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European Integration and Domestic Regions: A Numerical Simulation Analysis

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[Abstract] Does European economic integration create more inequality between domestic regions, or is the opposite true? While former research has asked for a general answer to this question, we argue that such a general answer does not exist and that the outcome depends on the liberalisation scenario. In order to examine this, we need models with higher dimensionality where the question is where and not whether there will be spatial agglomeration. For this purpose, the paper develops a numerical simulation model with nine countries and 90 regions in order to examine the impact of European and international integration on the regions. Eastward extension of European integration is beneficial for old as well as new members, but within countries the impact varies along the east-west axis. Reduction in distance-related trade costs is particularly good for the European peripheries. Each liberalisation scenario has a distinct impact on the spatial income distribution, and there is no general rule telling that integration causes more or less agglomeration.

Keywords: Regional inequality, international trade, European integration.

JEL codes: F12, F15, R12, O18.

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1. Introduction*

How does European integration affect domestic regions? This question is urgent not only for those directly affected but also for policy makers: regional support constitutes a main component of the common policies of the European Union. In the 2007-2013 Financial Framework of the EU, 36% of total funds is allocated to such "cohesion activities".[1] While Greece, Ireland, Portugal and Spain were the main beneficiaries of EU regional support during the years preceding the 2004 enlargement, regions in the new member states have now taken over this role.

On this background, it is of considerable interest to know whether integration as such tends to widen or narrow the core-periphery gaps inside countries. If the latter was to be true, European integration would by itself be a good regional policy, and the case for budget support would be weaker. Ederveen et al. (2006) find that EU structural funds are only effective in regions that are open or have good institutional quality. For EU policy, especially in the context of the EU Neighbourhood Policy (see e.g. Dodini and Fantini 2006), an urgent issue is whether there is an "agglomeration shadow" whereby regions outside the enlarged EU are worse off.

A growing body of evidence (see e.g. World Bank 2000, Römisch 2003, Landesmann and Römisch 2006) suggests that regional inequality is on the rise in new member states. According to a recent comprehensive assessment (Melchior 2008a) covering 36 countries in Europe and beyond, there is no doubt: During 1995-2005, there was a substantial increase in domestic regional inequality within all Central and Eastern European countries. Given that East-West European free trade agreements and EU enlargement has been implemented during the last decade, an issue is therefore whether integration as such has been a cause for the observed increase in regional inequality. Or is it, on the contrary, the case that European integration promotes regional convergence within countries?

Existing research provides no clear answers about whether international integration promotes convergence or divergence between domestic regions. In section 2, we review some empirical work as well as some recent theoretical contributions within the new economic geography (NEG) and conclude that the answer to our main question is ambiguous in terms of theory as well as empirics. In this paper, we argue that there is no general answer to this question, and searching for such a general rule is barking under the wrong tree.

As an illustration, some of our results suggest that East-West regional integration will have an uneven impact on western and eastern regions within former member states and the new members. In the new member states, for example, western regions may be more stimu-

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[1] See http://ec.europa.eu/budget/reform/budget_glance/what_for_en.htm.

lated by integration. Whether this contributes to more or less regional inequality, depends on the initial pattern of regional inequality. Furthermore, we show that the east-west impact of integration is quite different with other forms of international trade integration, for example multilateral trade liberalization of the WTO (World Trade Organization) type, or reduction in distance-related trade costs (such as transport costs). Hence the impact of international integration on domestic regional inequality depends on the type of integration as well as the initial income distribution. European regions have been affected by various stages of European integration, multilateral integration through WTO, and reductions in transport costs. We cannot expect that all these forms of integration have similar effects on domestic regions.

In order to address such integration effects, we should not only ask *whether* there will be spatial agglomeration of economic activity, but *where* this agglomeration will be. Will international integration stimulate growth in the north, south, east or west of a country, or its central areas? In order to address such issues, we need models of sufficient dimensionality: with a sufficient number of countries, and with distinct regions within each country. In trade theory and the new economic geography (NEG), the issues have mainly been addressed using low-dimensional models with three or four regions (see Section 2 for references). Many questions about European integration and domestic regions can however not be addressed within such models. Concluding their survey of the new economic geography (NEG), Fujita and Mori (2005) consider the development of higher-dimensional spatial models as one of the top priorities for future research in the field.[2]

The ambition in this paper is therefore to develop a higher-dimensional model for the study of European integration, in order to highlight the issue and develop a platform for empirical work in the field. In this way, we try to move from economic geography to *geographical economics*, by developing a model that is directly applicable to the empirical analysis of spatial development patterns in Europe. As another contribution in a related field, Stelder (2005) uses a large-scale NEG model to examine the location of cities in Europe. Except for this contribution we are not aware of similar large-scale models, although some regional CGE (Computable General Equilibrium) models may be partly related although these are mainly focusing on the national level only (see e.g. Bröcker and Schneider 2002). Multi-regional modeling has certainly been used also in the NEG context; see e.g. Fujita et al. (1999), but then mainly to answer questions about “whether” there will be agglomeration. In the current paper, we extend this by focusing more on the “where” question, and derive implications that can be applied to the map and used directly in the empirical study of geographical patterns of change in Europe. For example, we ask whether integration will have different impact in the west and in the east, within Europe as a whole and within each country.

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[2] The authors list four priority areas, and the others were; (i) unifying urban economics and NEG, (iii) better modeling and empirical understanding of transport costs and how it affects agglomeration, and (iv) exploring the impact of spatial knowledge spillovers.

In Section 2, we survey some recent research in the field. In Section 3, we discuss and motivate the theoretical modeling approach chosen and define the integration scenarios to be examined. We present the technical properties of the theoretical model and examine the behaviour of the model in a low-dimensional setting, before proceeding to the higher-dimensional numerical simulations. In section 4, we present the results from the modeling of various stages of regional and international integration affecting European regions. Some concluding remarks are presented in Section 5.

2. International integration and domestic regions: Some recent research

The new economic geography (NEG) (see Ottaviano and Thisse 2004 or Fujita and Mori 2005 or Fujita et al. 1999 for overviews, or Puga 1999 for a synthesis of some core models) provides a new micro-foundation for examining regional inequality. Some NEG contributions have also examined the relationship between international integration and domestic inequalities. In models of economic geography there is typically a centrifugal force working against agglomeration, and a centripetal force promoting a more uneven core-periphery pattern. Appearing in various shapes and embedded in different models, the standard engine for agglomeration is often the so-called "home market effect" demonstrated by Krugman (1980): Industries with economies of scale and imperfect competition tend to be located where market access is better. In Krugman (1980) it was the home market that created better market access, but it may also be a more favourable geographical location.

If workers are allowed to migrate in response to real wage differences, as in Krugman (1991), it amplifies market size differences, and regional inequality will increase. In this model, the centrifugal force is that workers in the "agricultural" sector are immobile and maintain an incentive to locate firms close to peripheral demand. Allowing labour to migrate between domestic regions but not internationally, it may then be studied how migration and domestic agglomeration is affected by international trade integration. Within such a framework, Paluzie (2001) and Monfort and Nicolini (2000) find that international liberalisation makes domestic agglomeration more likely. Monfort and Ypersele (2003) obtained similar results in a model without labour migration but with vertical linkages between industries. It is well known in the new economic geography literature (see e.g. Puga 1999) that the NEG labour migration model and the model with vertical inter-industry linkages of Krugman and Venables (1995) produce rather similar results.

The results outlined above are derived in models where domestic regions are symmetrically placed related to foreign countries or region, so there is no geographical core-periphery pattern. Crozet and Sobeyran (2004) also examined the asymmetric case where one domestic region is closer to the outside world. Now the conclusion about integration and regions is reversed: International integration promotes development in the border region.[3] A similar conclusion was obtained by Krugman and Livas Elizondo (1996), who replace the centripetal force working against concentration: When agglomeration is dampened by domestic congestion costs instead of immobile farmers, international integration also leads to less domestic concentration.[4]

What is the intuition behind these results? International integration makes intra-national trade less important and this weakens the forces for concentration as well as for dispersion:

- It weakens the "monopoly" of the domestic core region by facilitating the periphery's trade with the outside world, and this may promote convergence. The intuition may also be expressed as follows: It is borders that create the backwardness of some border regions, and when borders are made less important, domestic core-periphery patterns are weakened.
- On the other hand, increased demand from abroad also strengthens the incentive for agglomeration. In models where domestic real wage differences are ruled out since they lead to labour migration, international integration is then more likely to produce agglomeration.

From the still limited amount of *theoretical* research on this issue, it is therefore ambiguous whether international integration promotes convergence or divergence between domestic regions.

This ambiguity also applies to empirics. Some evidence indicates that international integration leads to more inequality: Summing up the results from a large-scale United Nations research project, Kanbur and Venables (2007, 209) conclude that "trade has on balance increased spatial disparities". Hanson (see e.g. Hanson 2003) has examined the impact of NAFTA on wages in Mexico and found that integration led to greater regional wage dispersion but a gain for more skilled labour close to the U.S. border.[5] Egger et al. (2005) found that export openness increased regional inequality with respect to real wages in Central and Eastern Europe. This evidence is important; it is however not a direct test of the mechanisms described in the theoretical models above.

On the other hand, there is also evidence suggesting that international integration promotes regional convergence:

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[3] Another contribution considering spatial asymmetries, regions and international trade is Behrens et al. (2006). Using a model with two countries each having two regions, they show, among other things, how the probabilities of agglomeration in the two countries are interdependent.

[4] See also Alonso-Villar (2005). Behrens (2003) also shows that some of these results depend on the Dixit-Stiglitz modelling approach where the firms' mill prices are unaffected by trade costs and changes in competition. If changes in competition lead to changes in prices, the share of trade costs in total costs may change, and this may change the results.

[5] According to Aroca et al. 2005), it was stagnation in South Mexico rather than prosperity in North Mexico that caused the divergence in incomes.

- Crozet and Soubeyran (2004) interpret their evidence about labour migration in Romania as support for the hypothesis that European integration has been to the advantage of border regions, as predicted by their model.
- Redding and Sturm (2005) found that the division of Germany during 1945-1990 had a particularly negative impact on border regions; thus indicating that disintegration contributed to stronger core-periphery pattern. They also found signs of recovery for border regions after reunification.

Hence also empirically, some contributions suggest convergence and others divergence.[6] Based on earlier research, the impact of international integration on domestic regions is therefore ambiguous theoretically as well as empirically.

