shock equilibrium, and to the pre-shock equilibrium levels in the case of optimal policy. The reasons for this is that this type of intervention on the one hand toughens export selection (resulting in a smaller extensive and a larger intensive margin of export) and thus increases average industry efficiency, and, on the other hand, increases aggregate demand *directly* by raising workers' income. Thus, an implication of this analysis is that workers' subsidies are

[14] Molana and Montagna (2013) discuss in more depth how international trade affects the impacts and the role of the policy.

[15] Targeted intervention has been typically based on worker type, e.g. the young or long-term unemployed. However, during the recent crisis, intervention has been advocated for small firms and/or exporters (see e.g. calls by the Irish Exporters Association).

[16] Molana and Montagna (2013) examine the impact of size dependent policies.

preferable to employment subsidies to firms. This casts doubt on the perception (see, e.g. Neumark, 2011) that hiring credits are more effective than worker subsidies in raising employment.[17]

Finally, since the effect of the shock is found to be larger in relatively less efficient countries (whose productivity distribution is more skewed towards less efficient firms), the required policy intervention to offset the shock grows in γ. Table 4 (in which for ease of comparison the first two columns repeat the first two columns of Table 2 corresponding to the no-active-policy equilibrium) shows that ex-ante optimal ALMPs (i.e. an active intervention being in place regardless of and/or prior to a shock), for a given value of γ, results in higher employment and welfare. Again, the optimal policy involves taxing firms and subsidising workers – and results in a redistribution of market shares towards more efficient firms, via a higher export cut-off (and a fall in the extensive and an increase in the intensive margin of exports) and a higher domestic cut-off. Hence, the equilibrium can always be improved by the use of ALMP – i.e. the optimal policy always entails intervention, in the form of taxing firms and subsidising workers, with the extent of intervention increasing in γ. However, the last two columns of Table 4 show, for the uniform policy case, that the effects of a shock are more enhanced when ALMP are in place. In this instance, a shock results in a greater fall in employment and welfare.

4. Evidence on the Role of Firm Size Distribution

In this section we carry out a brief empirical investigation of whether evidence supports the theoretical predictions concerning the role of shape of the firm size distribution in determining aggregate employment. Ideally, we would need either time series data for a number of countries over a sufficiently long period or cross country data for a large number of countries for a few years. However, we could not construct either type of dataset that would include the two main variables of interest – the shape parameter for firms' size distribution (as a proxy for the aggregate country-level productivity distribution) and the expenditure on active labour market policies – and provide sufficient degrees of freedom for robust econometric analysis. Thus, given these limitations, we shall restrict ourselves to examine, as a first step, within a cross-section time-series context, whether the shape parameter for firms' size distribution plays a significant role in determining aggregate employment. In particular, we use firm-level information from the AMADEUS dataset for 22 OECD countries (see the Appendix), which is available to us with annual frequency for a short time period (maximum period 2003-2011), to calculate (as explained in the Appendix)

[17] Although we do not report the results here, financing the policy via lump-sum taxation does not alter the qualitative nature of most of the results. However, since with lump-sum taxation the monotonicity between employment and welfare no longer holds, in this case the policy intervention aimed at maintaining employment at the pre-shock level entails taxing workers to subsidise firms.

the shape parameter of the firm size distribution in each country. Country level data on annual aggregate employment and output were obtained from the OECD (see the Appendix).

Given that overall employment is influenced by a number of factors, institutional and welfare state variables key among them, and that the business cycle plays a major role in determining its fluctuations, we would ideally want to use a robust dynamic panel regression technique that controls for these factors when examining the implications of the theory. However, since our sample is rather small and highly unbalanced, we cannot control for all the relevant explanatory variables and/or use the cyclically filtered series to distinguish between the short-run and long-run analysis. We therefore restrict our analysis to a static regression equation explaining the employment ratio (e_{jt}) by the logarithm of real GDP in constant US dollars (y_{jt}) and the (estimates of) the Pareto shape parameter (γ_{jt}), controlling for country and time fixed effects denoted below by η_j and ϕ_t. We report the LSDV estimates below[18] where the numbers in parentheses are the t-ratios based on *Panel Corrected Standard Errors* proposed by Beck and Katz (1995) which take account of period clustering, and those in square brackets are the P-values.

$$\hat{e}_{jt} = 0.2304 y_{jt} - 0.0460\gamma_{jt} + 0.0033\gamma_{jt} y_{jt} + \hat{\mu} + \hat{\eta}_j + \hat{\phi}_t$$

(8.07) (2.22) (2.16)

Unbalanced Sample: 22 Countries, 9 Years, No. of Observations = 148

Within $R^2 = 0.755$, $\bar{R}^2 = 0.705$

Country FE $\chi^2_{(21)} = 240[0.00]$; Time and Country FE $\chi^2_{29} = 256[0.00]$

The above result, although somewhat preliminary, is consistent with the theoretical predictions of our model: ceteris paribus, in countries in which the firm size distribution is less skewed towards smaller firms (i.e. with smaller γ) employment is higher (due to the direct impact of γ), and the impact of a fall in output on employment is lower (via the interaction effect γy).

