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Upward pressure on wages and the interregional trade spillover effects under demand-side shocks

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Upward pressure on wages and the interregional trade spillover effects under demand-side shocks

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Analysis No 03/2019*

Lecca, P., Christensen, M., Conte, A.,
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The **JRC Working Papers on Territorial Modelling and Analysis** are published under the editorial supervision of Simone Salotti and Andrea Conte of JRC Seville, European Commission. This series addresses the economic analysis related to the regional and territorial policies carried out in the European Union. The Working Papers of the series are mainly targeted to policy analysts and to the academic community and are to be considered as early-stage scientific articles containing relevant policy implications. They are meant to communicate to a broad audience preliminary research findings and to generate a debate and attract feedback for further improvements.

Abstract

The paper illustrates the effect of a permanent demand-side shock in the perturbed regions and the associated spillover effects in the non-perturbed regions using the RHOMOLO spatial-numerical general equilibrium model of the EU economy. We test to what extent gradual upward pressure on wages generated by a domestic increase in demand alters the magnitude of the economic impacts in the long-run and the degree to which this could result in changes in trade patterns. We also assess the size and the direction of the effects with varying trade substitution elasticities and under both perfectly and imperfectly competitive product markets.

Upward pressure on wages and the interregional trade spillover effects under demand-side shocks

Patrizio Lecca, Martin Christensen, Andrea Conte, Giovanni Mandras, and Simone Salotti

European Commission, Joint Research Centre Seville, Regional Economic Modelling team

1 Introduction

Two conflicting approaches have emerged from the recent and lively debate on the effectiveness and optimal design of regional development policy interventions (Barca et al., 2012): the space-neutral and the place-based approaches. The space-neutral approach (Sapir et al., 2004; World Bank, 2009) suggests reframing regional policy abstracting from space and thus recommends adopting a policy intervention strategies that do not favour target regions (such as the less developed ones), but essentially recommend to convoy and complement the existing agglomeration forces. In contrast, policy interventions grounded on a place-based approach (see, among others, Barca, 2009; OECD, 2009a and 2009b) fully reject the adoption of spatially-blinded instruments and advocate policies oriented to rebalance the geographical opportunities and potentials of regions with underutilized capacity and resources. It has also been argued that these two approaches are not necessarily mutually exclusive, rather they can interact and be combined to make an adequate policy development framework (Rodríguez-Pose, 2011; Varga, 2017).

Nevertheless, both approaches implicitly recognize a role to regional policies and the necessity to perform rigorous ex-ante and ex-post impact evaluation not merely aimed at measuring the impact on target regions but also taking into consideration and quantifying the impact in non-recipient regions. This implies measuring and quantifying the geographical spillover that could take place as a result of the implementation of regional development programmes. So far, most of the economic impact evaluation of regional policies has virtually concentrated on the effects generated in target and recipient regions and neglected the spillover effects affecting the non-assisted regions.

There is a vast literature on the economic effects of spatially targeted policies mostly based on partial equilibrium models and often related to the assessment of regional programmes such as the Cohesion Policy, the EU largest territorial policy programme¹, and the US Federal Empowerment Zone (see for example: Busso et al., 2013; Pellegrini et al., 2013; Crescenzi, 2009; Crescenzi et al., 2016; Rodríguez-Pose and Garcilazo, 2015; Percoco, 2016; and Fratesi, 2016;).

¹ There is an increased recognition among policy makers of the importance of the geographical structure and that the best way to tackle regional disparities and promote territorial cohesion is to put emphasis on geographical characteristics. For instance, the policy strategies currently adopted by the EU Commission through the Territorial Agenda of the EU 2020 (EC 2011 and EC 2015) and the Cohesion Policy implemented in the two recent programming periods (2007-2013 and 2014-2020) have undoubtedly a place-based focus.

These contributions typically use a micro-perspective and frequently ignore the system-wide impact of the policy and the feedback effects received by the non-assisted regions through trade links and factor mobility. Naturally, there are some exceptions. For instance, Kline and Moretti (2014) study the long-run efficiency and agglomeration effects of the US programme Tennessee Valley Authority at the local and national level finding that the agglomeration benefits of the programme were partially offset by losses in the rest of the country. A number of studies are based on macro-simulation models that adopt a general equilibrium perspective. Alonso-Carrera et al. (2009) evaluate the spillover effects among Spanish regions of public investments in infrastructure. Gilmartin et al. (2013) quantify the overall inter-regional spillover effects of increasing demand in Scotland and its consequences for the whole UK. Kline and Moretti (2013) study the implications of labor market frictions for the efficiency of place-based policies. Picek and Schroder (2018) evaluate the direction and the size of the spillover effects in Southern Europe arising from an expenditure boom in Germany.

Few contributions focus specifically on the system-wide economic impact of the EU Cohesion Policy.² For instance, Varga, and in't Veld (2010) use a New-Keynesian general equilibrium model to show that in the long-run the macroeconomic impact of such policy can be substantial. Di Comite et al. (2018) show that in the short run the Cohesion Policy can generate crowding out effects on GDP, consumption, and employment particularly in net-contributor regions, while in the long run all regions positively benefit from the policy.

The evidence arising from the literature briefly summarized above suggests that spillover effects are of the utmost importance when evaluating the macroeconomic effects of regional economic programmes. In this paper we concentrate on the spillovers transmitted by the recipient regions to the non-assisted regions in a variety of simulation scenarios. We inspect the spatial implications of an exogenous stimulus implemented in a given regional economy and its repercussions to the non-perturbed regions. Essentially, we analyse the extent to which a single regional economy is able to transmit a received policy shocks to the rest of the regions, as well as the degree to which such spillovers vary according to the assumed wage setting. We explore to what extent alternative adjustment mechanisms associated to the labour market assumptions affect the long-run equilibrium of each economy perturbed and the system-wide impact of such a stimulus. In order to do so, a system-wide perspective is required. For this reason we use the spatial numerical general equilibrium model RHOMOLO calibrated to a full set of interregional Social Accounting Matrix that includes bilateral trade flows between 267 EU NUTS2 regions for the year 2013 (Thissen et al. 2018).

² A number of partial equilibrium studies evaluate the impact of the EU regional development policy. In some cases, Cohesion Policy has been object of severe criticism by a number of scholar (Boldrin and Canova, 2001; Rodríguez-Pose and Fratesi, 2004; Dall'Erba and Le Gallo, 2008), while other evidence suggests that regional development policies generally have positive impacts with little evidence of crowding out effects (Becker et al., 2010 and 2012; Pellegrini et al., 2013).

For illustrative purposes, the simulations and analyses undertaken in the paper are deliberately simple, practically oriented, and reasonably comprehensive. At the risk of some oversimplifications, we perform simulations with demand-side shocks only, essentially neglecting the effects of supply-side policies at this stage. The magnitude of the impact and the transmission of the policy to the non-perturbed regions are contingent upon the initial regional conditions and wage settings. Wage adjustments can play a particularly crucial role as they may entail price changes which would eventually affect regional competitiveness. Therefore, we focus on a raise in internal demand in each of the 267 regions included in the model, undertaking the analysis for three alternative labour market options: a fixed wage, a wage curve, and a Phillips curve. Also, we further deepen our analysis to study the role of spillover effects by studying the impact of alternative trade elasticities under each of the three wage setting frameworks.