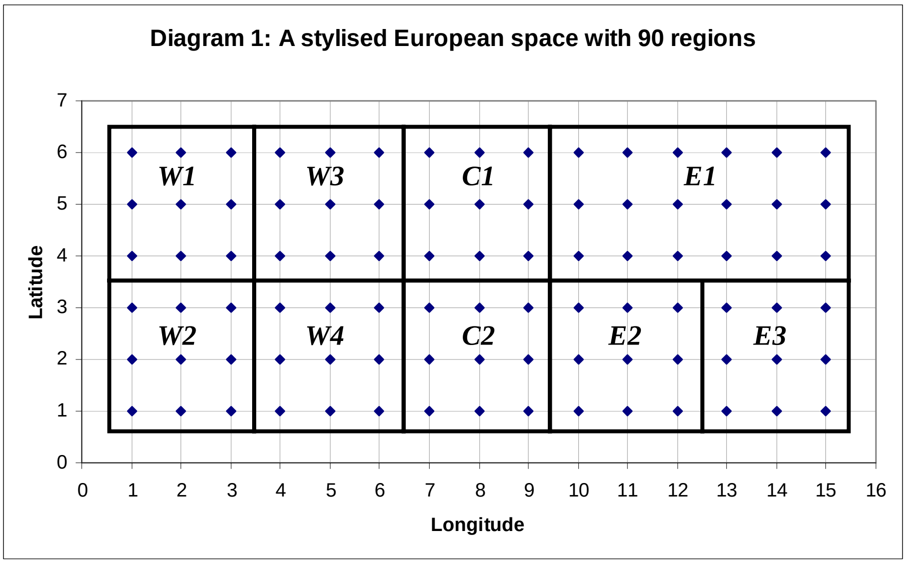
Except for the border region of Crozet and Soubeyran (2004), the theoretical models referred to above are essentially similar to trade bloc models containing three or four regions, with a limited spatial structure. It is therefore of interest to examine the issue in models where geographical location and distance plays a larger role. In order to obtain this, one needs greater dimensionality. Melchior (2000), using a 49-region multilateral version of the home market effect (HME) model of Krugman (1980), distinguishes between "spatial" trade costs (such as transport costs) and non-spatial trade costs (such as tariffs) and found that "spatial liberalisation" tends to promote more centralisation, while reductions in non-spatial trade costs tend to have the opposite effect. The distinction between spatial and non-spatial trade costs is also examined by Behrens et al. (2007), who study agglomeration effects with gated regions, and it will be an important element in the modelling undertaken here. Spatial trade costs allow the forces of geography and distance to work properly, while non-spatial costs allow the modelling of countries and trade blocs. When the two types are combined, one generally obtains effects that are distinct from those that apply with each of them alone.

3. The modeling approach

3.1. A synthetic European space

In the theoretical analysis, we use a two-dimensional rectangular grid of 9 countries divided into 90 regions. Diagram 1 illustrates this "synthetic" European space:

[6] Some research focuses on other variables; e.g. that international integration promotes more similar export structures; see Beine and Coulombe (2007)and Crespo and Fontoura (2007).



In the diagram, each dot represents a region of equal size in terms of population or labour force. Eight of the countries have nine regions each, while the last North-East country, E3, has 18. While the map is highly stylized, the idea is to capture aspects of the true European space. The four countries W1-W4 to the left represent the "old EU" or Western Europe whereas C1-C2 represent the "new members" or Central Europe. Eastern Europe is represented by E1-E3, of which one (E1) is a large, long and narrow country which is meant to capture some dimensions of Russia. E2 could in terms of geographic position resemble Turkey or Ukraine and E3 might represent Eurasian countries further east. The 90-region landscape has distinct North-South and even more East-West dimensions; there is a sufficiently rich regional structure inside each country, and we have a sufficient number of countries to study different integration scenarios, and their impact on insiders and outsiders.[7]

The map in Diagram 1 captures some aspects of the true European space but we should nevertheless be aware of the limitations:

- There is no outside world so the model will tend to overestimate the isolation of regions at the borders of the landscape. Given that e.g. regions in the Russian Far East is now benefiting from more intensive trade with China, USA and others, this is a limitation.
- The landscape is stylized and misses many features of true geography, which has more countries, oceans, lakes, mountains, climatic differences and so on. For example, the results for "W1" may not be appropriate in order to assess the impact of European integration on Nordic regions. The North-South dimension is limited and allows limited analysis of e.g. EU enlargement towards the South

[7] Before choosing this format, we also experimented with a more geographically realistic approach using up to more than 500 regions, using true regional map coordinates. It is however an illusion that the model is much more realistic even if the coordinates are true: After all, it is only theory. With a more stylised landscape, it is easier to interpret the results and we avoid some technical computation problems that are present in models with larger scale and variable region size.

and North. This is a deliberate choice since our focus here is particularly on the East-West dimension.

Neary (2001, 551) also calls for two-dimensional extensions of NEG models but fears they will be "long on trigonometry and short on elegance"! With a richer landscape it is inevitably the case that the effects and results are also more complex. By choosing the rectangular grid rather than true geography, it is nevertheless easier to see the principal results in a stylized way. In order to show how the core model affects the results, we shall also proceed in two steps, by exploring the model properties in a low-dimensional setting before proceeding to the 90-region landscape.

3.2. Scenarios and trade costs

A core feature of the approach used here is that we include some trade costs that are a function of distance, and others that are independent of distance. We call the first *spatial* trade costs, and the second *non-spatial*. As shown by Melchior (2000); when the two types are present simultaneously one obtains effects on the spatial distribution of activity or incomes that are not present when each is considered in isolation.

We may think of spatial trade costs as transport costs, but it could also be the case that policy-shaped barriers or regulations have a spatial dimension. For example, if geographical distance also reflects institutional similarity it could be that standards and regulations are more similar in countries and regions that are close to each other and their protective impact could then be correlated with distance. The relationship between transport costs and distance is also not straightforward: while e.g. the costs of road transportation in Europe may be monotonously increasing with distance, this may not be so clear for long-distance sea freight. Similarly, we may think of trade policy barriers as non-spatial and this is certainly the case for e.g. a Most-Favoured Nation (MFN) tariff applying to all countries. But if countries form trade blocs with their neighbours only, there may also be a correlation between trade policy barriers and distance. In the analysis here, trade costs represent distribution costs in general, and it is an empirical issue which trade costs are spatial and non-spatial. In the European context, the European internal market is a large-scale project containing thousands of reforms, of which some may be spatial and others non-spatial.

In the model simulations, trade costs always include a spatial as well as a non-spatial component:

- Spatial trade costs are present within as well as between nations. We use the notation $d_{ij}=\beta_d*D_{ij}/D_{max}$. Here D_{ij} is the "geographical" distance in Diagram 1; varying from one between adjacent regions up to the maximum, $D_{max}\approx 14.03$. We divide by D_{max} so the right hand side ratio is maximum equal to one. β_d is a scaling factor, which we use to scale up or down the magnitude of spatial trade costs.

- We assume that there are non-spatial trade costs present between all regions, also within nations. We use three levels; within nations ($t_{domestic}$), between regions in different nations but within the same trade bloc (t_{rta}, where the rta subscript refers to some regional trade agreement), and between regions in different nations that have made no special integration agreement (t_{mfn}, where mfn refers to Most Favoured Nation). We always assume $t_{domestic}<t_{rta}<t_{mfn}$ and for simplicity we let the level for regional integration be mid-way between the domestic and MFN barriers. If we had allowed $t_{domestic}=t_{rta}$ countries would not exist any more. Since international trade costs are always higher than the domestic ones, countries continue to matter in all scenarios.

We will simulate the following ten scenarios:

1. A base case without any regional integration agreements (BASE). The results are not reported in detail, but it is used as a yardstick for comparing the results of regional integration.
2. Western integration (WEST): A regional integration agreement is formed among the four countries to the west (W1-W4). This is meant to represent the earlier stages of integration in Western Europe.
3. Iron curtain (IRON): Prohibitive barriers are erected between WEST countries and the rest. By reversing the sign of the predicted effect, we check the impact of the fall of the iron curtain.
4. West-Central integration (WIDER): The Central European countries C1 and C2 are added to the regional integration scheme. This intended to capture aspects of the eastward extension of European integration; through various free trade agreements and finally EU enlargement.
5. Multilateral integration (WTO): We examine the impact of changes in t_{mfn}, with no changes in the other trade cost components. This sheds light on the impact of multilateral liberalization and also "preference erosion" whereby the intra-European preference margin is reduced.
6. Eastern integration (EAST): We examine the impact of integration between the three countries to the east; E1-E3. This may be relevant for discussing the dissolution of the Soviet Union as well as current integration efforts within CIS (the Commonwealth of Independent States).
7. Reduced transport costs (SPATIAL): We examine the impact of reduced spatial trade costs, while all other trade costs remain unchanged. In this way, we check how regions could be affected by the "death of distance", or more realistically a reduction in its costs.
8. Further eastward extension of integration (EAST-WEST): E2 joins the regional integration agreement and we examine the national and regional impact. This could be relevant for assessing further EU enlargements or free trade agreements to the South East, e.g. with Ukraine or Turkey.

9. Unilateral liberalization in the East (EASTOPEN): We explore the impact of unilateral liberalization in an eastern country (E2). In this case we simulate the outcome with initially trade costs higher than t_{mfn}; and the impact of reducing these to t_{mfn}. Transition and WTO membership have led to a significant reduction in trade costs in some Eastern European countries, and this scenario is intended to capture such changes.
10. Capital region dominance (CAPITAL): In Central and Eastern Europe there has been faster growth in capital regions and a potential explanation is that some nations have a hub-and-spoke pattern where the capital is a hub. We try to capture this by assuming that half of the trade of regions in the three eastern countries E1-E3 has to pass through their capital. We may think of this literally as if goods have to be transported via the capital, or – perhaps more plausibly – that other aspects of distribution and sales are related to the capital. In order to model this, we designate capitals based on the outcome of earlier simulations and recalculate the matrix of trade costs. We use the three eastern countries as illustrations, but have no à priori prediction about where such capital hub effects are relevant. Brülhart and Koenig (2006) tested what they called the "Comecon hypothesis" and found that for wages and service employment, capital regions in five of the new EU member states (with respect to the 2004 enlargement) were better off. Hence this scenario may potentially be relevant also for Central European countries. In Melchior (2008a) it is shown that higher regional inequality invariably corresponds to a larger income gap between capital regions and the country average, and this applies to Central as well as Eastern European countries.

3.3. The choice of model

Models of the new trade theory and NEG are well-suited for our purpose since in such models, industrial location or income levels are affected by market access. The archetype version of this argument is the "home market effect" (HME) model of Krugman (1980): In this model, large countries tend to be net exporters with respect to a "manufacturing" sector with scale economies, monopolistic competition and trade costs. While most models of the new trade theory and NEG have shared this focus on *net export effects*, Krugman (ibid.) demonstrated that market access could alternatively show up in the form of nominal wage differences rather than net trade effects. In their survey of empirical work on the new economic geography, Head and Mayer (2004, 2663) conclude that the relationship between market access and wages is more robustly supported than the relationship between market access and the structure of production. Empirical research therefore strengthens the case for models with endogenous wages rather than net trade effects. In this paper, we therefore depart from Krugman's idea about nominal wage effects and develop a multilateralised version which we call the "wage gap model". In the analysis, we compare this to a multilateral version of the HME model and argue that the wage gap model is indeed a plausible alternative.