As discussed, we cannot meaningfully examine the effect of labour market variables and their interaction with the shape parameter on employment, as data availability restrictions would result in the samples not being comparable. However, an important dimension of industry adjustments – that is not captured by our standard theoretical framework – is that changes in aggregate performance as a result of policy or other shocks are not only resulting from compositional changes between firms for a given distribution, but also from shifts or changes in the shape in the distribution. The latter would be reflected in a change in the shape

[18] This requires y_{jt} to be weakly exogenous with respect to e_{jt}. To this end, we carried out weak exogeneity tests at the country level using quarterly data and found that these tests did not reject the weak exogeneity assumption. The results are not reported here but are available on request.

parameter of the distribution. In this light, it is therefore instructive to examine (for the available subsample) whether labour market institutional variables influence the size distribution of firms. To this end, we regressed γ_{jt} on *ALMP* (expenditure on active labour market policies as a percentage of GDP), *PLMP* (expenditure on passive labour market policies as percentage of GDP), *PROT* (overall strictness of employment protection, scale 0 to 6 representing least to most stringent), *UDENS* (union density) and, *UMEMB* (union membership) and found the following results where again η_j and ϕ_t denote country and time fixed effects and the numbers in parentheses are the t-ratios based on *Panel Corrected Standard Errors* and those in square brackets are the P-values:

$$\hat{\gamma}_{jt} = -3.5127 ALMP_{jt} - 0.3599 PLMP_{jt} - 0.6090 PROT_{jt} + 0.0820 UDEN_{jt}$$

(2.34) (0.83) (0.75) (1.95)

$$+ 0.0007 UMEM_{jt} + \hat{\mu} + \hat{\eta}_i + \hat{\phi}_t$$

(1.02)

Unbalanced Sample: 20 Countries, 7 Years, No. of Observations = 100

Within $R^2 = 0.7319$, $\overline{R}^2 = 0.6153$

Country FE $\chi^2_{(19)} = 97[0.00]$; Time & Country FE $\chi^2_{25} = 100$ [0.00]

Although not all estimated coefficients are statistically significant, these results suggest that welfare state and labour market variables affect the size distribution of firms;[19] active labour market policies in particular have a significant and negative effect on the shape parameter of the distribution – i.e. they skew the distribution towards larger firms. Thus, these results suggest that the size distribution of firms affects the employment rate and acts as a channel for the transmission of shock – which is fully consistent with our theoretical predictions – and that ALMP appear to influence that channel.

5. Conclusions

We have argued that inter-country differences in firm size (and productivity) distribution can contribute to explaining differences between countries regarding the relationship between output and employment. We have developed a small open economy model and shown the intra-industry inter-firm heterogeneity and selection acts as a channel through which shocks, by affecting average industry productivity, impact on employment and welfare. In particular, a negative demand shock results in an anti-competitive effect that – by reallocating market shares towards less efficient firms – lowers average industry productivity, aggregate employment and welfare. Countries with a 'more efficient distribution of firms' are shown to

[19] This is in line with the findings of Garicano *et al* (2013) and Gourio and Roys (2013).

weather out the shock better than less efficient ones, experiencing a weaker anticompetitive selection effect, and smaller aggregate employment and welfare losses.

The model also shows that the use of ALMP to sustain employment entails, in most cases, taxing firms and subsidising workers – a policy mix that toughens export selection (thus reducing the extensive and increasing the intensive margin of export), increases average industry efficiency, and expands aggregate demand directly by increasing workers' income. Only when the relatively less efficient firms (i.e. domestic production alone) are targeted is this result reversed. Furthermore, a uniform policy (that does not discriminate between production for domestic markets and for exports) is dominated, from a welfare point of view, by a policy that targets exports only (hence concerns the more efficient firms). Thus, the 'best' policy (in terms of employment and welfare) entails picking winners (i.e. the exporters) by taxing their production for export in order to sustain aggregate demand and employment via worker subsidies.

A key testable hypothesis emerging from the model is that in countries with a lower degree of firm heterogeneity – i.e. with a firm size distributions that is more skewed towards smaller (and less efficient) firms – a negative shock should have a stronger negative effect on aggregate employment. We estimated a measure of the shape parameter of the distribution and used it to examine its effect on the employment-output relationship for a number of OECD countries. Our results confirm the predictions of the theory: not only is the shape parameter of the distribution negatively related to employment (i.e. as the size distribution of firms becomes more skewed towards smaller firms, aggregate employment falls), but the impact on aggregate employment of a fall in aggregate output is reduced by the size parameter of the distribution.