Our modelling exercise yields three key results. First, it demonstrates that the upward wage pressure resulting from an internal increase in demand generates losses in competitiveness that partially offset the impacts on economic activities. Second, it illustrates the potential importance of wage settings in generating regional spillovers. We find that intensity and magnitude of the latter are magnified by the introduction of real wage rigidities in the model. Finally, the inter-regional trade structure of the economy is subject to a larger degree of alteration when upward pressure on prices is higher. This result draws attention to the importance of the labour market institutions when assessing trade spillovers. Furthermore, as in Gilmartin et al. (2013), we show that under fixed real wages the system operates in a manner which is rather similar to a Leontief-type model according to which spillovers strictly depend on the calibrated shift and share parameters.

A second set of results is related to the role played by trade elasticities. A typical general equilibrium model rely on an Armington (1969) structure according to which trade flows depend on the relative prices between the various regions featured in the model (Feenstra et al., 2018). We find that the lower the trade elasticities, the lower the adverse competitiveness effects of an increase in wages when either a wage curve or a Phillips curve are operational. On the other hand, trade elasticities play no role when the wage is fixed.

A final result arising from our modelling experiment is that for an increase in internal demand that abstracts from supply-side effects, differences between the results obtained in perfectly and imperfectly competitive market settings are almost negligible.

The remainder of the paper is organized as follows. In the next Section we briefly outline the main adjustment mechanisms governing the model to help the reader to identify the main drivers and determinants of the spatial outcomes generated by the model. Section 3 is dedicated to the simulation strategies while Section 4 and 5 presents and discusses the results obtained in the perturbed regions, and in the non-perturbed regions respectively. Section 6

illustrates the implications of alternative market structures. Finally, Section 7 offers some concluding remarks.

2 Description of the RHOMOLO model

In this Section we provide a brief overview of the spatial general equilibrium model RHOMOLO used for this analysis. We focus on the features more relevant for the specific simulations carried out here, while a detailed mathematical description can be found in Lecca et al. (2018).³ The RHOMOLO model share some similarities with other macroeconomic models currently adopted for policy analysis and policy evaluations existing in the economic literatures. However, the high spatial dimension and the flexibility to switch among alternative closures and markets settings make the model peculiar and distinctive.

The economy consists of a set of 268 regions made of 267 endogenous EU NUTS2 regions and one single exogenous region representing the Rest of the World (ROW). Currently RHOMOLO features ten NACE rev.2 economic sectors. Furthermore the model distinguishes three different labour categories which correspond to the level of skills or education (low, medium, and high).

Final goods are consumed by Households, Governments and Investors (in the form of capital goods), whilst firms consume intermediate inputs. Regional goods are produced by combining the value added (labour and capital) with domestic and imported intermediates, creating vertical linkages between firms. Trade between and within regions is costly and subject to transport costs that are assumed to be of the iceberg type. This means that the spatial configuration of the system of regions has a direct impact on the competitiveness of regions because firms located in more accessible regions can source their intermediate inputs at lower price and thus gain larger market shares in local markets. Transport costs are identical across varieties but specific to sectors and trading partners (region pairs). They are based on the transport costs estimation developed by Persyn et al. (2018).

In the current version of the RHOMOLO model, we can easily switch among perfectly and imperfectly competitive commodity markets of various types: monopolistic competition a la Dixit-Stiglitz, Cournot and Bertrand oligopolistic competition. In each region and sector, identical firms produce a differentiated variety which is considered an imperfect substitute for the varieties produced within the same region and elsewhere. The number of varieties in the sectors is endogenous and determined from the zero-profit equilibrium condition, according to which profits must be equal to fixed costs.

³ RHOMOLO is a spatial computable general equilibrium model of the European Commission, developed by the Joint Research Centre (JRC).

Firms' pricing behaviour is generically characterised by a Lerner-type mark-up equation that relates equilibrium price-cost margins to the perceived elasticity of demand which is solely a function of the fixed elasticity of substitution under Monopolistic Competition. Given $p_{r,r',j}$ the price set by a firm of region r (net of trade cost τ and production taxes τ_r^p) selling to region r' , for a set of monopolistic competitive sectors f (a subset of economic sectors indexed by \mathbf{I} where $f \in \mathbf{F} \subset \mathbf{I}$) the optimal mark-up over the marginal cost $P_{r,f}^*$, is given as follows:

$$p_{r,r',f} = \frac{P_{r,f}^*}{1 - \frac{1}{\varepsilon_{r,r',f}}} \quad (1)$$

where, $\varepsilon_{r,r',f}$ is the perceived elasticity that in monopolistic competition is defined as follows:

$$\varepsilon_{r,r',f} = \sigma_{r',f}; \quad f \in i; \quad i \in \mathbf{I} \quad (2)$$

Where $\sigma_{r',f}$ is the elasticity of substitution in trade. For the perfectly competitive sectors the market price is equal to the marginal cost, that is:

$$p_{r,r',c} = P_{r,c}^*; \quad c \in i; \quad c \in \mathbf{C} \subset \mathbf{I} \quad (3)$$

This implies that the relative market power of region r in region r' is not transferred through changes in the prices in that region. A region sells their goods and services to all the other regions at the same price. Alternative price settings à la Cournot or Bertrand are easily introduced by relating firms' market power (and hence mark-ups) to the perceived elasticity. Under Cournot conjectures, the perceived elasticity is defined in equation (4):

$$\varepsilon_{r,r',f} = \sigma_{r',f} + (\Omega - \sigma_{r',f})s_{r,r',f} \quad (4)$$

where Ω is the conjectural variation parameter that for simplicity we set equal to 1. Under Bertrand, the perceived elasticity is:

$$\varepsilon_{r,r',j} = \frac{1}{\sigma_{r',f}} - \left(\frac{1}{\sigma_{r',j}} - \Omega \right) s_{r,r',f} \quad (5)$$

With

$$s_{r,r',f} = \frac{S_{r,r',f}}{N_{r,f}}$$

$S_{r,r',j}$ is the market share of region r on the market of region r' .

Both oligopolistic competition frameworks share the intuition that firms with large market shares in local markets are aware of the impact of their pricing choices on the local price index and therefore find it optimal to charge a higher price than they would if their market share were negligible (and thus not affecting the local price index).

The main difference between the three types of market structures rests on the determination of the mark-up. Under standard monopolistic competition firms do not internalise their impact on the market-wide price index and so the mark-up is fixed for all firms and depends only on trade elasticities. Given that trade elasticity is the same for each region-pair, the selling price set by firms is the same for the equivalent variety sold in all the regions. By contrast, in the other two cases the mark-up not only depends on trade elasticity but also depends on the market shares of varieties of region r in region r' . The implications is that while under the simple case of monopolistic competition we assume integrated markets, under Cournot and Bertrand markets are segmented and prices differ across regions for the same variety of goods. In all three cases the pure love-for-variety incorporated in the model take the form of a simplified Armington–Dixit–Stiglitz model, where the demand nesting function collapses towards a single nest structure with a single constant elasticity of substitution between goods of all geographic origins.