A multilateral version of the HME model was applied to the analysis of spatial inequality by Melchior (1997, 2000) or more recently Behrens et al. (2005, 2007).[8] In the multi-region setting, the HME model has the advantage of simplicity: It has a simple matrix-form solution so numerical exercises can be carried out with little technical difficulty. Hence the model has some of the virtues requested by Fujita and Mori in their quest for developing high-dimensional models (2005, 396); "A most desirable model would be one that has solvability at the low dimensional setup and computability even at the fairly high dimensional setup." The drawback, however, is that for the HME model, a solution with positive production in all regions only exists within a restricted range of parameter values. Helpman and Krugman (1985, Chapter 10.3) showed that even in the two-region case, the range with positive production in both regions is limited in the HME model. In the case with many regions, this problem is severely aggravated. The implication for numerical modeling is that the model is "sustainable" only for quite high levels of trade costs, limited region size differences, and a high elasticity of substitution. This severely limits the applicability of the HME model in high-dimensional modeling. Another limitation of the HME model is the somewhat arbitrary assumptions about the numeraire sector. This sector is sometimes referred to as "agriculture", but it is empirically not very plausible that there is completely free trade for agriculture but not manufacturing. As shown by Davis (1998) (and discussed further in Fujita et al. 1999, Chapter 7), the HME disappears if trade costs are equal in the two sectors. [9] In spite of these limitations of the HME model, the model demonstrates in an extreme form a powerful mechanism that is present also in other models and crucial in the whole NEG literature.

Based on these arguments, we choose in this paper to develop an alternative model with endogenous wage differences instead of net export effects. Following Krugman (1980) and dropping the numeraire sector in the HME model, we obtain a model where wage differences are driven by differences in market access. Dispensing with sector differences and collapsing the economy into one sector, using one sector and one factor of production only, we can think of this as a "sector average" for the economy. To this we may later add other features: Sector differences in trade costs or technology, adding more produc-

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[8] In addition to the "manufacturing" sector referred to above, there is a numeraire sector which is freely traded at zero cost and produced with constant returns to scale. When labour is the only factor of production, free trade with the numeraire good equalizes wages in all regions/countries (provided they all produce that good). With no nominal wage differences, any advantage in market access or home market size is reflected in larger production in the differentiated goods sector. Since large countries obtain a more than proportionate share of production, we obtain the HME effect.

[9] Also if we replace the numeraire sector with another "Dixit-Stiglitz sector" with trade costs, the HME effect may disappear and the pattern of specialization and trade will depend on differences in elasticities and trade costs across the two sectors. As shown by Venables (1999) in a two-dimensional setting (a circular plain), a complex "chess-board-like" pattern of alternating specialization may then occur.

tion factors and so on.[10] Ideally, we would like to have net trade effects as well as wage effects simultaneously, but – given the dimensionality of the model – we start with wage effects only.

We call this *the wage gap model* since differences in market access are reflected in the form of different nominal and real wages. While this is our main approach, we shall also retain the HME model as part of the analysis and compare the two models: Are the wage effects in the wage gap model just a mirror of the net export effects in the HME model? As we shall see, this is sometimes but not always the case.

An alterative choice might have been to use NEG models along the lines of Krugman (1991) or Krugman and Venables (1995). While these models have some interesting properties, they generally generate multiple equilibria and even in the simple two-region case the analysis of stability can be demanding. For the purpose at hand, with 90 regions, we deliberately avoid models with multiple equilibria.[11] With many possible equilibria and no yeardstick to choose between them, it may be difficult to evaluate the results coming from numerical simulations. For the purpose of analyzing European regional income distributions, we are also interested in a model which allows for a continuum of possible outcomes rather than catastrophic agglomeration in one region. European peripheral regions are generally not empty, but they have lower nominal and real incomes and we would like the model to capture this. Nevertheless, our choice is mainly for technical reasons and an interesting extension might be to develop more multi-region application of the NEG models with ad hoc dynamics, labour migration or externalities.

3.4. Properties of the wage gap model: Are wage effects and net export effects similar?

In Appendix A, the technical details of the model are presented. Here we shall illustrate some of the properties of the model. We start by examining the model in a low-dimensional setting, before proceeding to the 90-region simulations.

Some basic properties of the wage gap model are:

- Since there is only one sector in the economy overall trade has to be balanced so there is only intra-intra-industry trade.[12]

[10] For example, the model of Markusen and Venables (1998) adds a Heckscher-Ohlin type supply-side to the HME model so that market access differences will affect wages as well as net exports. Exploring how this model performs in a higher-dimensional setting is a task for future research. In a higher-dimensional setting, the technical challenge increases with the number of unknowns, e.g. two factor prices for each country rather than one.

[11] With two regions, we obtain bifurcations and the well-known “Tomahawk diagram” (see e.g. Fujita et al. 1999, 68). With 90 regions, “star wars” would be a possibility!

[12] We cannot exclude “triangular” trade so that there is a trade imbalance bilaterally, but aggregate trade always has to be balanced.

- Given that trade is balanced, domestic consumption and production of the differentiated goods must be equal. For this reason, the number of firms will be proportional to country size.
- Wage levels will however differ and for this reason the value of production and consumption will also differ across countries.
- Welfare is equal to the nominal wage divided by the price level; i.e. for region *i* per capita welfare will be $X_i=w_i/P_i$. Regions with a favourable location close to markets will have lower price levels. In general, we will see from the results that effects via the price levels are larger than the nominal wage changes.

In Appendix A, we also include the HME model as a parallel case which we use as a yardstick for comparison and a useful contrast that sheds light on the results. In the following, we shall also compare the two models since it usefully sheds light on how net export effects and wage effects may differ. Given that net export effects play a key role in most NEG models, this exercise has broader relevance.

Does the wage gap model live up to the requirement of low-dimensional solvability and high-dimensional computability? Based on our experience, the answer is generally yes with respect to computability. The model has a solution although we cannot guarantee that it has always a positive and real solution for all possible parameter values. In the simulations undertaken, the model was well-behaved with positive solutions. Hence the model seems well-behaved in terms of computability. Solvability for low dimensions is trickier: Although an explicit analytical can be found for the case of two regions and with the elasticity of substitution $\varepsilon=2$ (see end of Appendix A), this solution is not very user-friendly and one has to use numerical methods to check its properties.

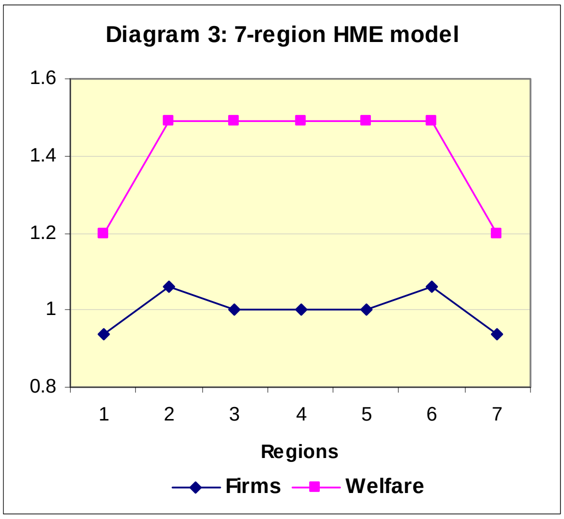
As a first illustration, we may use this analytical solution for two regions in order to shed some light on the properties of the wage gap model. In Diagram two, we assume that region 1 is twice as large as region 2; i.e. the labour endowment ratio $L=L_1/L_2=2$. Diagram 2 shows the wage ratio w_1/w_2 when trade costs are varied. In this low-dimension case, there is only one type of trade costs, $t_{12}=t_{21}=t$.

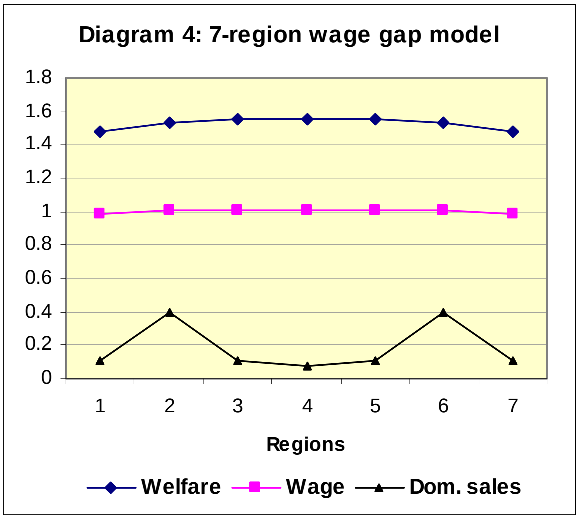
Here trade costs vary from zero (t=1) and 300% (t=4). At high levels of trade costs, we can (using the expression for w in Appendix A) find that the wage ratio converges to $L^{1/3}$; in this case approximately 1.26. When trade costs are lowered, the wage gap is gradually eliminated. Some implications of this are:

- In the two-region case, *reduction in trade costs reduces the wage difference between large and small countries/regions. There is a monotonous relationship and not an "inverse U"* relationship as in some NEG models. Hence this is a NEG model without bifurcations.
- For a given size distribution of regions, there is *an upper bound on the nominal wage inequality when t increases*; in the case with two regions and ε=2 it is equal to $L^{1/3}$. Observe however that since the limit value is a function of L, there is *no upper limit on the wage ratio when L increases*.
- The HME model has the paradoxical property that while agglomeration is created by differences in market access, the effect becomes stronger when these differences are reduced. In this sense the wage gap model is more plausible: *Trade liberalization reduces the wage gap*. Furthermore, the difference between price indexes must also be reduced when differences in market access disappear, so liberalization will lead to converging welfare levels. Hence *small countries must gain more from trade liberalization*, while in the HME model the welfare gain from liberalization is proportional across countries.
- Compared to the HME model, *the wage gap model is well-behaved with positive solutions for a larger range of parameter values*. Although negative and complex roots can also be observed, the problem is marginal compared to the HME model.

According to this first check, it therefore appears that the wage gap model is more plausible then the HME model, by being better-behaved and by eliminating the paradoxical outcomes of the HME model at low levels of trade costs.

In order to examine further some properties that are relevant for spatial modeling, we next compare the two models using a "Hotelling" world where regions of equal size are dispersed evenly along a line. If trade costs are increasing exponentially with distance in this setting; i.e. $t_{ij}=t^{|i-j|}$ where t>1 is the trade cost between adjacent regions, and i and j denote the positions along the line, i,j=1,..,N, the HME model has a simple analytical solutions for an arbitrary number of regions (see Melchior 1997, Chapter 3). With no migration, demand from the peripheries (ends of the line) represents the centrifugal force, and the manufacturing clusters are located in the regions next to the periphery. Diagram 3 illustrates such a HME model, using ε=5 and t=1.5. In Diagram 4, we illustrate the wage gap model for the same set-up, using numerical simulation.