Other testable hypotheses emerging from the theoretical model concern the role of ALMP and how it is influenced by the shape of the size and productivity distribution of firms. Our data availability at the cross-country level prevented us from assessing these empirically; we shall pursue this in future research.

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Appendix

1. Specification of the structural VAR and ARDL models

For each of the four countries, we find that Δy and Δe are I(0), and that although *y* and *e* are I(1) they do not cointegrate. We therefore work with the following VAR(p) specification

$$\begin{aligned}\Delta y_t &= \eta^y + \sum_{j=1}^{p}\left(\beta^y_{e,j}\Delta e_{t-j} + \beta^y_{y,j}\Delta y_{t-j}\right) + D_t\phi^y + \varepsilon^y_t,\\ \Delta e_t &= \eta^e + \sum_{j=1}^{p}\left(\beta^e_{e,j}\Delta e_{t-j} + \beta^e_{y,j}\Delta y_{t-j}\right) + D_t\phi^e + \varepsilon^e_t,\end{aligned} \qquad \text{(A1.1)}$$

where D' = (d08q2, d08q3, d08q4, d09q1, d09q2) is a vector of 5 dummies each assuming the value of unity for the corresponding date — 2008q2 to 2009q2 — and zero elsewhere. These are simple shift dummies which are used to capture the impact of the crisis so as to leave the residuals clean and raise the robustness of the estimates.

For each country we try to find a parsimonious restricted version of the above, by simple general to specific estimation and testing, and use it to estimate the structural version

$$\begin{bmatrix} 1 & 0 \\ -a_{21} & 1 \end{bmatrix}\begin{bmatrix} \varepsilon^y_t \\ \varepsilon^e_t \end{bmatrix} = \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix}\begin{bmatrix} u^y_t \\ u^e_t \end{bmatrix}, \qquad \text{(A1.2)}$$

where u^y_t and u^e_t are the orthogonalised exogenous disturbances and can be considered as the random shocks specific to *y* and *e* respectively.

First, given that the structural form above is the appropriate theoretical framework for examining the impact of an exogenous shock to *y* on *e*, we use its estimates to examine the impulse response of *e* to u^y_t. These are given in left-hand-side panel of Figure 4. Next, since (A1.2) is empirically appropriate if Δy_t is weakly exogenous in Δe_t equation (which we have established by the appropriate tests), we can also work with the corresponding ARDL equation

$$\Delta e_t = \tilde{\eta}^e + \gamma^e_y \Delta y_t + \sum_{j=1}^{p}\left(\tilde{\beta}^e_{e,j}\Delta e_{t-j} + \tilde{\beta}^e_{y,j}\Delta y_{t-j}\right) + D_t\tilde{\phi}^e + \tilde{\varepsilon}^e_t, \qquad \text{(A1.3)}$$

or in its appropriate restricted version as long as $\gamma^e_y \simeq a_{21}$. We used this setup to generate the dynamic multipliers for the impact of Δy_t on Δe_t (the first impact being $\frac{\partial \Delta e_t}{\partial \Delta y_t} = \gamma^e_y$), which are given in right-hand-side panel of Figure 4.

2. Estimation of the shape parameter for the size distribution of firms

Suppose that the random variable *size* is defined over $s \geq s_0 > 0$ and is generated by the Pareto distribution with the probability density function

$$f\left(s; s_0, b\right) = b s_0^b s^{-(1+b)};\ \ s \geq s_0 > 0,\ b > 0\,,$$

where s_0 and *b* are also known as the scale and shape parameters, respectively. Quandt's maximum likelihood estimator of *b* uses the joint likelihood function

$$L\left(b, s_0\right) = \prod_{i=1}^{N} b s_0^b x_i^{-(1+b)}\,,$$

whose logarithm is maximised with respect to s_0 and *b*. It is straightforward to see that the corresponding estimators are $\hat{s}_0 = \min(x_i)$ and hence $\hat{b} = N\left[\sum_{i=1}^{N} \ln\left(\frac{x_i}{\hat{s}_0}\right)\right]^{-1}$.

3. Data Appendix

The firm-level data was obtained from the February 2013 update of the Amadeus database – a commercially available database supplied by Bureau van Dijk – of standardised financial information covering over 17 million companies across Europe. Our analysis focuses on the number of employees reported by firms within 22 EU countries (Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Turkey, and United Kingdom) from 2003-2011. In order to ensure that employees of the same corporate group are not reported in multiple company records, we focused on companies that had only unconsolidated accounts, and had not been involved in mergers on de-mergers. The final selection criteria used is that the company had one employee or more during at least one year from 2008 to 2011.