A number of labour market options are incorporated. For each skill-type labour, the default wage setting relationship is represented by a wage curve (Blanchflower and Oswald, 1994), whose implication is that lower levels of unemployment increase workers' bargaining power, thereby increasing real wages. The general formulation is expressed in logs as in Equation (6):

$$rw_{r,e,t} = a_e + \alpha rw_{r,e,t-1} - \beta u_{r,e,t} + \zeta \Delta p_{r,t} - \theta \Delta u_{r,e,t} \quad (6)$$

The real wage $rw_{e,t}$ at time t is differentiated by skills, e , and it is negatively related to the unemployment rate, $u_{e,t}$ and the change in unemployment rate between two subsequent periods, $\Delta u_{e,t}$. The real wage is also positively related to past real wages and changes in the price of output between two subsequent periods, $\Delta p_{r,t}$.

This formulation allows us to easily switch between a wage curve and a Phillips curve specification of the labour market by changing the related parameter of interest.⁴ The model could also be run assuming the more conventional neoclassical rule that implies perfect competition in the labour market. Assuming no changes in labour force, a vertical labour supply curve applies to each period of the model. The long-run equilibrium obtained under full flexible wage is expected then to be the same as the long-run equilibrium generated under the Phillips curve. Furthermore, the model can also accommodate wage rigidities by assuming fixed real or nominal wages.

When modelling regional economies within a general equilibrium framework, one should take into account that typically regions are more open than their national counterparts. Hence, closure rules normally in operation in national economies can not necessarily be applied straightforwardly when modelling regional economies (see Lecca et al., 2013 and McGregor et al., 2010). For this reason, we separate the investment from saving decisions. Households'

⁴ If $a=0$ we fall in the case of a wage curve while for $a=1$ we run the model with a Phillips curve.

savings are determined as fixed shares of current income while regional investments are determined through a simple adjustment rule, according to which the additional level of investments in each region is governed by the gap between the desired level of capital and the actual level of capital. This is a typical accelerator model, as originally developed by Jorgenson (1963) and consistent with the capital adjustment rules of Uzawa (1969). According to this formulation the investment capital ratio φ is a function of the rate of return to capital (rk) and the user cost of capital (uck) which allow the capital stock to reach its desired level in a smooth fashion over time:

$$\varphi = \varphi(rk, uck) \quad (7)$$

where

$$\frac{\partial \varphi}{\partial rk} > 0; \quad \frac{\partial \varphi}{\partial uck} < 0 \quad (8)$$

Everything else equal, higher user costs of capital are associated with lower desired capital stock and disinvestments due to lower profits. In this framework, the balance of payments is satisfied by not imposing any constraints on net inflows from the Rest of the World (ROW). This also means that the demand for investment in excess of domestic savings is fully compensated by external markets.

The model calibration process assumes the regional economies to be initially in steady-state equilibrium. This means that the capital stock is calibrated to allow depreciation to be fully covered by investments. All shift and share parameters are calibrated to reproduce the base year (2013) data in the EU interregional SAM derived from Thissen et al., (2018).

The structural and behavioural parameters of RHOMOLO are either borrowed from the literature or estimated econometrically. Typically, we assume a rather low elasticity of substitution in production and consumption (0.3), and a fairly high for trade between regions (4).

3 Simulation strategies

We appraise the capacity of each individual region to contribute to the overall EU economy through trade spillover by simulating a permanent increase in final demand of €10M in each of the 10 economic sectors, separately implemented for each of the 267 EU-NUTS2 regions incorporated in the RHOMOLO model. The experiment thus implies a total permanent monetary injection of €100M per year in each regional economy. We provide a comparative static analysis where the initial steady-state equilibrium is compared with a post-shock long-run

steady-state economy.⁵ We deliberately neglect any adverse supply-side effects that would arise from endogenous offsetting effects as we would have under a balanced budget framework for instance. Yet, the nature of the government spending is such that any increase in consumption does not affect public physical assets, that is to say it will only increase demand for final goods and services, again ignoring direct supply-side implications.

Depending on the labour market assumptions, the wage response to the shock could be fully incorporated into commodity prices that in turn affect competitiveness and trade patterns.⁶ For this reason we run the same shocks for a number of alternative wage settings: fixed real wage, wage curve and Phillips curve. The idea here is to gradually increase upward pressure on wages and measure the likely effects of alternative labour market assumptions directly on the perturbed and non-perturbed economies. We are also interested to analyse the extent to which wage pressure in the perturbed regions are passed onto other regions. That is, the degree at which, competitiveness effects in one region generate economic benefits or losses to other regions through changes in trade patterns.

Under the fixed real wage assumption, we attempt to mimic the behaviour of a conventional Input-Output (IO) Leontief model with infinite supply of factors and fixed prices (see for example McGregor et al., 1996, and Gilmartin et al., 2013). Essentially, with fixed real wages the upward pressure on commodity prices in the long-run is significantly reduced and of almost of no importance and we expect an adjustment path that would bring prices back to their initial steady-state level.⁷ This means that, in the absence of price changes, in the long-run the magnitude of the impact and the transmission of the effects from the perturbed regions to the other regions will solely (or mostly) depend on the initial calibrated shift and share parameters of the model.

When we move to the other labour market assumptions, endogenous wage effects should generate upward pressure on prices as a consequence of an initial exogenous demand disturbance. In the long-run, it is likely to observe higher wage pressure under Phillips curve wage behaviour because increased demand for labour resulting from a surge in demand of final goods and services has to be fully offset by a rise in wages.

Changes in wages are likely to be transmitted to the price of commodities altering the initial domestic and trade backward linkages. To have an idea of the backward linkages initially governing our steady-state economy, in Figure 1 we plot the domestic backward linkages (x -axis) and trade backward linkages (y -axis) derived from a Type I Leontief multiplier (Miller and

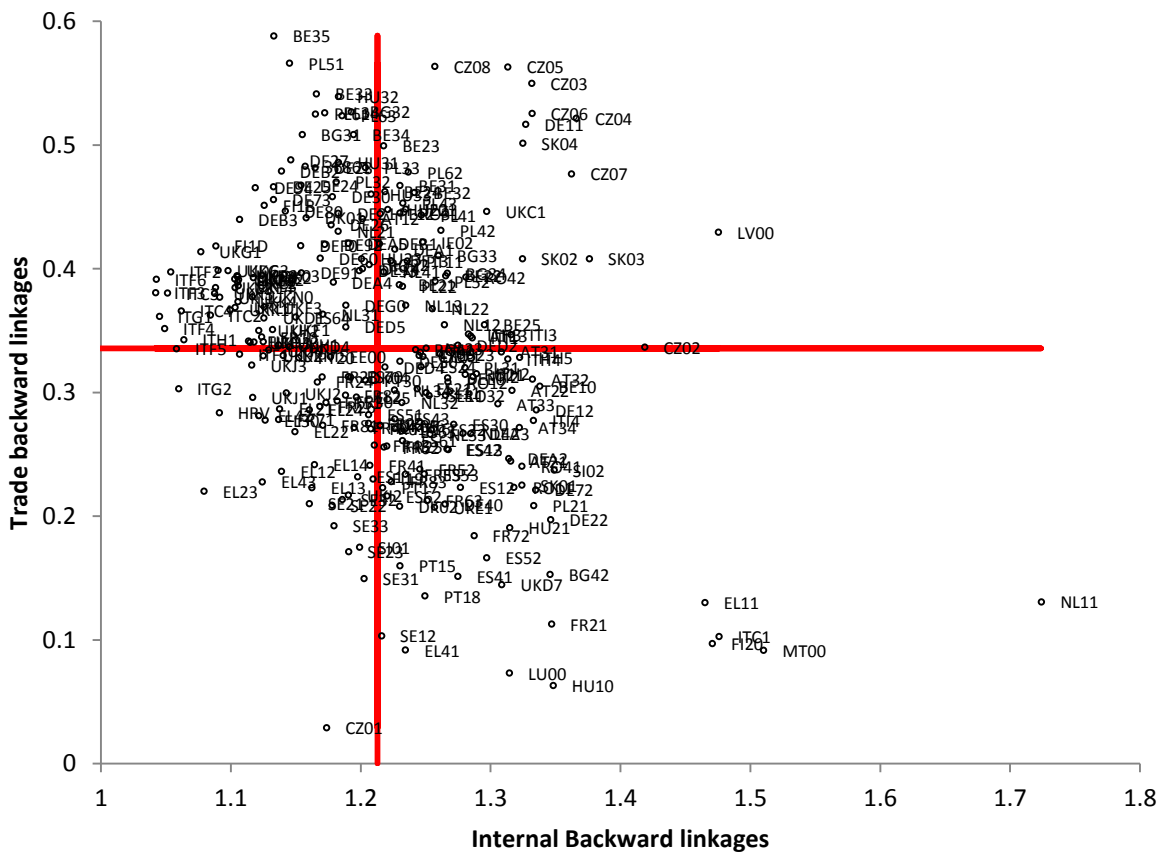
⁵ The associated dynamic path can be seen in Lecca et al. (2018).