The HME model (Diagram 3), produces a duocentric or bipolar pattern of manufacturing agglomeration, where regions 2 and 6 have higher levels of "manufacturing" production, and the peripheral regions 1 and 7 lower. The central regions 3-5 have average levels of production (=1/N), but they have a better geographical location and therefore the welfare levels of regions 2 through 6 are equal. In this model, reduction of trade costs leaves production in the central regions unaffected but increases the gap between regions 2,6 and 1,7. For sufficiently low trade costs, the peripheral regions 1,7 will be deindustrialised.[13]

Now consider the wage gap model to the right, in Diagram 4. It produces *a smooth monocentric core-periphery pattern without distinct agglomerations*. Nominal wages (the curve in the middle) are slightly higher in the central regions, but price levels are also lower so the welfare (real wage) gaps are even higher. The "duocentric" pattern is however visible in the lowest curve for domestic sales: Due to lower wages in the peripheral regions, and lower price levels in the central regions, regions 2 and 6 now export less and become more closed, with a higher share of production sold domestically. This is diametrically opposite to the HME model where the 2,6 regions are "big traders".

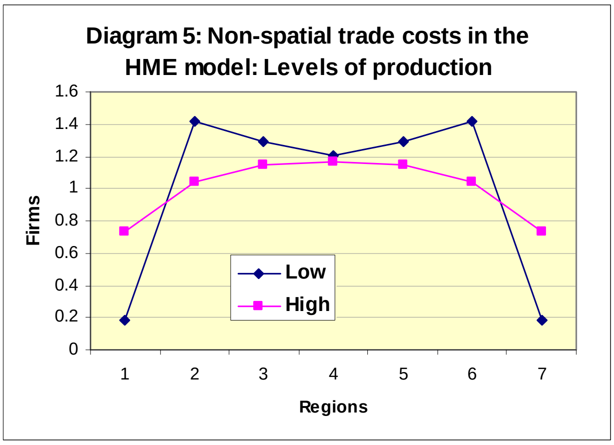
In the two models, the welfare results are similar in the sense that they are both monocentric. This may indicate that welfare predictions may be considered as more robust and less dependent on modeling assumptions than predictions about agglomeration or wage changes. To some extent, we may be more agnostic about whether the main impact is on the net trade pattern or income as long as the welfare effects are more comparable.

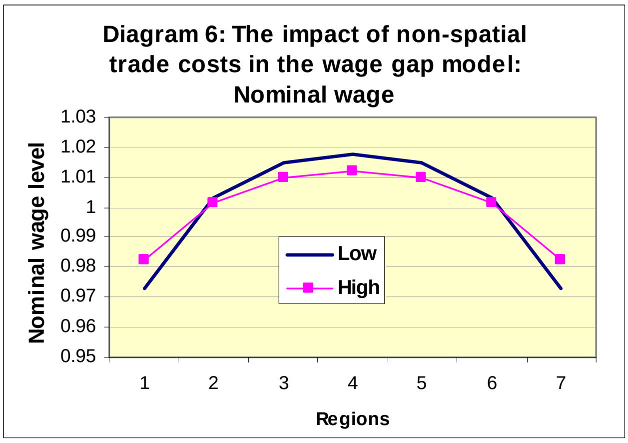
For empirical analysis, a useful property of the wage gap model is that it offers predictions about nominal variables: nominal wage effects may differ from welfare results and frequently, price level effects are more important than nominal changes and appropriate handling of

[13] When $t^{\varepsilon-1}=2$ the peripheral regions will have zero production. For example, with $\varepsilon=5$ the peripheries will be de-industrialised for t lower than 1.19.

the real/nominal distinction may be quite important. Nominal changes are not "nuisance" that should be cleaned away to approach the real things; they may be important for understanding change.

Using simulations with the HME model, Melchior (2000) found that the relative magnitude of "spatial" and "non-spatial" trade costs determined whether a duocentric or (in a two-dimensional model) "manufacturing belt" outcome occurred, or a more centralized outcome. With a higher level of non-spatial trade costs, a centralized pattern may be the outcome even in the HME model. In order to illustrate this, we add a non-spatial trade cost that applies to sales to all other regions, together with the spatial or transport-cost type of trade costs. We then examine what happens when either type of trade costs is changed. Diagrams 5 and 6 show the outcomes in the HME model (the number of firms) and the wage gap model (the nominal wage), respectively.[14]





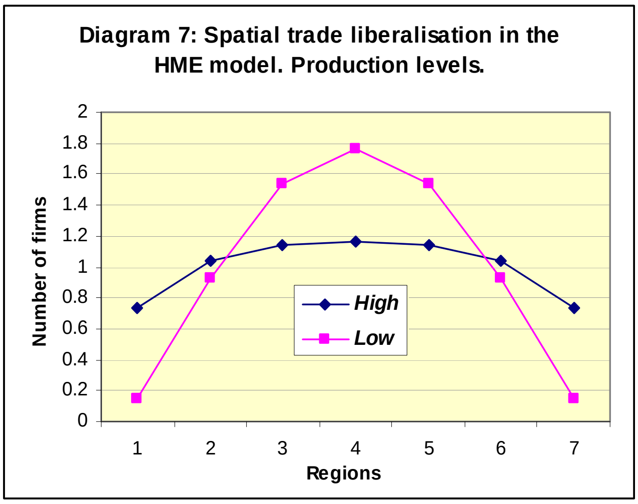
In both cases, *the introduction of non-spatial trade costs creates a more even distribution*. In the HME model, there is a radical change from the duocentric to a monocentric pattern of agglomeration, and the sharp inequality between the two regions at each end of the line and the rest has disappeared. In the wage gap model, the wage distribution is still monocentric but with less inequality than before. There is a significant increase in the nominal wages of the peripheral regions, and reduced nominal wages in the central regions. Changes in welfare are similar but more modest.

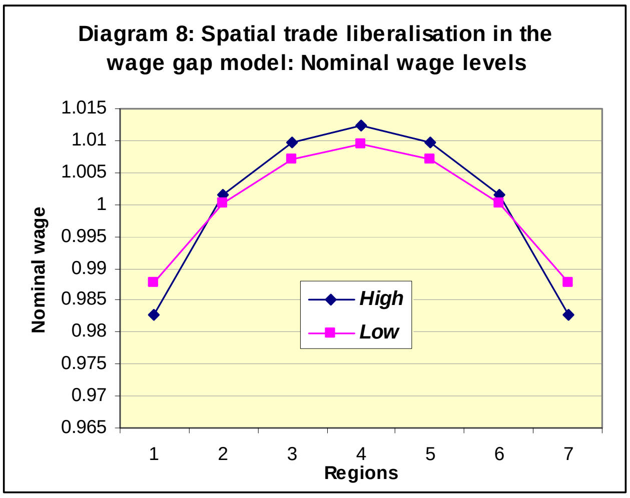
If we reverse the sequence in both models, moving from "with" to "without" in the diagrams, it is evident that, a *reduction in non-spatial trade costs will create more regional inequality*. In the HME model, liberalization will also promote a movement from a "mono-

[14] In both diagrams we use ε=5, spatial trade costs that are 1/6*distance (i.e. =100% between the peripheral regions which have distance 6), and in the "high" curve in the graph non-spatial trade costs=0.2 for sales in all regions except own region. Hence spatial trade costs now increase linearly with distance. Total trade costs with other regions are then 1+1/6*distance+0.2. In Diagram 6 non-spatial trade costs=0 for the "low" curve. With these value, however, regions 1 and 7 obtain negative production in the HME model, so in Diagram 5 we use non-spatial costs at 0.05 for the "low" curve.

centric" pattern of agglomeration to the duocentric or bipolar pattern that obtains in the HME model without non-spatial trade costs.[15]

Now turn to the reduction of spatial trade costs: We start from the situation described by the "with" curve in Diagrams 5 and 6, and reduce the spatial trade costs only.[16] Diagrams 7 and 8 show the outcome, for the HME and the wage gap models respectively:





Contrary to the case with non-spatial liberalization where the outcome was similar, the impact of liberalization in the two models is now diametrically opposite: *In the HME model, spatial trade liberalization leads to a stronger core-periphery pattern, while in the wage gap model the opposite is the case.* Spatial liberalization weakens the centrifugal force of the model; peripheries can now be served from the central areas and there is no wage adjustment stopping the relocation of production toward the centre. But in the wage gap model, spatial trade liberalization is to the advantage of the peripheral regions. Later, we shall see that this also applies in the simulations with our stylized European map.

These results show that the modeling approach may be crucial for some of the results in spatial models. In our simulations, we should therefore be aware about the sensitivity of results to the modeling assumptions, and in particular the model choice. In general, we consider the results from the wage gap model as more intuitive since the model is technically more well-behaved, and is does not have the counterintuitive properties related to the impact of trade liberalization. Nevertheless, we cannot exclude the possibility that "duocentric" outcomes and the net export effects of the HME model, with stronger relocation effects, are empirically relevant. We shall therefore carry out simulations also with the HME model, and check whether results differ between the two modeling approaches.

[15] Observe that we still have no country borders, so we only have regions but no countries. In the simulations to be undertaken, we also let regions form countries, and in that context the impact of spatial liberalization may be modified.
[16] We reduce the scaling parameter for spatial trade costs from 1/6 to 0.05.

In the simulations, we use different levels of trade costs in order to check the sensitivity of results with respect to the levels of trade costs. There is generally no "U-shape" in our model so that agglomeration is stronger at intermediate levels of trade costs; it is nevertheless possible that integration effects depend on the level of trade costs. A reason for this is that *trade liberalization is generally not neutral with respect to the ratio between spatial and non-spatial trade costs*. An illustration is the following: Assume that trade costs to a neighbour region a are t_{a1}=1+0.2+0.2=1.4; where the two terms equal to 0.2 represent spatial and non-spatial trade costs, respectively. To a region b twice as far away, we assume that trade costs are t_{b1}=1+0.4+0.2=1.6, since distance costs are doubled. Now cut both types of trade costs by half, so that new trade costs are t_{a2}=1.2 and t_{b2}=1.3. We see that $t_{a1}/t_{b1}<t_{a2}/t_{b2}$. A proportional reduction in all trade costs thus tends to make spatial trade costs relatively less important, and this might affect the model outcome.

In Table B1, Appendix B, we show the parameter values used in the various simulations. We call these "High", "Main" and "Low" and we will generally report only results from the "Main" alternative with an intermediate level of trade costs. Table B2 shows the average level of trade costs for trade between regions in different countries in one of the scenarios (the WEST scenario). We see that the average level of trade cost is around 25% in the "Low" scenario, around 50% in the "Main scenario" and around 200% in the "High" scenario. In spite of the suggestion by Anderson and van Wijnkoop (2003) that total trade costs broadly defined, including distribution costs, could be as high as 170%, we consider the level in our "High" scenario as somewhat exaggerated. However, that is the level required if all regions are to have positive production in all scenarios in the HME model. We include this in order to be able to run simulations with the HME model in parallel to the wage gap model. We wish to include HME simulations in order to check whether the regional patterns of sector agglomeration effects are similar to outcome in the wage gap model.