Seasonally adjusted nominal GDP and GDP deflators were obtained from the OECD National Accounts (June 2012 edition). Data on harmonised unemployment rates were obtained from the OECD Main Economic Indicators (November 2012 edition), again seasonally adjusted. In both instances quarterly and annual data was acquired. Quarterly data is used in Section 2 of the paper, while Section 4 employs the annual data.

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Figure 1. Employment Rate and Real GDP

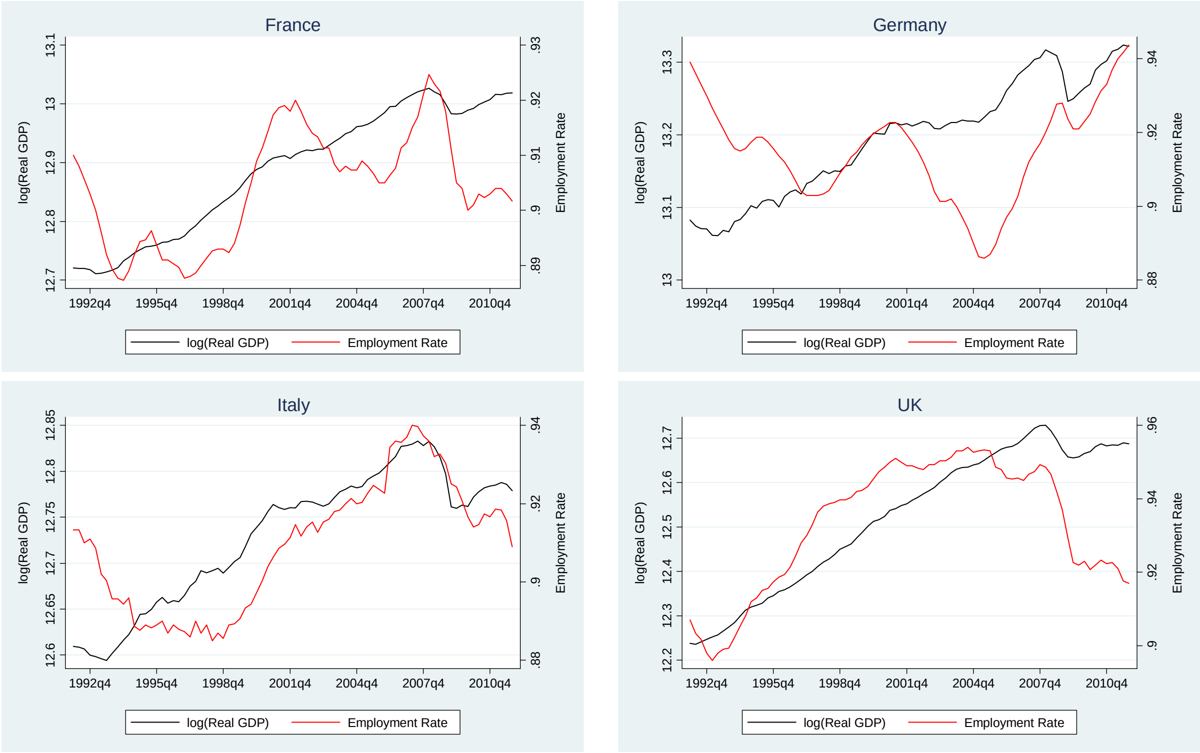


Figure 2. Employment Rate and Real GDP: Trend and Cycle

Table 1. Time Series Behaviour of Employment and Output, 1992q1-2011q4

AR Coefficients	AR representation of Employment Rate Dependent Variable: Δe_{it}				AR representation of Real GDP Dependent Variable: Δy_{it}			
	France	**Germany**	**Italy**	**UK**	**France**	**Germany**	**Italy**	**UK**
Intercept	4.38E-06 [0.022]	7.71E-05 [0.56]	-3.73E-05 [0.11]	0.000101 [0.54]	0.001489 [2.58]	0.002197 [2.26]	0.001337 [1.73]	0.001847 [2.56]
lag 1	0.5946 [5.25]	1.2736 [11.12]	0.0219 [0.18]	0.6000 [5.17]	0.6135 [6.79]	0.3150 [2.92]	0.4850 [4.23]	0.8205 [6.95]
lag 2	0.1401 [1.06]	-0.6818 [3.96]	0.1597 [1.34]	0.0978 [0.72]	--	--	0.0429 [0.34]	0.0903 [0.58]
lag 3	0.1495 [1.13]	0.2520 [2.19]	0.1793 [1.52]	0.1890 [1.41]	--	--	0.2096 [1.67]	-0.2435 [2.07]
lag 4	-0.3099 [2.75]	--	0.2228 [1.83]	-0.2574 [2.24]	--	--	-0.3130 [2.75]	--
AR Roots	.73±.33i -.43±.54i	.82 .23±.51*i*	.84 -.09±.64*i* -0.64	.70±.27*i* -.40±.55*i*	.61	.31	.67±.37*i* -.43±.59*i*	.65±.32*i* -.47