⁶ It is then likely to expect that changes in prices drive the sign and the magnitude of the impacts within the perturbed region and the non-perturbed regions.

⁷ The system behaves almost as an IO model (see for example Gilmartin et al., 2013). In reality prices are not exactly converging to pre-shock levels since nominal wages adjusts to offset changes in CPI.

Blair, 2009).⁸ The red lines identify the computed average domestic and trade backward linkages that divide the quadrant in four. On the top-right quadrant we have regions that generate greater internal multiplier and at the same time generate high spillover at the benefit of the rest of EU. On the contrary the bottom-left quadrant identifies regions that not only provide little spillover to the other regions but also generate lower multipliers in their own domestic economy. Under the wage curve and Phillips curve wage setting we expect this initial situation to be altered. However under fixed real wage, if prices remain fixed in the long-run (or close to pre-shock levels), no changes in the relative composition of the external and internal backward linkages are expected to happen.

Figure 1: Calibrated backward linkages



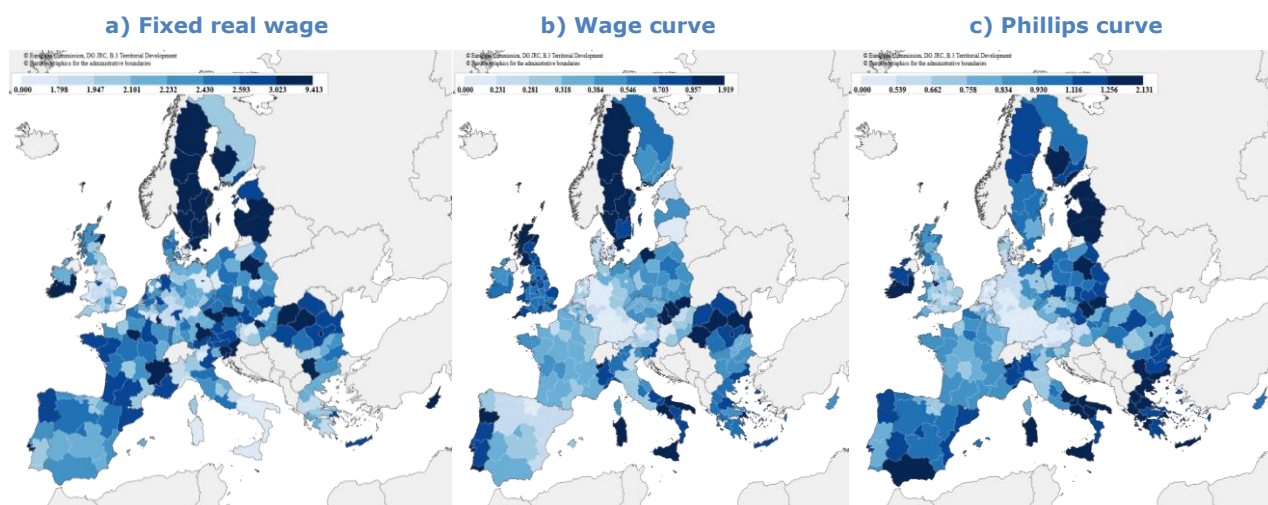
We proceed gradually. We initially show the results obtained assuming that all the product markets are perfectly competitive and using the trade elasticities of the standard version of the RHOMOLO model. Then, we re-run the simulations by reducing those elasticities to understand their role in the generation of spillover effects. Finally, we also present a set of simulations obtained by assuming the following imperfectly competitive market structures: monopolistic competition, and oligopolistic competition à la Bertrand and à la Cournot.

⁸ Let $L = \begin{pmatrix} l_{11} & \dots & l_{1r} \\ \vdots & \ddots & \vdots \\ l_{r1} & \dots & l_{rr} \end{pmatrix}$ be the Leontief Matrix obtained using the Interregional Input-Output framework at the base of our calibrated data where $r = 267$ regions; the domestic backward linkages obtained in each region are represented by the diagonal of the Leontief Matrix $\{l_{11}, l_{22}, \dots, l_{rr}\}$. The trade backward linkages are instead the sum in each row of the Leontief matrix except the region involved.

4 The impact on the perturbed regions

Figure 2 maps the long-run regional GDP multipliers (measured as changes in GDP divided by the changes in final demand) obtained by shocking separately the 267 NUTS 2 regions incorporated in the model distinguishing for the three labour market assumptions: fixed real wage (left panel), wage curve (central panel), and Phillips curve (right panel). The resulting outcome shows different impacts in the European regions (some descriptive statistics are reported in Table 1), with darker shading highlighting regions with greater GDP multiplier effects.⁹ As a results of different competitiveness effects associated to the three labour market options, the expected economic impact in the perturbed regions and the propagation of the spillovers when transmitting the shock from the perturbed regions to the non-perturbed regions vary according to the to the degree of wage pressure considered. It seems that those regions registering higher multiplier effects under one regional wage setting do not necessarily generate greater multiplier effects under other wage setting structures. For instance, regions in England and South of Italy report larger multiplier effects (darker shading) with a Phillips curve and a wage curve but not under fixed real wages.