In the analysis, our main concern is about changes from one scenario to another. Hence we are interested in e.g. how the change from WEST to WIDER affects income and welfare. The main purpose is not to explain the current income distribution in Europe, but to examine how this is affected by changes in market access. Hence we do not try to calibrate the model to some actual distribution, but choose a configuration of parameter values that appears plausible and technically feasible, and then examine changes from there. Using the wage gap model, we obtain an income distribution similar to diagram 4, with modestly higher wages and welfare in the central regions of the rectangular grid. Diagram 9 shows welfare levels in the "base case" before any regional blocs are formed, with intermediate level of trade costs.

Diagram 9: Scenario "Base case" — welfare levels

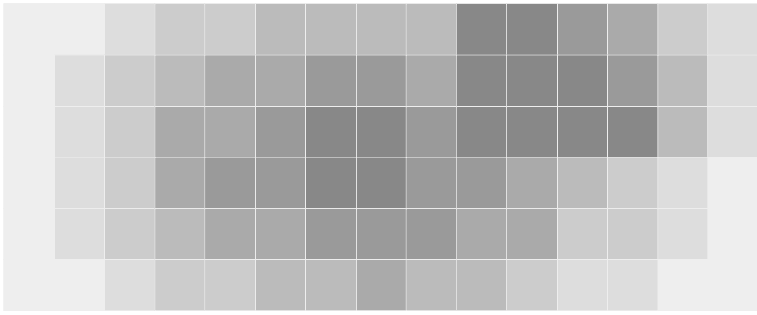
Dark areas = higher welfare

Keywords about outcome:

Gravity—like outcome with higher welfare in central regions

Peripheries in the west, far east and partly north and south

Country—size advantage for the larger country "Cyberia"



Simulation results — wage gap model

We observe a core-periphery pattern with lower welfare particularly in regions far to the west and east. Observe also the high welfare level in E1, due to the market access advantage of larger country size. Given that this situation without integration might represent the post-war situation in the 1940s and 1950s, it is evident that there was communism in the Soviet Union. In the model used here, results are driven by market forces and it is therefore inadequate to explain welfare changes during the Soviet period. For the Soviet/ COMECON period, the results may therefore be of limited relevance. For Western Europe (the four countries W1-W4), however, the pattern with peripheries in the west and higher incomes in W3+W4 is quite plausible in the light of empirical research (see e.g. Combes and Overman 2004 or Dall'erba 2005), although the true European map is certainly richer than ours.

From this starting point, we examine how regional distribution is affected in the 10 scenarios. In tables B3-B5 in Appendix B, we show correlation coefficients between results using different levels of trade costs. We also show how results with the HME model, available for a high level of trade costs, are correlated with the results using the wage gap model. These tables provide another check of the robustness of results. The general conclusions are:

- The results are robust with respect to the level of trade costs since similar results are obtained with low, intermediate and high trade costs. In general, the absolute values of the correlation coefficients are above 0.9 in most cases.[17] For example, for the WIDER scenario, welfare results in the wage gap model are correlated with a correlation coefficient between 0.94 and 0.99 (Table B3), and

[17] Observe that the sign depends on which variable is involved; welfare and wages are positively correlated in the wage gap model, and the same applies to domestic sales and the price index; but these two pairs of variables are negatively correlated.

changes in welfare from scenario WEST to WIDER are correlated with coefficients at 0.95-0.99 (Table B4).

- For the HME model, domestic sales (i.e. in own region) is an appropriate indicator also for per capita welfare (see Appendix A). Hence we observe from Table B3 that welfare in the HME model with WIDER is highly correlated with welfare in the wage gap model (absolute value of correlation coefficient=0.97), and this also applies to the welfare change (0.98, see Table B4).
- For production levels in the HME model, however, correlations with results from the wage gap model are still significant but in most cases lower. For example, with high trade costs, the number of firms under WIDER using the HME model, and the wages obtained using the wage model, are positively correlated with a coefficient of 0.56. Hence the spatial pattern of change is partly different in the two models.

In Table B5, we show such correlations for more scenarios and they confirm that production or net trade effects in the HME model is often less correlated with all other results. In some cases, results from the HME and wage gap models are even opposite. These are shown by shaded cells in Table B5. These cases are nevertheless exceptions and in the majority of cases, the direction of the effects is similar in the two models. Base on the comparison, we conclude:

- The HME model and the wage gap model behave qualitatively similarly for scenarios with European regional integration; in the sense that welfare results, and production vs. wages, are positively correlated.
- For the SPATIAL scenario where distance-related trade costs are reduced, the two models give opposite predictions, as in Diagrams 7-8.
- For EASTOPEN, the HME model suggests that unilateral liberalization gives a welfare loss while the opposite is the case for the wage gap model. This illustrates that the wage gap model is more “trade-friendly” than the HME model, where unilateral protectionism may sometimes improve welfare.

Hence in some cases, the results depend on the type of model used. It is ultimately an empirical issue what is true, although – as argued – we have more faith in the wage gap model as an average effect across sectors for the whole economy.

This concludes our methodological examination of the model. The challenge for numerical modeling is to show that results are not only stories with limited generality based on some arbitrary parameter values. We believe to have shown that the results that are presented in the following are more than this. They hold for a wide range of parameter values, and we have illuminated some of the model mechanisms that create the results.

4. Model simulation results

The numerical modeling results are intended as a point of departure for empirical examination of the issues. Therefore, a wide variety of scenarios and results are included. We will here only briefly sum up some main results. In Appendix C, Tables C1-C18 and the corresponding Diagrams C1-C18 we report results from scenarios 2-10. We only report results for the wage gap model with an intermediate level of trade costs.[18] For each scenario, the tables include nominal wage levels and welfare levels, and changes in these from some other scenario (specified in the tables, often the WEST scenario). For each table, there is a corresponding grey-scale map graph which shows changes for each region, with some key words in the header. We generally do not repeat much detail in the main text so the readers are invited to use these graphs in Appendix C as an intuitive visualization of the results.

The results encompass standard results about regional integration from the new trade theory (see e.g. Baldwin and Venables 1995 for an overview) where participating countries gain and outsiders may sometimes lose. As shown in this literature, an "agglomeration shadow" may fall on non-participants close to the trade bloc. In standard HME or NEG models, this effect is driven by net export effects and so-called "production-shifting". In the wage gap model, there is no such production-shifting and the agglomeration shadow takes the form of lower nominal and real wages. Another new feature in our analysis is that positive and negative effects vary across regions inside countries.

The results clearly indicate that there is no unambiguous conclusion about how international integration affects domestic regions. All our scenarios represent international integration, but the impact on regions is different in each case. By the same reasoning, we cannot expect any unambiguous conclusion about regional inequality: International integration may lead to convergence in some cases, and divergence in others. Our analysis has therefore provided the "non-answer" we were searching for: There is no unambiguous rule, and searching for a universal answer is like barking under the wrong tree.

Our simulations include four regional integration scenarios; WEST, WIDER, EAST-WEST and EAST. In all the four cases, all the participating regions unambiguously gain in terms of welfare. Hence also in the case of widening integration from 4 to 6 and 7, the old members improve real wages. The gains are to some extent unevenly distributed:

- In WEST, there is a larger gain for regions that are close to the centre of the WEST area, around the point where the four countries all border to each other.
- In WIDER, the gain is larger in the new member states. For these, the gain is larger in the western regions, but for the old members

[18] Results from other scenarios used in the robustness checks in Tables B3-B5 can be provided upon request.

W1-W4, the opposite is the case. Hence EAST-WEST is better for W3 and W4 than for W1 and W2, and better for eastern regions in these countries. EAST-WEST moves the centre of gravity in the regional integration area to the east.
- EAST-WEST gives a strong welfare gain for the new participant (E2) and modest positive effects for all the old participants, with a slightly better outcome for regions closer to the new participant. According to this, present participants of European integration have no reason to fear further enlargement.
- With Eastern integration (EAST),[19] the larger country E1 generally gains less than the other two since without integration, it already benefits from its large country advantage. In the wage gap model, integration is better for the small countries by creating wage convergence.

In some, but not all cases, the welfare gain from integration is accompanied by a nominal wage increase as well. This is however not always the case, as seen in Appendix C.

In a non-spatial model of regional integration, the "agglomeration shadow" or negative impact on outsiders apply to all countries outside. In our case, the integration shadow is clearly visible but it is stronger in outside regions close to the trade bloc that is formed. In the WEST scenario, the negative impact on wages as well as welfare is larger for Central/ Eastern European regions close to the WEST bloc, and weaker for remote regions. There is however a negative impact for all outside regions. This applies also to the impact of WIDER and EAST-WEST on the outsiders.

The results on European regional integration show that eastward widening of the trade bloc gradually moves the "centre of gravity" eastward, while former members also gain from integration. Since the centre of gravity then gets closer and closer to the centre of the rectangular grid, the benefits of integration will be strongly correlated with any measure of "market potential". This strengthens the case for market potential approaches in the study of European integration (see e.g. Brülhart et al. 2004). Such a correlation between market potential and the impact of integration is however not present in all scenarios. For the "iron curtain" (IRON) scenario, WTO and especially SPATIAL (reduced distance costs) there may actually be a negative correlation, at least with simple market potential measure of the types introduced by Harris (1954):

- While the "iron curtain" is bad for welfare all over Europe, it is particularly adverse for regions close to the curtain itself; in western regions in Central Europe, or eastern regions in WEST.
- The WTO scenario is especially positive for countries and regions that do not participate in regional trade blocs. When "multilateral trade liberalization" (WTO) is undertaken in the presence of

[19] Observe that Eastern integration departs from a situation with WEST, so it is not the only trade bloc, like in the other three cases of regional integration.

WEST, it is particularly positive for regions outside but close to WEST. But also members of the regional bloc gain from such liberalization. WTO liberalization erodes the European trade preferences and thereby dampens trade policy discrimination.
- Reductions in spatial trade costs have a powerful equalising effect by being more positive for peripheral regions along the border of the rectangular space, in particular the regions far to the west and to the east. Observe that in this case the HME model and the wage gap model gives different predictions, and our simulation results are along the lines with the pattern shown in Diagram 8.

Hence the spatial impact of different types of integration varies, and some trade reforms will lead to more income growth in regions with a lower market potential in the sense of Harris (1954).

Finally, observe that if capital cities are "hubs" so that business has to take place via the capital (scenario CAPITAL), it strongly boosts the real wage level in capital regions.[20] In our Russia-like country E1, the hub effect is particularly severe for regions to the far east. For these regions, even some of their trade with neighbour regions has to pass through the capital, and this creates a sharp increase in trade costs. The hub effect is also more severe and negative for some regions in north-west E2 and north-west Eurasian E3: These regions can no longer exploit their geographical proximity to Europe but have to ship some of their goods indirectly via capitals. On the other hand, north-west E3 and south-east E3 are in fact relatively better off since the hub effect implies a rebalancing of regions within the two countries, by eliminating some of the geographical relative disadvantages. Hub-and-spoke effect inside countries tend to eliminate the east-west and north-south differences in the impact of various policies, since all peripheries in the country become peripheral, wherever they are located. If the distance to the capital is larger, as for eastern E3 in our map, the impact is worse.