Mean of Dep. Variable	2.22E-05	0.000180	4.44E-06	0.000280	0.003831	0.003170	0.002407	0.005798
SE of Dep. Variable	0.002333	0.002492	0.002937	0.002166	0.005153	0.008457	0.007200	0.006906
SE of Residuals	0.001703	0.001190	0.002809	0.001608	0.004091	0.008071	0.006083	0.004449
Sum of Sq. Residual	0.000203	0.000102	0.000552	0.000181	0.001272	0.004951	0.002591	0.001425
B.L.P. Q Stat.	1.94 (0.925)	1.84 (0.93)	1.85 (0.93)	1.61 (0.95)	5.72 (0.46)	3.16 (0.79)	3.40 (0.76)	0.43 (0.99)
Residual SC LM stat.	3.93 (0.69)	3.21 (0.78)	6.57 (0.36)	9.75 (0.14)	5.60 (0.47)	3.47 (0.75)	5.93 (0.43)	1.60 (0.95)
R^2	0.496017	0.781087	0.134921	0.478814	0.377712	0.101097	0.324635	0.601564
$\bar{R}^2$	0.467218	0.771966	0.085488	0.449032	0.369524	0.089269	0.286043	0.584963

(a) OLS estimates are reported, with the AR order chosen using sequential likelihood ratio test and Schwarz information criterion. **(b)** Unit root and stationarity tests show that both e_{it} and y_{it} are integrated of order one, I(1), while Δe_{it} and Δy_{it} are stationary, I(0) — tests are not reported here. **(c)** Figures in square brackets are the t-ratios. B.L.P. **(d)** Q Stat is the Box-Pierce-Lujng Q statistic for the residuals for 6 lags, asymptotically distributed as $\chi^2_{(6)}$ with the figure in parentheses providing the table P-value. **(e)** Residual SC LM is the Breusch-Godfrey LM statistic for up to 6th residuals serial correlation asymptotically distributed as $\chi^2_{(6)}$ with the figure in parentheses providing the table P-value.

Figure 3. Comparing the AR Residuals (Estimates in Table 1)