Figure 2: The regional economic impact of simulating 100 M increase in government expenditure - Simulations performed separately for each individual region under three labour market assumptions



It is thus noticeable that the three set of results differ not only in the magnitude of the impact experienced by each region, but also and more importantly in the geographical pattern that might change according to the labour market assumptions used in the simulations. To reinforce this finding and to test whether the outcome obtained under the three different wage structures are correlated with each other, in Figure 3 we plot absolute long-run GDP changes obtained for each region compared across specifications of labour market structures. The absolute changes in real GDP obtained in each of the 267 perturbed regions under the fixed

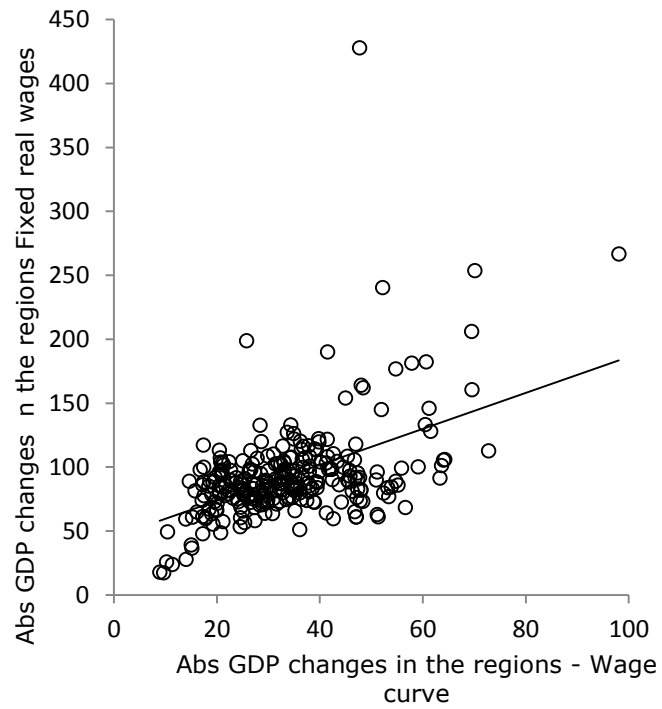
⁹ In the maps reported in Figure 2 we are not using the same scale for each of the wage configurations. Groups are thus defined on the GDP changes obtained specifically under each of the labour market closures. Application of the same groups for each of the three simulations would result in illegible maps given that the magnitude of the impact differs significantly among labour market closures.

real wage and the wage curve are plotted in panel a), while panel b) compares absolute changes in real GDP under fixed real wage and the Phillips curve, and finally in panel c) the scatterplot illustrates the relation between regional outcomes associated with wage curve and the Phillips curve assumptions. The correlation between the results obtained under the wage curve and Phillips curve is around 0.8 whilst the correlation between the results obtained under fixed real wage and wage curve on the one hand and fixed real wage and Phillips curve on the other hand is around 0.5 in both cases. Thus, it appears that assuming a fixed vs variable real wage marks an important difference for the outcomes of the model for the policy shock considered. Then, the type of real wage setting mechanism also affects the results as shown by the differences between those obtained with the Phillips curve and the results obtained using a wage curve.

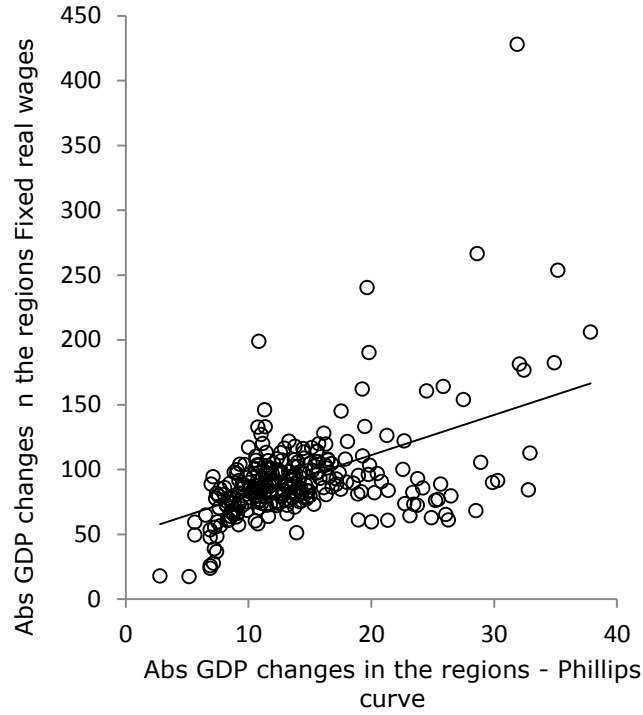
The strong co-movement of the output generated under the wage curve and Phillips curve could be explained by the fact that in both cases there is an upward pressure on real wages as a consequence of an augmented aggregate demand that in turn causes an increase in labour demand. More specifically under the Phillips curve, the long-run rise in labour demand is fully counteracted by an increase in wages which is required to maintain a vertical labour supply curve at the natural rate of unemployment. By contrast, under the wage curve, the excess demand for labour is cleared through adjustments in unemployment rates that in turn act as 'discipline device' (or as a measure of bargaining power of workers). In our experiments, unemployment rates fall, placing workers in the position to claim and obtain a rise in real wages. In both cases upward pressure on wages results in an increase in commodity prices that generate a fall in competitiveness and in turn a reduction in exports particularly exports to the ROW. The strong co-movement between exports and real wages can be seen in Figure 4 where the exports-real wages relationships are plotted for the case of wage curve (top panel) and Phillips curve (bottom panel). In the perturbed economy, the loss in competitiveness only partially offsets the positive effect of an increase in demand, thus the ultimate effect in both wage configurations is an increase in real GDP in the perturbed regions. As we will discuss in the next Section, by lowering the trade elasticity the negative term of trade effects that provide adverse competitiveness effects will be moderated generating in turn bigger multiplier effects.

Figure 3 Co-movements between internal multiplier under three labour market assumptions