Central European countries C1-C2 are strongly affected in a number of different scenarios, be it as part of a European integration scheme, or being in the shadow outside trade blocs to the west or to the east, or benefiting from "preference erosion" due to WTO liberalization, or being trapped closed to the iron curtain. Hence not only armies have rolled over Central Europe; our results suggest that the forces of economic geography are also strong compared to the more "quiet corners" to the west and to the east.

5. Concluding remarks

The main purpose of this paper has been to provide an extended theoretical underpinning for the empirical study of European integration

[20] In Tables C17-18, we show the case when this capital hub effect occurs in a setting departing from the WEST scenario. We have also tried with other scenarios, and the impact is similar so we only report this case. The presence of hub effects may modify the analysis of changes between different scenarios, but we do not address this in order to avoid too much detail.

and regional income gaps in Europe. Carrying out such empirical work is an extensive task that has been left for future research. The model simulations show a number of different scenarios and a task for empirical analysis is to determine the relevance of each scenario. During the last decades, different trade reforms have occurred simultaneously (e.g. EU integration, East-West trade agreements, WTO or GATT liberalization, dissolution of the Soviet Union, fall of the iron curtain etc.). In the context of Central and Eastern Europe, a challenge is the phenomenon of "transition" which may imply that there is an extended period of institutional change from the former planning system to the market economy. Although the most dramatic change probably had occurred by the mid-1990s, some effects of this change may be long-lasting and possibly overshadow other events.

Our analysis captures some mechanisms but certainly not all, and the development of European regions is certainly affected by other aspects that are not addressed by the model. Input-output effects constitute a core feature in regional CGE (computable general equilibrium) models that have been constructed for some European countries (see e.g. Bröcker and Schneider 2002).[21] While our model has nine countries, it leaves out the rest of the world and this is surely a shortcoming. For example, the industrial change of Germany is surely affected by competition from Asia, which is left out in our framework. Hence the results should be interpreted with these reservations in mind.

In spite of these limitations, the results provide a rich set of hypotheses about the spatial and regional impact of integration in Europe, which will hopefully be of use in further research in the field. The scenarios shed light on different policy events and give predictions about nominal as well as real income changes and their spatial variation. In Melchior (2008b) we use the results derived here as a platform for empirical analysis of European regions during 1995-2005.

[21] With more factors of production, new effects may arise; for example, in Haaparanta (1998) trade-induced factor market competition can drive up factor prices and even cause a welfare loss in some cases.

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Appendix A: The modelling framework

We present the model here in a form which encompasses both models used in the numerical simulations; the wage gap model (which is the main approach) and the home market effect (HME) model (which is used for comparison and as a supplement to shed light on trade effects).

There are N regions. Each region, indexed i or j, has a single factor of production; labour, with endowment L_i[22] and wage w_i. The total income of the economy is therefore $Y_i=w_iL_i$. In order to keep notation simple, we use only one set of subscripts (not for regions and countries separately).

Following a standard Dixit-Stiglitz approach, labour can be used in the production of individual varieties of manufactured goods under increasing returns to scale. For an individual variety x_i produced in region i, there is, measured in labour units, a fixed production cost f, constant marginal costs c and trade costs t_{ij} for sales in market j.[23] For a good produced in region i and sold in market j, the cost in value terms is equal to $w_i\ (f+ct_{ij}x_{ij})$.

Trade costs are expressed as a mark-up on marginal costs so $t_{ij}\geq 1$, e.g. a trade cost of 10% implies t_{ij}=1.1. For the purpose of the analysis here, we also allow non-zero trade costs in the home market, so t_{ii} may be larger than 1.[24] For example, some Russian regions are huge with low population density, and it would be implausible to assume that internal trade costs are zero. While zero domestic trade costs are normally assumed in theoretical applications, it is technically no problem to have non-zero trade costs. We assume that $t_{ij}>t_{jj}$; i.e. inter-regional trade may be thought to include the intra-regional cost plus some additional inter-regional cost. This assumption is plausible but also needed for the model to be well behaved.

We assume standard CES (constant elasticity of substitution) demand functions, so demand for a variety from region i in market j is equal to $x_{ij} = p_{ij}^{-\varepsilon}P_j^{\varepsilon-1}D_j$ where p_{ij} is the price of a variety from region i in market j, ε is the elasticity of substitution between varieties (with the standard assumption ε>1), P_j is the CES price index in region j, and D_j is the total value of manufactured goods sold in market j (we revert to how this is determined). With monopolistic competition, firms maximise profits $\pi_i=-fw_i+\ \Sigma_j\ (p_{ij}-w_ict_{ij})x_{ij}$, and we obtain the standard pricing condition $p_{ij}=[\varepsilon/(\varepsilon-1)]\ w_i\ ct_{ij}$. Furthermore, free entry and exit imply that total profits have to equal sunk costs f, and as a consequence the total value of sales for a firm in region i will be $\varepsilon f w_i$.

[22] For the purpose of empirical analysis, it may sometimes be useful to think of this as "efficiency units" rather than population, in order to adjust for different productivities in the economy.

[23] We consider it simpler in terms of notation to express trade costs as a mark-up on marginal costs rather than the usual iceberg formulation where goods melt away in transport. The results are similar.

[24] In the results presented in the text, we have assumed zero trade costs within each region. Simulations including such trade costs, for example as a function of land area or population density, were however also tried and we therefore express the model in a form which allows this possibility.

Now write $v_{ij} = x_{ij}p_{ij}$ for the value of sales of an individual firm from region i in some market j. Dividing v_{ij} by v_{jj}, we can express the sales v_{ij} in some market j as a function of the home market sales v_{jj} of firms in that market: Using the demand functions and the pricing condition, we obtain $v_{ij} = v_{jj} * (w_i/w_j)^{1-\varepsilon} (t_{ij}/t_{jj})^{1-\varepsilon}$. Using this, the total sales of a firm in region i, $\sum_j v_{ij}=\varepsilon f w_i$, can be written as

$$\sum_j v_{jj} (w_i/w_j)^{1-\varepsilon} (t_{ij}/t_{jj})^{1-\varepsilon}= \varepsilon f w_i$$

or, moving the common term w_i to the right hand side,

$$\sum_j v_{jj} w_j^{\varepsilon-1} (t_{ij}/t_{jj})^{1-\varepsilon}= \varepsilon f^* w_i^{\varepsilon}.$$

For the N regions, we have N equations with 2N unknowns (v_{ii}, w_i). In order to express this in matrix form, we define

$$T_{N\times N}=\begin{bmatrix} 1 & \left(\frac{t_{12}}{t_{22}}\right)^{1-\varepsilon} & \dots & \dots & \left(\frac{t_{1N}}{t_{NN}}\right)^{1-\varepsilon} \\ \left(\frac{t_{21}}{t_{11}}\right)^{1-\varepsilon} & 1 & \dots & \dots & \left(\frac{t_{2N}}{t_{NN}}\right)^{1-\varepsilon} \\ \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots \\ \left(\frac{t_{N1}}{t_{11}}\right)^{1-\varepsilon} & \left(\frac{t_{N2}}{t_{22}}\right)^{1-\varepsilon} & \dots & \dots & 1 \end{bmatrix}$$

T expresses the relative trade costs in all markets, relative to domestic supply. Using this, the equation system above can be written as

(1) $\quad T_{N\times N} \times Diag\ (w_i^{\varepsilon-1})_{N\times N} \times [v_{ii}]_{N\times 1} = \varepsilon f \times [w_i^{\varepsilon}]_{N\times 1}$

where $Diag\ (w_i^{\varepsilon-1})_{N\times N}$ is the diagonal matrix with $w_i^{\varepsilon-1}$ as diagonal elements, $[v_{ii}]_{N\times 1}$ is a vector with v_{ii} (i.e. the home market sales of firms in each region) as elements, and $[w_i^{\varepsilon}]_{N\times 1}$ is a vector with w_i^{ε} as diagonal elements.

The sales of all firms in market j must add up to D_j; i.e. $\sum_i n_i v_{ij}=D_j$. n_i is the number of manufacturing firms in region i, and since there is no firm heterogeneity, and no sunk exports costs, all firms will sell a (large or small) positive amount in any market. Expressing all v_{ij}'s in terms of home market sales as above, we can put w_i and v_{ii} on the right hand side and obtain the system of N equations

(2) $\quad T_{N\times N}' \times Diag\ (w_i^{1-\varepsilon})_{N\times N} \times [n_i]_{N\times 1}$
$\quad\quad = Diag\ (v_{ii}^{-1})_{N\times N} \times Diag\ (w_i^{1-\varepsilon})_{N\times N} \times [D_i]_{N\times 1}$

Combining (1) and (2) we have 2N equations with 3N unknowns (n_i, v_{ii} and w_i). By adding more structure we can reduce the number of unknowns to 2N and solve the system. The wage gap model and the HME model represent two alternative approaches:

In the wage gap model, we assume that manufacturing is the only sector in the economy. Then the whole income is spent on manufactured goods so we have $D_i=w_iL_i$. Given that firm size is determined (see above) and assuming full employment, the number of manufacturing firms must be $n_i= w_iL_i/(\varepsilon f w_i)= L_i/(\varepsilon f)$. Thereby eliminating the unknowns n_i, we obtain a system with 2N unknowns that may be solved. Equation (2) then simplifies to:

$$(2a) \quad T_{N\times N}' \times Diag\,(w_i^{1-\varepsilon})_{N\times N} \times [L_i]_{N\times 1} = \varepsilon f \times Diag\,(v_{ii}^{-1})_{N\times N} \times Diag\,(w_i^{2-\varepsilon})_{N\times N} \times [L_i]_{N\times 1}$$

This is however a non-linear system where no explicit analytical solution can be found.[25] We therefore use numerical simulation in order to determine the outcome. As noted, we call this *the wage gap model* since differences in market access show up in different wages. For example, large regions will, *ceteris paribus*, have higher wages, a shown already by Krugman (1980).

In the numerical simulations, it requires more time and is computationally less efficient to run the whole system with 2N equations; it is better to express $[v_{ii}]_{N\times 1}$ as a function of the wage and insert in (2a). We then simulate (2a) with the N wage levels as the only unknown. Given that no explicit matrix solution is available, an approximate solution has to be found by numerical iteration. In the simulations, we minimize the function

$$\Sigma_i\left(\frac{LHS_i}{RHS_i}-1\right)^2$$

where LHS and RHS refers to the left hand side and right hand side, respectively, of each of the 90 equations. In order to have the exact solution this sum would have to become zero but that is generally not possible. Hence we have to decide some upper threshold for this sum of squared deviations and find an approximation to the solution. In all then simulations presented, the values of F_i was below one, and below 0.5 in the most important scenarios. The accuracy depends on computer time and the number of iterations. For the scenarios simulated here and with the ranges of parameter values used, we obtained strictly positive solutions in all cases. The results were also checked, e.g. by computing trade flows and checking adding-up properties and this indicated a high degree of accuracy.