Employment	Output

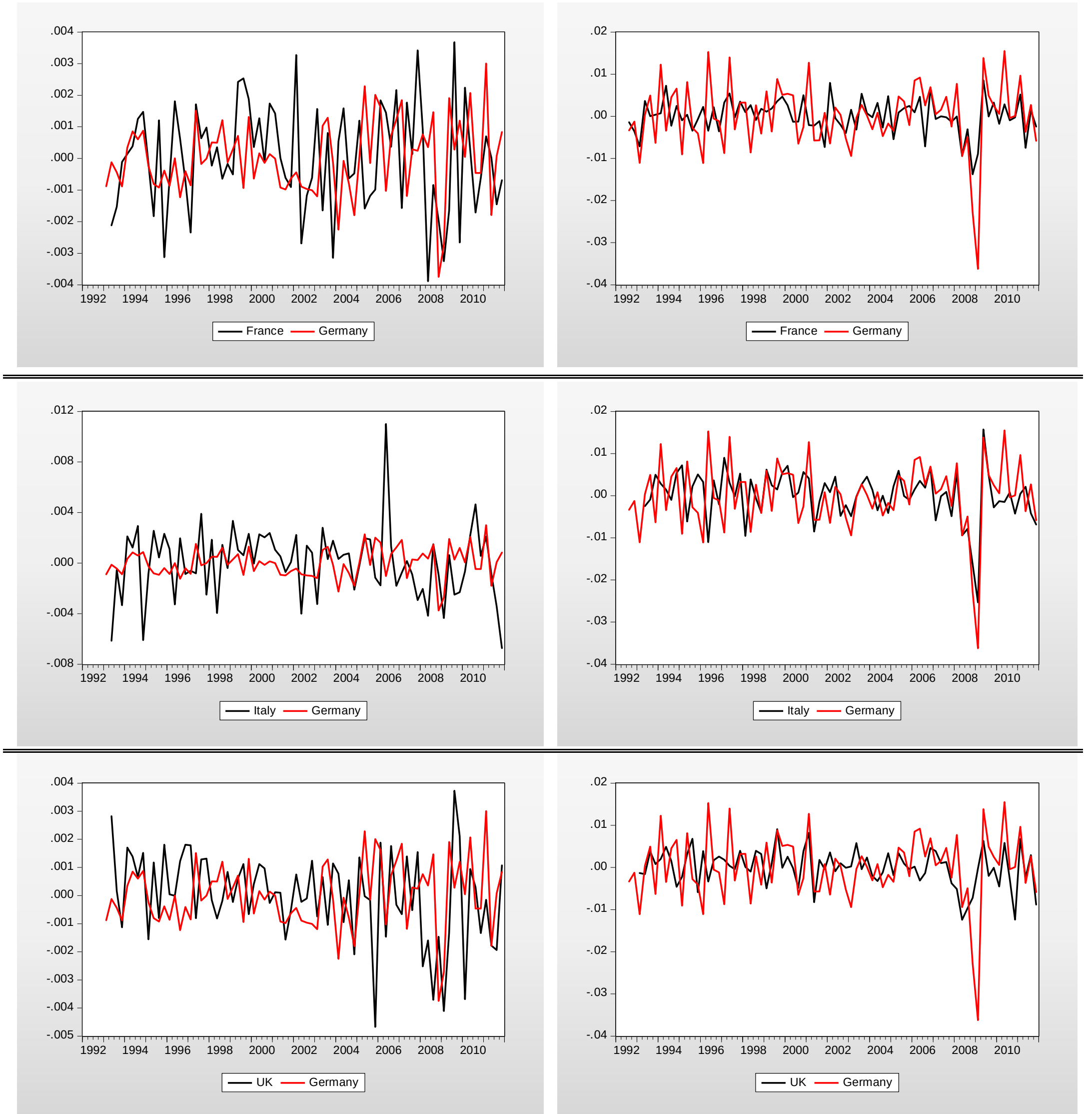
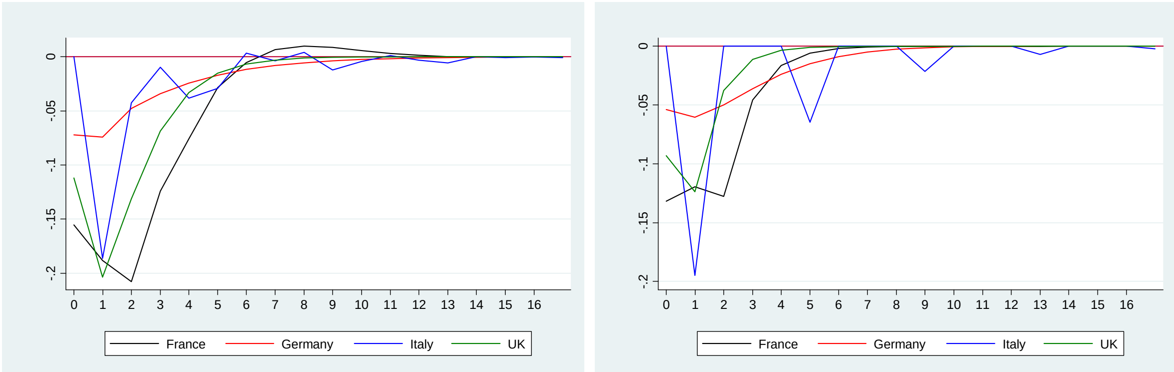


Figure 4. Response of the change in employment, Δe_{it}, to negative shocks



Impulse response to an exogenous shock based on the restricted Structural VAR models

Dynamic multipliers with respect to a unit fall in Δy_{it} based on the restricted ARDL models

Figure 5. Cumulative Distribution of Firms' Size (number of employees)