a) Fixed real wage – Wage curve



b) Fixed real wage – Phillips curve



c) Wage curve – Phillips curve

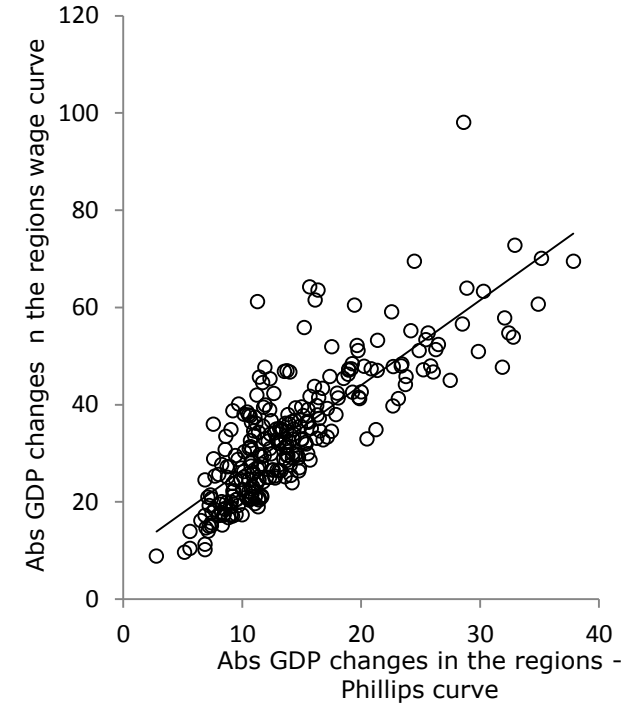
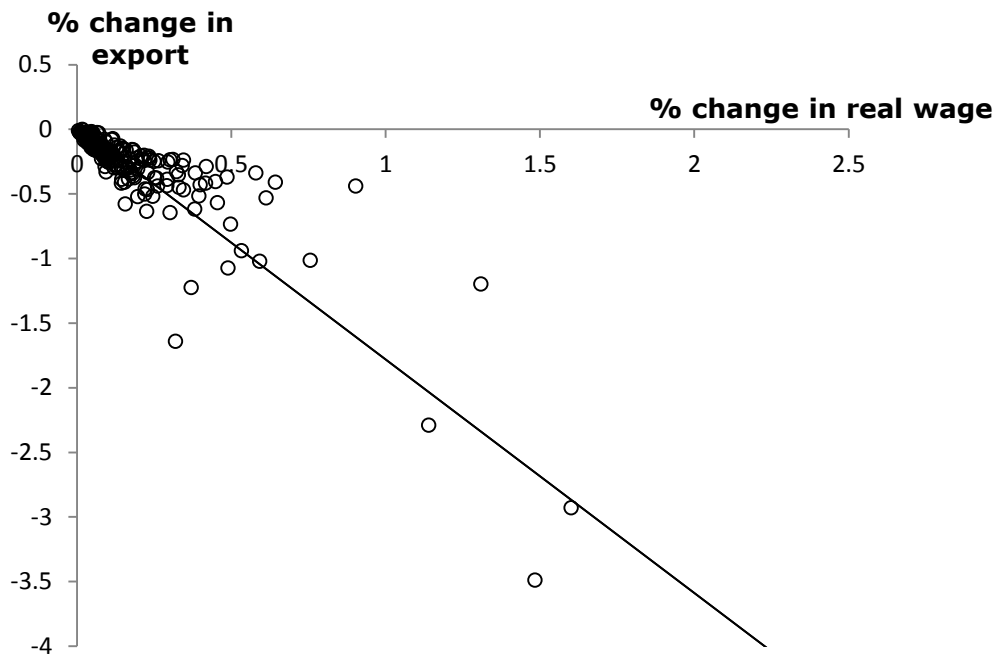
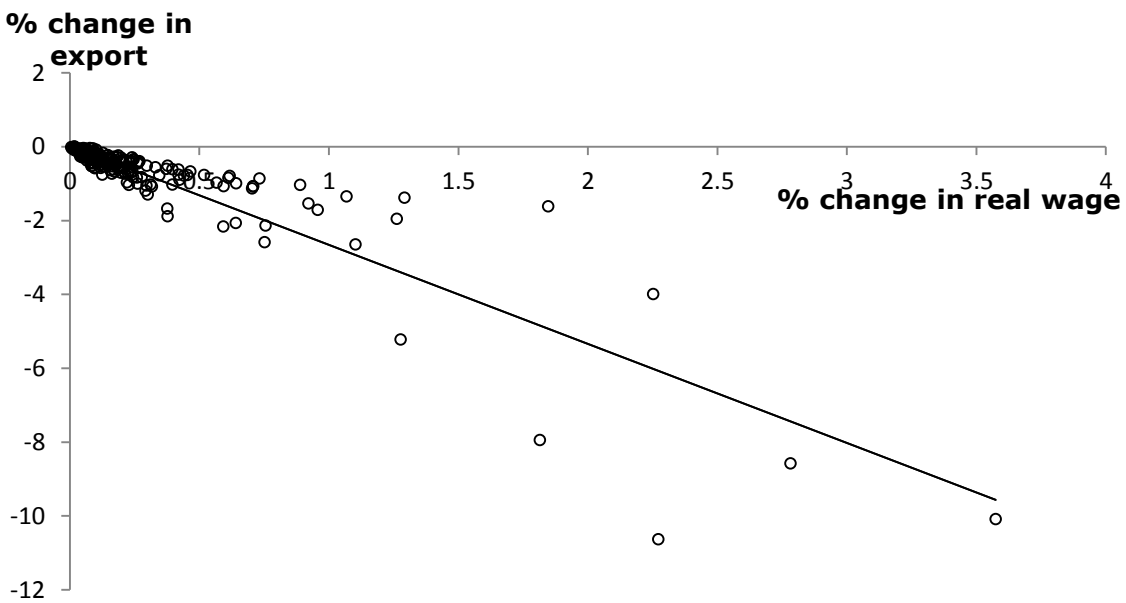


Figure 4. The relationship between exports and real wages - wage curve and Phillips curve

a) Wage curve



b) Phillips curve



For the case of fixed real wages, and specifically for the example considered in this paper, where supply-side effects of an expansion in government expenditure are intentionally neglected, the long-run equilibria derived from the model is close to that of a conventional IO model with infinite supply of factors and fixed prices. With no changes in real wages, changes in prices are constrained to be small and not sufficient to cause adverse competitiveness effects.¹⁰ It is therefore normal to obtain larger regional multiplier effects under fixed real wages.

The descriptive statistics contained in Table 1 confirm that, at the individual regional level, larger upward pressure on wages reduces the economic impact on the perturbed regions. We observe the highest impact under fixed real wages (0.93) while the lowest impact is recorded under the Phillips curve (0.14). Greater regional variation is observed under fixed real wages where the standard deviation for the regional multiplier effects is higher (0.38). The lowest standard deviation is recorded under the Phillips curve wage assumption (0.06) suggesting that under this labour market closure each single regional economy is by and large generating a similar internal multiplier effect (or at least close to the average).

Table 1. GDP multiplier effects under three alternative labour market closures

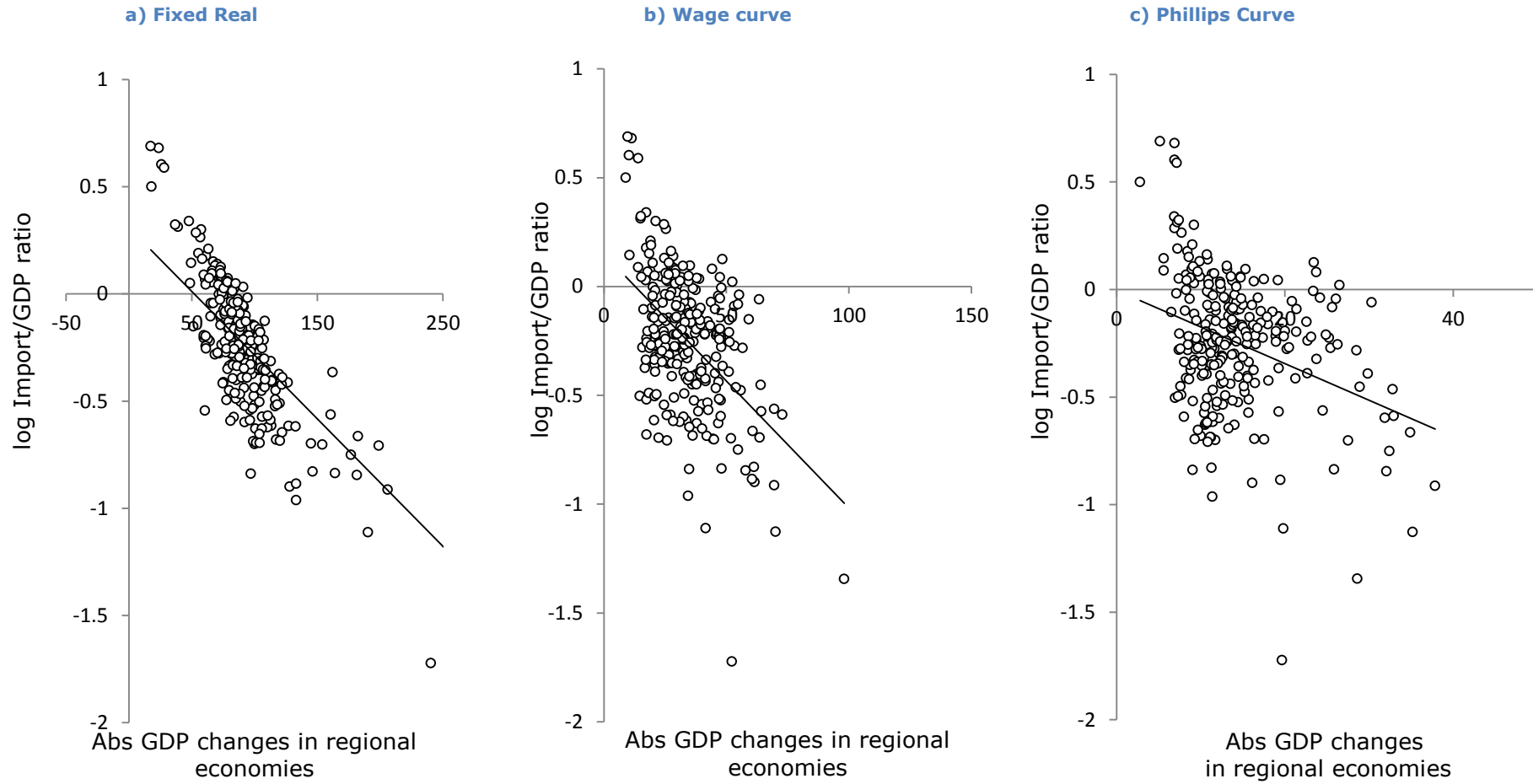
	<u>Regions</u>			<u>EU</u>		
	PC	WC	FRW	PC	WC	FRW
Average GDP Multiplier	0.14	0.34	0.93	-0.10	0.10	3.04
	(0.06)	(0.13)	(0.38)	(0.39)	(0.62)	(0.77)