Observe also that the nominal level of wages, prices and sales is not determined and may be scaled up or down. We therefore have to

[25] We did actually solve it for the case with two countries and $\varepsilon=2$, but in the general case an explicit solution is hard to find. Note also that in (2a) we cannot "abbreviate" the similar terms on the left and right hand sides, since in general, for three matrices A, B and C, AC=BC does not necessarily imply that A=B.

normalise all results since the numerical results may end up at different levels. Since productivity is unchanged throughout the "events" we simulate, we normalise the average wage to equal one.

A second option, frequently used in the literature and referred to as the HME model, is to add a "numeraire sector" in which labour produces a homogeneous good with constant returns to scale. Assuming that one unit of labour produces one unit of output of the homogeneous good and that such goods are traded at zero trade costs, wages per efficiency unit in the regions must be equalised as long as all regions produce the homogeneous good. Using the homogeneous good as numeraire, wages everywhere must then equal one; $w_i=1$ for all i. The version here is a slightly modified and multilateralised version of the "home market effect model" of Krugman (1980). We must also address how consumption is divided between the two types of goods; using a Cobb-Douglas upper-tier function with consumption share α for manufacturing, total demand for manufacturing becomes $D_j= \alpha L_j$ (since total income is now L_j). In the multilateral version, equation (1) simplifies to $T_{N\times N} \times [v_{ii}]_{N\times 1} = \varepsilon f \times [1]_{N\times 1}$ (i.e. with a unit column on the right hand side). The solution for $[v_{ii}]_{NxN}$ can then be found. Equation (2) becomes

$$\text{(2b)} \quad T_{N\times N}' \times [n_i]_{N\times 1} = \alpha \times Diag\,(v_{ii}^{-1})_{N\times N} \times [L_i]_{N\times 1}$$

Using the solutions for v_{ii}, we can then also solve for the number of firms, and it can be shown that, ceteris paribus, large countries will have a higher than proportionate share of manufacturing.

In the wage gap model, the advantage of better market access is realised in the form of a higher nominal wage per efficiency unit, whereas in the home market effect model, the advantage appears in the form of manufacturing agglomeration. Corresponding to these two outcomes, the trade patterns also differ: In the wage gap model, external trade in manufactured goods has to be balanced and all trade is intra-industry trade. In the home market effect model, trade in manufactured goods may be unbalanced, but has to be matched by a compensating trade imbalance for homogeneous goods.[26]

In the HME model, we can use the CES price index for manufactured goods as a measure of welfare *per capita*. It is analytically convenient to use $R_i=P_i^{1-\varepsilon}$ as an indicator of welfare (which can be done since it is monotonically related to P_i). We can then express the vector $[R_i]_{N\times 1}$ in matrix form as

$$\text{(3b)} \quad [R_i]_{N\times 1}=\left(\frac{\varepsilon}{\varepsilon-1}\right)^{1-\varepsilon}\times\left[Diag\left(t_{ii}^{1-\varepsilon}\right)\right]_{N\times N}^{-1}\times T'_{N\times N}\times[n_i]_{N\times 1}$$

[26] Whereas bilateral trade flows for manufactured goods are determined in this model, only the aggregate trade balance for homogeneous goods is determined, not the bilateral flows. Hence different patterns of bilateral trade in homogeneous goods are possible, and additional assumptions are needed to pin down the exact pattern. For the purpose of evaluating e.g. income or welfare, this is however not a problem or shortcoming.

From (2b) we can find the solution for $[n_i]$ and substitute into (3b). The components $T' \times (T')^{-1}$ then cancel out and we obtain the expression

(3c)

$$[R_i]_{N\times 1} = \alpha \times \left(\frac{\varepsilon}{\varepsilon - 1}\right)^{1-\varepsilon} \times \left[Diag\left(t_{ii}^{\varepsilon-1}\right)\right]_{N\times N}^{-1} \times \left[Diag\left(v_{ii}^{-1}\right)\right]_{N\times N} \times [L_i]_{N\times 1}$$

Since the inverse of a diagonal matrix is a diagonal matrix with inverse diagonal elements, we can also write

(3d)

$$[R_i]_{N\times 1} = \alpha \times \left(\frac{\varepsilon}{\varepsilon - 1}\right)^{1-\varepsilon} \times \left[Diag\left(t_{ii}^{1-\varepsilon}\right)\right]_{N\times N} \times \left[Diag\left(v_{ii}^{-1}\right)\right]_{N\times N} \times [L_i]_{N\times 1}$$

We observe that for region i, welfare is positively related to home market size L_i, and inversely related to the home market sales of firms (v_{ii}) as well as domestic trade costs (t_{ii}).[27] The intuition is that

- in economically large regions that have a higher share of production, consumers buy a larger fraction of goods from domestic producers and thereby pay less trade costs (since $t_{ij}>t_{jj}$)
- domestic trade costs increase prices and reduce welfare
- if firms sell a large share of production domestically, it reflects that inter-regional trade costs are high and that reduces welfare.

In this model, the world total number of firms is constant $(=\sum_i L_i/(\varepsilon f))$ so there is no welfare effect of changes in the number of varieties.

In the wage gap model, welfare depends on nominal wages as well as the price level. Welfare can then be measured directly by the CES quantity aggregator or utility function $X_i=[\sum_i x_i^{1-\varepsilon}]^{1/(1-\varepsilon)}$. Since total consumption equals total income; i.e. for region i we have $X_iP_i=w_iL_i$, we simply obtain that per capita welfare is equal to

(4) $$\frac{X_i}{L_i} = \frac{w_i}{P_i}$$

Using numerical solutions for w_i, we can derive P_i and use this expression to evaluate welfare.

The wage gap model can actually be solved analytically in the case of two regions, symmetrical trade costs $t_{12}=t_{21}=t$ and $\varepsilon=2$. Using the notation $L=L_1/L_2$, $z=1-\varepsilon$ and $x=(w_2/w_1)^2$, the system has three roots

[27] In most simulation results presented in the paper, we assume that $L_i=1$ for all regions and that there are no domestic trade costs, $t_{ii}=1$. In that case, we can directly use v_{ii} as an index of welfare.

of which two are complex. The third root, which is used for some numerical illustrations in the text, is equal to

$$(5)\quad x=\frac{t^z\left(2L^2+t^z\right)}{3L^2}-\frac{2^{1/3}a}{3L^2\left(b+\sqrt{4a^3+b^2}\right)^{1/3}}+\frac{\left(b+\sqrt{4a^3+b^2}\right)^{1/3}}{3\times 2^{1/3}L^2}$$

where

$$a=6L^2t^z-L^4t^{2z}-4L^2t^{3z}-t^{4z}$$

and

$$b=27L^4+2t^{3z}\left(2L^2+t^z\right)^3-9L^2t^{2z}\left(2L^2+t^z\right)\left(2+L^2t^z\right)$$

In some special cases, the square root term in (5) can become negative so that the root of x becomes complex. In the text, we use this equation to simulate how the model behaves for different parameter values (Diagram 2).

Table B1: Parameter values in model simulations (common values in all simulations, and specific changes in each scenario)				
Elasticity of substitution		5 in all simulations except for Diagram 2 in text, where ε=2 since the solution (5) from Appendix A is used.		
Level of trade costs				
		High	Inter-mediate/ main	Low
Abbreviated name		High	Main	Low
Scaling of distance (equal to maximum of spatial trade cost)		2.5	0.5	0.25
Trade costs that are inde-pendent of distance	Other regions intra-nationally	0.5	0.1	0.05
	In regional trade blocs	0.75	0.2	0.1
	To/from countries out-side trade bloc	1.0	0.3	0.15
Specific adjustments in each scenario:				
SPATIAL: Distance scaling changed to		2	0.25	Not calcu-lated
WTO: Barriers to/from countries outside trade bloc reduced to		0.9	0.25	
EASTOPEN: E2's trade costs increased to		1.5	0.5	
IRON: Non-spatial barriers between WEST and the rest changed to		10	10	
Regional integration scenarios (WEST-WIDER and EAST-WEST): The level of trade costs applying to trade blocs applied to the relevant members in each case.				
CAPITAL: A separate matrix of trade costs was calculated where all trade with and inside the three countries to the east (E1, E2 and E3) had to pass through the capitals. The designated capitals were regions (5, 11), (2,11) and (2,14). Distances were recalculated. Trade costs were then calculated using the average between this and the ordinary distance matrix, with equal weights.				

Table B2: Illustration of the level of trade costs used in the simulations Level of trade costs between regions in the "WEST" scenario, country averages (percentage levels)										
High level of trade costs										
	Receiving country:									
	W1	W2	W3	W4	C1	C2	E1	E2	E3	Average
W1	69	129	129	149	203	214	278	261	309	**193**
W2	129	69	149	129	214	203	285	253	303	**193**
W3	129	149	69	129	154	174	228	214	261	**168**
W4	149	129	129	69	174	154	238	203	253	**166**
C1	203	214	154	174	69	154	179	174	214	**171**
C2	214	203	174	154	154	69	194	154	203	**169**
E1	278	285	228	238	179	194	87	164	164	**202**
E2	261	253	214	203	174	154	164	69	154	**183**
E3	309	303	261	253	214	203	164	154	69	**214**
Average	**193**	**193**	**168**	**166**	**171**	**169**	**202**	**183**	**214**	
Intermediate level of trade costs (main case)										
	W1	W2	W3	W4	C1	C2	E1	E2	E3	Average
W1	14	31	31	35	51	53	66	62	72	**46**
W2	31	14	35	31	53	51	67	61	71	**46**
W3	31	35	14	31	41	45	56	53	62	**41**
W4	35	31	31	14	45	41	58	51	61	**41**
C1	51	53	41	45	14	41	46	45	53	**43**
C2	53	51	45	41	41	14	49	41	51	**43**
E1	66	67	56	58	46	49	17	43	43	**49**
E2	62	61	53	51	45	41	43	14	41	**45**
E3	72	71	62	61	53	51	43	41	14	**52**
Average	**46**	**46**	**41**	**41**	**43**	**43**	**49**	**45**	**52**	
Low level of trade costs										
	W1	W2	W3	W4	C1	C2	E1	E2	E3	Average
W1	7	15	15	17	25	26	33	31	36	**23**
W2	15	7	17	15	26	25	33	30	35	**23**
W3	15	17	7	15	20	22	28	26	31	**20**
W4	17	15	15	7	22	20	29	25	30	**20**
C1	25	26	20	22	7	20	23	22	26	**22**
C2	26	25	22	20	20	7	24	20	25	**21**
E1	33	33	28	29	23	24	9	21	21	**25**
E2	31	30	26	25	22	20	21	7	20	**23**
E3	36	35	31	30	26	25	21	20	7	**26**
Average	**23**	**23**	**20**	**20**	**22**	**21**	**25**	**23**	**26**	