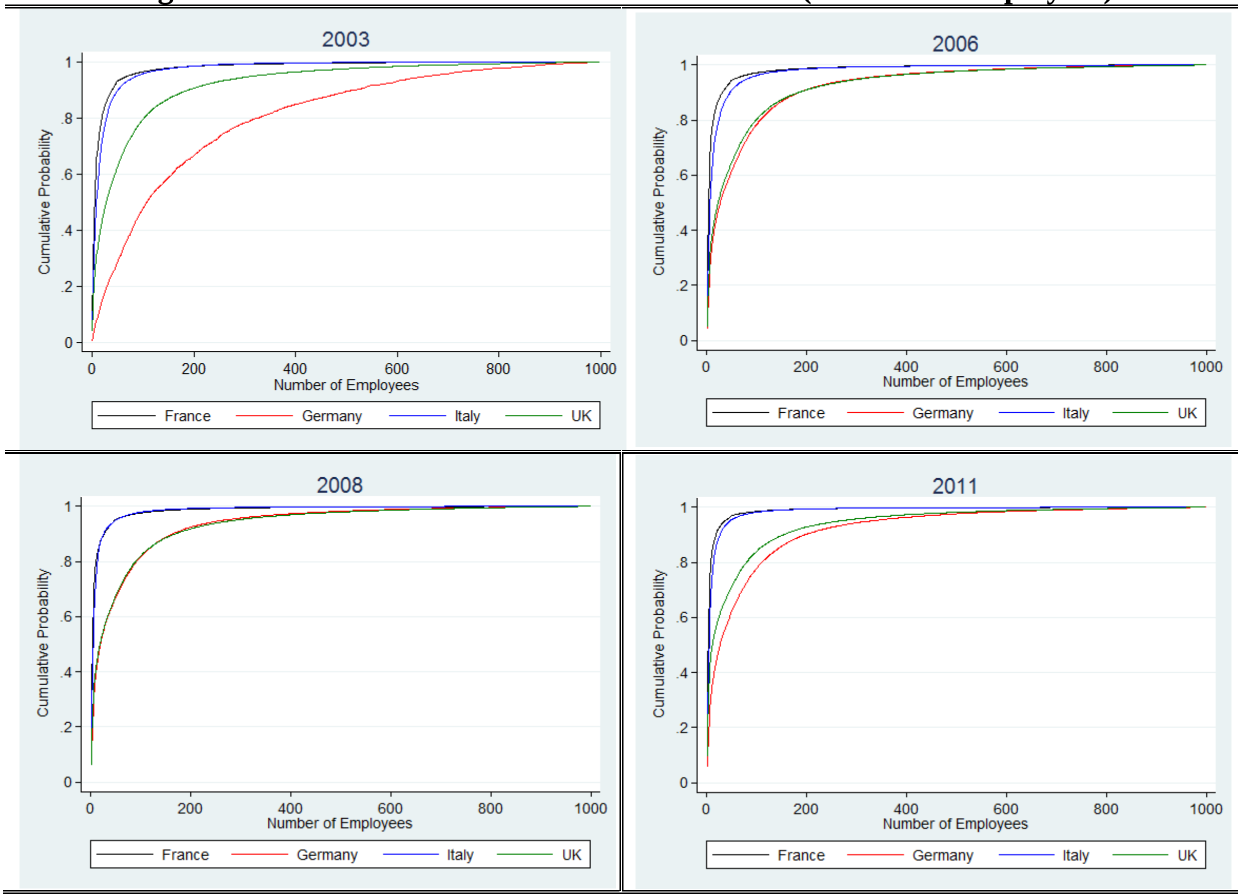


Table 2. The role of firms' concentration/distribution in the absence of any policy in transmitting the impact of a shock
($s = s^* = t = \tau = 0$ and a negative export shock equivalent to a reduction in $\beta^* I^*$ from 300 to 270)

Variables \ Cases	(I) Equilibrium with $\gamma = 2$	(II) Equilibrium with $\gamma = 1.95$	(III) Post-shock equilibrium with $\gamma = 2$	(IV) Post-shock equilibrium with $\gamma = 1.95$	(V) Impact of the shock with $\gamma = 2$ %Δ from pre-shock level	(VI) Impact of the shock with $\gamma = 1.95$ %Δ from pre-shock level
F	7.442	8.581	7.157	8.285	-3.83	-3.45
M	4.198	2.552	4.165	2.534	-0.79	-0.72
M^*	1.034	0.531	0.931	0.477	-9.96	-10.00
L	760.927	901.973	754.948	895.474	-0.79	-0.72
L_A	149.877	223.630	167.286	240.504	11.62	7.55
$L_D + L_D^*$	611.05	678.342	587.662	654.970	-3.83	-3.45
L_D	409.326	479.138	406.11	475.686	-0.79	-0.72
L_D^*	201.724	199.204	181.552	179.284	-10.00	-10.00
x	612.064	2372.676	602.608	2339.052	-1.54	-1.42
x^*	2466.026	10619.661	2549.186	11009.482	3.37	3.67
ϕ_c	1.331	1.862	1.311	1.836	-1.50	-1.42
ϕ_c^*	2.682	4.168	2.773	4.321	3.39	3.67
u	2.937	4.892	2.869	4.787	-2.32	-2.15
P_D	0.111	0.073	0.114	0.074	2.70	1.82
$(1-t)w/P$	5.79	8.136	5.699	8.019	-1.57	-1.44
p	0.237	0.119	0.241	0.121	1.69	1.44
p^*	0.118	0.053	0.114	0.051	-3.39	-3.54

The parameter values used in all simulations are $N = 1000$; $\sigma = 2.9$; $\delta = 2$; $\theta = 10$; $\alpha = 2.5$; $\alpha^* = 5$; $f = 40$; and $\beta = 0.8$.