Standard deviation in brackets. PC: Phillips curve. WC: Wage curve. FRW: Fixed real wage. Source: RHOMOLO simulations.

For each of the wage configurations considered in the simulations it is helpful to investigate the role played by the calibrated shares parameters. Intuitively, we would expect that the capacity to generate higher multiplier effects within a region is contingent upon its import intensity. If a region satisfies the increased demand for goods and services through higher imports, the resulting impact is likely to be lower than the case in which excess demand are met through internal production. In Figure 5, we evaluate the model's ability to match these facts by showing the correlation between the simulated absolute GDP changes and the log of the share of import/GDP ratio as in the initial steady-state for each of the wage structures: fixed real wage (panel a), wage curve (panel b), and Phillips Curve (panel c).

¹⁰ Under fixed real wage, the nominal wage might change in response to changes in the regional consumer price index (CPI). Furthermore, all the excess demand of labour is absorbed raising labour market participation.

Figure 5. The relationship between the change in real GDP and import intensity - three labour market assumptions



We observe a strong negative correlation under fixed real wage whilst for the remaining wage setting alternatives the correlation is lower, though still negative as expected. Under fixed real wages, the steady-state economy does not suffer from significant price pressure and therefore the economic impact mainly depends on the initial (pre-shock) ability to meet augmented demand using internal production. In other words, the initial backward linkages play a great role in determining the economic impact associated to an external disturbance. As said above, under fixed real wages the RHOMOLO model operates similarly to an extended standard IO-based demand-driven model where all the elements of final demand are endogenous (see for example Lecca et al., 2015, and Swales, 2005). However, for the case of wage curve and Phillips curve, the change in prices alter the initial economic structure making the regional economy less dependent from the calibrated share parameters. In these circumstances the indirect supply-side effect achieved through change in prices contrary to the case of the fixed real wage is able to modify the existing pre-shock backward linkages.

5 The interregional spillover effects

The capacity of a single regional economy to transmit the shock to the non-perturbed regions is subject to extensive variation. The numbers reported in Table 1 permit us to gauge the importance of the wage setting structure for the impact of a regional shock on the rest of the EU regions (REU). The average spillover (that is the impact on the REU economy as whole) can be calculated from the difference between the EU multiplier obtained with a single regional shock and the regional multipliers (since the magnitude of the shock is the same).

Both under fixed real wages and a wage curve, we register a positive impact for the EU as a whole (the multipliers equates to 3.04 and 0.10 respectively), while the overall EU impact obtained under the Phillips curve is on average negative (-0.10). Only under the fixed real wage, the EU multiplier is significantly higher than the internal average multiplier observed in the regions (0.93), meaning that the impact on the REU is positive. For the remaining two labour market assumptions, the resulting spillovers generate on average negative effects on the economy of the REU. The reported standard deviations suggest that not all regions generate negative spillover for the REU. In general, we observed that a single region perturbation generates positive spillovers within the country they belong to, but ultimately the impact in the other REU regions is negative. Typically, distance matters for backward spillovers, however, country boundaries seem to be highly important for spillovers in our analysis.¹¹

¹¹ It is part of our future agenda to undertake further research to analysis the extent to which trade spillover are affected by distance.

The perverse effects in operation under upward wage pressure on the REU economy need to be analysed further. When a single region is perturbed, the demand for intermediate and final goods from the REU economies increases. Therefore, the overall REU economy will enjoy an increase in exports towards the perturbed regions and possibly towards the other remaining EU regions. However, the increase in demand for goods and services in the REU economy generates also an increase in wages that in turn cause commodity prices to rise, resulting in negative terms of trade effects. Ultimately, loss in competitiveness especially with respect to the ROW will come into play. While loss in competitiveness in the perturbed regions are fully counteracted by the increase in internal production, in the REU economies (the non-perturbed regions) the fall in the exports to the ROW could fully offset the positive benefit of an increase in interregional exports.¹² This is what is happening for the wage curve and Phillips curve cases as shown in Table 1. The upward wage pressure registered under these two labour market closures is able to make in average the REU economy worst off.

Under these two wage setting options, an important role in determining the effectiveness of the channels of interregional spillover is played by trade elasticities; lower values being associated with bigger multipliers within the region due to a higher resistance of regional consumers to trade-off locally produced goods for imported goods when the prices of the former rise.

In order to test how sensitive our results can be to variations in trade elasticities, in Table 2, we report the EU average multipliers obtained lowering the substitution possibilities with the REU and the ROW. The default elasticity is set to 4 in both cases. We now implement the same simulations recalibrating the model with an elasticity of substitution equal to 2 in EU interregional trade while for the international trade (trade with the ROW) the elasticity is now set to 0.5. The GDP impact in the perturbed regions increases significantly compared to the case of default elasticities. Furthermore the overall impact on the EU and the REU is now positive for all three wage structures considered. As anticipated above this is the result of lower substitution possibilities in trade that reduce the adverse competitiveness effects previously occurring in the REU economy.

Table 2. The GDP multiplier effect under three alternative labour market closures obtained with lower trade elasticity

	<u>Regions</u>			<u>EU</u>		
	PC	WC	FRW	PC	WC	FRW
Average GDP Multiplier	0.35	0.56	0.93	2.49	2.26	3.04
	(0.4)	(0.25)	(0.38)	(2.09)	(0.88)	(0.77)

Standard deviation in brackets. PC: Phillips curve. WC: Wage curve. FRW: Fixed real wage. Source: RHOMOLO simulations.

¹² In addition, the rise in domestic prices makes the import of goods and services relatively cheaper.