Table 3. Different subsidy options financed by proportional income taxation to compensate employment effect of a negative shock ($\gamma = 2, \tau = 2$ and negative export shock equivalent to a reduction in $\beta^* I^*$ from 300 to 270)

Cases / Variables	Uniform policy subsidising domestic and export production equally ($S = S^*$)		Targeting domestic production of all firms (S^*=0)		Targeting production for exports only (S=0)	
	(I) Using $S = S^*$ to keep L at pre-shock level	**(II)** Using $S = S^*$ to maximise u (and hence L)	**(III)** Using S to keep L at pre-shock level	**(IV)** Using S to maximise u and hence L	**(V)** Using S^* to keep L at pre-shock level	**(VI)** Using S^* to maximise u and hence L(1)
s	-0.088	-0.360	0.122	0.360	0.000	0.000
s^*	-0.088	-0.360	0.000	0.000	-0.046	-0.200
t	-0.065	-0.239	0.069	0.232	-0.010	-0.039
F	7.522	8.441	6.851	6.067	7.248	7.502
M	4.112	3.857	4.448	5.074	4.242	4.456
M^*	0.931	0.931	0.931	0.931	0.890	0.776
L	760.927	767.403	760.927	766.639	760.927	777.330
L_A	193.025	257.810	145.693	90.399	173.704	191.610
$L_D + L_D^*$	567.902	509.593	615.234	676.239	587.223	585.720
L_D	400.967	376.099	433.682	494.687	413.581	434.427
L_D^*	181.552	181.552	181.552	181.552	173.643	151.293
x	621.730	680.022	570.529	502.699	600.924	596.510
x^*	2613.369	2768.338	2494.067	2347.030	2623.112	2858.981
ϕ_c	1.352	1.479	1.241	1.094	1.307	1.298
ϕ_c^*	2.842	3.011	2.713	2.553	2.853	3.110
u	2.937	3.013	2.937	3.004	2.937	3.131
P_D	0.121	0.142	0.102	0.079	0.113	0.111
$(1-t)w/P$	5.790	5.889	5.790	5.877	5.790	6.042
p	0.254	0.290	0.223	0.185	0.241	0.243
p^*	0.111	0.105	0.116	0.124	0.116	0.122

(1) In this case, the utility function is decreasing in S^* hence the higher is the tax on exporting firms the higher is u and L, since as the tax rises a smaller but more efficient mass of firms survives. The figures in this column are just an example, with exporting firms paying 20% tax on wage. However, note that the marginal gain in welfare and employment gets smaller and smaller as the firms are taxed at higher rates.

Table 4. The role of firms' concentration/distribution in determining the extent of policy

Cases / Variables	$\beta^* I^*$ = 300 and no Policy ($S = S^* = t = \tau = 0$) (as columns I and II in Table 2)		$\beta^* I^*$ = 300 and optimal policy providing uniform subsidy ($S = S^*$) financed by a proportional income tax only		Comparing effects of a negative shock with $\gamma = 2$ (reducing $\beta^* I^*$ from 300 to 270) without and with optimal policy	
	(I) $\gamma = 2$	**(II)** $\gamma = 1.95$	**(III)** $\gamma = 2$	**(IV)** $\gamma = 1.95$	**(V)** %Δ from column I	**(VI)** %Δ from column III
s	0	0	-0.40	-0.33	0	-10.00
s^*	0	0	-0.40	-0.33	0	-10.00
t	0	0	-0.27	-0.21	0	-11.24
F	7.442	8.581	8.91	9.96	-3.83	-5.29
M	4.198	2.552	3.88	2.36	-0.79	-0.66
M^*	1.034	0.531	1.03	0.53	-9.96	-10.00
L	760.927	901.973	776.21	914.18	-0.79	-1.13
L_A	149.877	223.630	253.54	319.90	11.62	1.68
$L_D + L_D^*$	611.05	678.342	522.67	594.29	-3.83	-2.50
L_D	409.326	479.138	378.58	443.94	-0.79	-0.66
L_D^*	201.724	199.204	201.72	199.20	-10.00	-10.00
x	612.064	2372.676	696.45	2663.43	-1.54	-2.36
x^*	2466.026	10619.661	2698.59	11463.63	3.37	2.58
ϕ_c	1.331	1.862	1.52	2.09	-1.50	-2.36
ϕ_c^*	2.682	4.168	2.94	4.50	3.39	2.58
u	2.937	4.892	3.12	5.09	-2.32	-3.37
P_D	0.111	0.073	0.14	0.09	2.70	-0.17
$(1-t)w/P$	5.79	8.136	6.03	8.36	-1.57	-2.26
p	0.237	0.119	0.29	0.14	1.69	-0.51
p^*	0.118	0.053	0.11	0.05	-3.39	-2.52

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Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs a change: The financial crisis has exposed long neglected deficiencies in the present growth path, most visibly in unemployment and public debt. At the same time Europe has to cope with new challenges ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundations for a new development strategy that enables a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four year research project within the 7th Framework Programme funded by the European Commission started in April 2012. The consortium brings together researchers from 33 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). Project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

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