With lower trade elasticities the perturbed regions are faced with lower adverse competitiveness effects of an increase in wages resulting in a higher GDP impact. Similarly in the REU economies, the fall in exports to the ROW is now not able to counteract the benefit of an increase in demand of goods and services coming from the perturbed regions and the rest of other REU regions. Hence impact on GDP is positive for most of the non-perturbed regions.

It is worth noticing that trade elasticity however plays no role under fixed real wage. For this wage configuration the results reported on Table 2 are identical to those reported in Table 1. In this case the change in output prices in the long-run are negligible making changes in elasticity of substitutions of no importance. Hence with fixed real wages the propagation of the shock towards the other EU regions will exclusively depends from the capacity to generate bigger internal output multipliers and from the initial propensity to import from the REU economies.

In summary, there are two sets of stylized facts that deserve to be highlighted in the simulations. The first stylized fact is related to the importance of the wage setting regime. The propagation of the shock to other regions crucially depends on the wage regime adopted in the model. Clearly the labour market closure adopted in the model has to be as close as possible to that empirically observed in the region under scrutiny. In our analysis we show that under fixed real wages the magnitude of the spillovers is higher than that obtained under alternative wage setting regimes for two main reasons. First, the internal multiplier generated in the perturbed regions is greater than in the other wage specifications because the absence of upward wage pressure prevents loss of competitiveness. Second, the spillovers are transmitted to the non-perturbed regions without altering the initial geographical trade pattern because the initial import intensity is not affected significantly since long-run output prices return to their initial steady-state level.

The second stylized fact is related to the importance of trade elasticities. The choice of trade elasticity in combination with the labour market channels could results in a widely different outcome. The real GDP changes for the non-perturbed regions under a wage curve and a Phillips Curve could be negative if the trade elasticity is high enough to cause adverse competitiveness effects. However, under fixed real wage the non-perturbed regions always benefit from an increase in demand occurring in the perturbed region. The extent of the trade spillover, that is the impact on the REU economies, in this case will necessary be influenced by the share of imports of goods and services from the REU by the perturbed region. This can be seen in Figure 6, where for each of the wage structures assumed we plot the absolute GDP changes in the REU on the *x-axis* and the log of import from REU by each region as a share of GDP. The scatterplots suggest that only under fixed real wage we can envisage positive correlation between the two variables. However any sort of correlation is hard to be identified under the other two wage setting regimes.

The role played by trade elasticities has particularly intriguing implications for all the modelling-based studies in which the Armington assumption plays a role, that is most of the commonly used CGE and DSGE models used in the economic literature. As recently highlighted by Feenstra et al. (2018), the magnitude of the Armington elasticities governing the substitution between goods from different countries is subject to debate, with estimates varying widely across countries and studies. Several approaches and data to estimate such parameters are available but there is no consensus on a single procedure nor on the existing econometrically estimated or calibrated parameters (Imbs and Mejean, 2015, Hertel et al., 2007). Moreover, many of the existing strategies can only be used for specific products/sectors and regions of the world for which detailed trade data are available (see for example Balistreri et al., 2010, and Mundra and Russell, 2010).

The results of our analysis focused on demand shocks call for a thorough examination of the role played by the modelling assumptions regarding trade. In the absence of robust estimates of the parameters governing the elasticity of substitution between domestic and imported goods, and between goods imported from different countries, some effort should be devoted to the investigation of

the sensitivity of the results to alternative sets of parameters and elasticities.

6 Analysis of the results under alternative product-market structures

In Section 2, we have seen that RHOMOLO is equipped to deal with three configurations of imperfectly competitive markets: monopolistic competition and oligopolistic competition à la Bertrand and à la Cournot.

A comparison of simulation results under the three different models is reported in Table 3. For the sake of comparability we also report the results shown in the previous section, obtained under perfectly competitive product markets. Similarly to the analysis carried out in Section 3 we compute the average multiplier obtained in the perturbed regions under the three labour market assumptions. These results are reported on the left-side of Table 3. We also show the magnitude of the spillovers obtained shocking a single region by reporting the associated average multipliers for the EU as whole on the right-hand side of the same table.

Our modelling experiment suggests that the magnitude of the macroeconomic effects generated in the perturbed regions under the three alternative imperfectly competitive market structures are similar. Under Phillips curve wage behaviour, the multiplier is around 0.13, under wage curve equates to 0.31, while under fixed real wage the multiplier is around 0.93-0.94. So the main stylized fact emerging from this analysis is that regardless of the pattern of adjustments that might occur under alternative mark-up specifications, in the long-run a demand shock does not generate dramatic differences among alternative configurations of

market structures. As observed for the perfectly competitive case, we obtain higher average multiplier under fixed real wages for both the perturbed and the non-perturbed regions.

Table 3. The GDP multiplier effect under three alternative labour market closures and different assumptions on market structures

	Regions			EU		
	PC	WC	FRW	PC	WC	FRW
Perfect competition	0.14 (0.06)	0.34 (0.13)	0.93 (0.38)	-0.10 (0.39)	0.10 (0.62)	3.04 (0.77)
Monopolistic competition	0.13 (0.06)	0.31 (0.13)	0.93 (0.38)	-0.14 (0.40)	-0.03 (0.68)	3.04 (0.77)
Bertrand	0.13 (0.06)	0.31 (0.13)	0.93 (0.38)	-0.14 (0.40)	-0.03 (0.68)	3.08 (0.80)
Cournot	0.13 (0.06)	0.31 (0.13)	0.94 (0.41)	-0.14 (0.40)	-0.03 (0.68)	3.24 (1.31)

Standard deviation in brackets. PC: Phillips curve. WC: Wage curve. FRW: Fixed real wage. Source: RHOMOLO simulations.

The sign and the size of the EU impact differ according to the market structure. Inspecting the right-hand side of Table 3 we notice that under Phillips curve and fixed real wage the magnitude of the impact increases while moving from perfectly to imperfectly competitive markets. Interesting, it becomes further negative under Phillips curve but increasingly positive under fixed real wage. On the contrary under the wage curve assumptions, we register positive effects on the EU economy under perfect competition but negative impact arise with imperfectly competitive markets.

7 Conclusions

This paper makes two primary contributions. It quantifies the sign and the size of an increase in expenditures in each of the 267 EU NUTS 2 regions and measures the corresponding spillover effects in the REU economy distinguishing between three alternative labour market specifications, gauging at the same time the importance of the assumptions related to trade elasticities. Also, the role of the goods market's structure is investigated. A second contribution is methodological. We develop a spatial model that incorporates a high level of details and distinctive features.

In our analysis we find that market structure assumptions seem to play a relatively low role in shaping the results. However we found that the labour market is an important transmission channel of the regional policy. It is a determining factor in shaping the magnitude of the economic impact in the perturbed and non-perturbed regions. Therefore researchers should beware of the appropriate wage settings adopted when modelling tools are used to evaluate regional policy programmes. We also found that the size of the impact in the perturbed regions

and the extent and sign of the spillover effects changes substantially depending on the assumed elasticity governing the substitution between domestic and imported goods.

We believe our conclusions to be of extreme importance for the policy makers. Adoption of place-based or spatially blinded policies ultimately has an effect on neighbourhood regions as well.

We are conscious of the limitations of our analysis that is based on a demand-side shock neglecting at this time the potential supply-side implications of regional development policy programme. In addition, we have not taken into account the budgetary and fiscal effects of policy financing. It is however on top of our research agenda to explore the above issues in our future research.

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