Table B3: Correlations between results from different simulations, the WIDER scenario																
Model			**Wage gap model**												**HME model**	
	Variable		**Wage**			**Domestic sales (in own region)**			**Price index**			**Welfare**			**Firms**	**Dom. sales**
		Scenario	High	Main	Low	High	Main	Low	High	Main	Low	High	Main	Low	High	High
Wage gap model	**Wage**	**High**	1.00	0.97	0.89	-0.99	-0.93	-0.83	-0.99	-0.96	-0.93	1.00	0.96	0.94	0.71	-0.96
		Main		1.00	0.93	-0.96	-0.96	-0.88	-0.95	-0.99	-0.98	0.96	1.00	0.98	0.54	-0.87
		Low			1.00	-0.91	-0.90	-0.72	-0.92	-0.92	-0.91	0.91	0.93	0.97	0.53	-0.84
	Dom. Sales	**High**				1.00	0.92	0.78	1.00	0.95	0.92	-1.00	-0.95	-0.93	-0.72	0.97
		Main					1.00	0.93	0.91	0.98	0.99	-0.92	-0.97	-0.97	-0.47	0.83
		Low						1.00	0.77	0.92	0.94	-0.80	-0.90	-0.87	-0.32	0.67
	Price Index	**High**							1.00	0.94	0.91	-1.00	-0.95	-0.93	-0.74	0.98
		Main								1.00	0.99	-0.95	-1.00	-0.99	-0.52	0.86
		Low									1.00	-0.92	-0.99	-0.98	-0.46	0.82
	Welfare	**High**										1.00	0.96	0.94	0.73	-0.97
		Main											1.00	0.99	0.53	-0.87
		Low												1.00	0.50	-0.85
HME model	**Firms**	**High**													1.00	-0.85
	Dom.	**High**														1.00

Note: Pearson correlation coefficients, N=90. All results are statistically significant at the 1% level or better (P=0.0002 in one case, P<0.0001 in all other).

Table B4: Correlations between *changes* from WEST to WIDER, for different simulations and variables																
Model			**Wage gap model**												**HME model**	
	Variable		**Wage**			**Dom. sales (in own region)**			**Price index**			**Welfare**			**Firms**	**Dom. sales**
		Scenario	**High**	**Main**	**Low**	**High**	**Main**	**Low**	**High**	**Main**	**Low**	**High**	**Main**	**Low**	**High**	**High**
Wage gap model	**Wage**	**High**	1	0.96	0.90	-0.96	-0.79	-0.94	-0.95	-0.91	-0.91	0.99	0.96	0.91	0.56	-0.97
		Main		1.00	0.95	-0.91	-0.73	-0.90	-0.90	-0.91	-0.93	0.94	0.97	0.94	0.44	-0.90
		Low			1.00	-0.93	-0.84	-0.87	-0.93	-0.97	-0.98	0.93	0.98	0.99	0.39	-0.88
	Dom. Sales	**High**				1.00	0.89	0.93	1.00	0.97	0.96	-0.99	-0.96	-0.95	-0.53	0.97
		Main					1.00	0.89	0.91	0.94	0.92	-0.86	-0.86	-0.90	-0.29	0.80
		Low						1.00	0.92	0.94	0.94	-0.94	-0.94	-0.92	-0.36	0.88
	Price Index	**High**							1.00	0.97	0.96	-0.99	-0.96	-0.96	-0.52	0.97
		Main								1.00	1.00	-0.96	-0.98	-0.99	-0.38	0.91
		Low									1.00	-0.95	-0.99	-1.00	-0.36	0.89
	Welfare	**High**										1.00	0.97	0.95	0.55	-0.98
		Main											1.00	0.99	0.42	-0.92
		Low												1.00	0.37	-0.90
HME model	**Firms**	**High**													1.00	-0.70
	Dom. sales	**High**														1.00

Note: Pearson correlation coefficients, N=90. All results are statistically significant at the 1% level or better (0.0001<P<0.005 in six cases, P<0.0001 in all other).

Table B5: Do different models and levels of trade costs give similar results?							
		High level of trade costs				Intermediate	
		Wage	**Welfare**	**Firms**	**Dom. sales**	**Wage**	**Welfare**
WEST	**Wage**	1	1.00	0.36	-0.96	0.98	0.98
	Welfare		1.00	0.39	-0.97	0.98	0.98
	Firms			1.00	-0.60	0.24	0.23
	Dom. sales				1.00	-0.92	-0.91
	Wage					1.00	1.00
	Welfare						1.00
WIDER	**Wage**	1	0.99	0.56	-0.97	0.96	0.96
	Welfare		1.00	0.55	-0.98	0.94	0.97
	Firms			1.00	-0.70	0.44	0.42
	Dom. sales				1.00	-0.90	-0.92
	Wage					1.00	0.97
	Welfare						1.00
IRON	**Wage**	1	0.74	0.41	-0.73	0.98	0.38
	Welfare		1.00	0.42	-0.95	0.70	0.90
	Firms			1.00	-0.63	0.38	0.25
	Dom. sales				1.00	-0.69	-0.82
	Wage					1.00	0.33
	Welfare						1.00
WTO	**Wage**	1	0.95	0.23	-0.86	0.77	0.94
	Welfare		1.00	0.35	-0.95	0.89	0.97
	Firms			1.00	-0.60	0.23	0.19
	Dom. sales				1.00	-0.83	-0.87
	Wage					1.00	0.94
	Welfare						1.00
EAST	**Wage**	1	0.99	0.39	-0.97	0.47	0.95
	Welfare		1.00	0.33	-0.96	0.41	0.95
	Firms			1.00	-0.56	0.28	0.20
	Dom. sales				1.00	-0.45	-0.90
	Wage					1.00	0.61
	Welfare						1.00
SPATIAL	**Wage**	1	0.38	-0.30	-0.01	0.03	0.05
	Welfare		1.00	-0.44	-0.41	0.43	0.37
	Firms			1.00	-0.61	-0.70	-0.70
	Dom. sales				1.00	0.37	0.42
	Wage					1.00	1.00
	Welfare	On shaded cells, see main text for explanation					1.00
EAST-WEST	**Wage**	1	0.99	0.61	-0.98	0.94	0.98
	Welfare		1.00	0.61	-0.98	0.91	0.97
	Firms			1.00	-0.74	0.52	0.52
	Dom. sales				1.00	-0.89	-0.94
	Wage					1.00	0.97
	Welfare						1.00

Table B5: Do different models and levels of trade costs give similar results?							
		High level of trade costs				Intermediate	
		Wage	Welfare	Firms	Dom. sales	Wage	Welfare
EASTOPEN	Wage	1	-0.96	0.92	-0.60	1.00	-0.98
	Welfare		1.00	-0.83	0.41	-0.97	0.99
	Firms			1.00	-0.80	0.89	-0.87
	Dom. sales				1.00	-0.55	0.48
	Wage					1.00	-0.99
	Welfare	On shaded cells, see main text for explanation.					1.00

Diagram C1: Scenario "WEST": Nominal wage changes

Relative change from base case with no integration

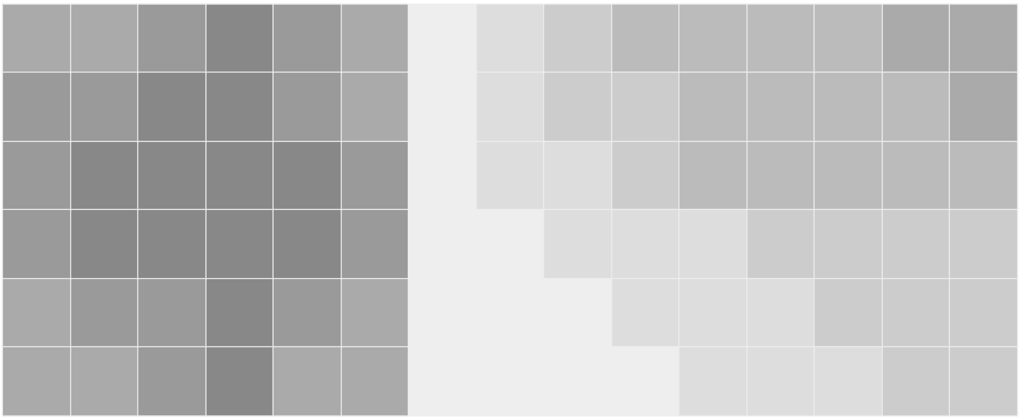
Dark areas = stronger nominal wage increase

Key words about outcome:

Nominal wage increase in all WEST regions, reductions outside

Slightly stronger increase at the centre of the WEST area

"Agglomeration shadow" with stronger wage reductions in Central Europe



Simulation results — wage gap model

Table C1: Nominal wages – scenario WEST

Results from numerical model simulations

Levels (percentage deviation from average)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-1.8	-0.7	0.1	0.5	0.9	1.0	-0.6	-0.5	-0.6	0.7	0.6	0.3	-0.3	-1.1	-2.3
North	5	-1.1	0.1	0.9	1.3	1.7	1.8	0.1	0.3	0.1	1.4	1.3	1.0	0.4	-0.5	-1.7
	4	-0.8	0.4	1.2	1.7	2.1	2.1	0.4	0.5	0.4	1.6	1.5	1.2	0.6	-0.3	-1.6
	3	-0.8	0.4	1.2	1.7	2.1	2.1	0.4	0.5	0.4	0.2	0.0	-0.6	-1.1	-1.8	-3.0
South	2	-1.1	0.1	0.9	1.3	1.7	1.8	0.1	0.3	0.1	0.0	-0.3	-0.8	-1.3	-2.0	-3.1
↓	1	-1.8	-0.7	0.1	0.5	0.9	1.0	-0.6	-0.5	-0.6	-0.7	-1.0	-1.5	-2.0	-2.7	-3.7
		W2			W4			C2			E2			E3		

Change in levels from scenario "base case without integration"

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	0.8	0.9	1.0	1.0	0.9	0.8	-0.7	-0.7	-0.7	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5
North	5	0.9	1.0	1.0	1.1	1.0	0.9	-0.8	-0.7	-0.7	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5
	4	1.0	1.1	1.1	1.2	1.1	0.9	-0.8	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5
	3	1.0	1.0	1.1	1.2	1.1	0.9	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6	-0.6
South	2	0.9	0.9	1.0	1.1	1.0	0.8	-0.8	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6
↓	1	0.8	0.9	0.9	1.0	0.9	0.8	-0.8	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6
		W2			W4			C2			E2			E3		

Diagram C2: Scenario "WEST": Welfare (real wage) changes

Relative change from base case with no integration

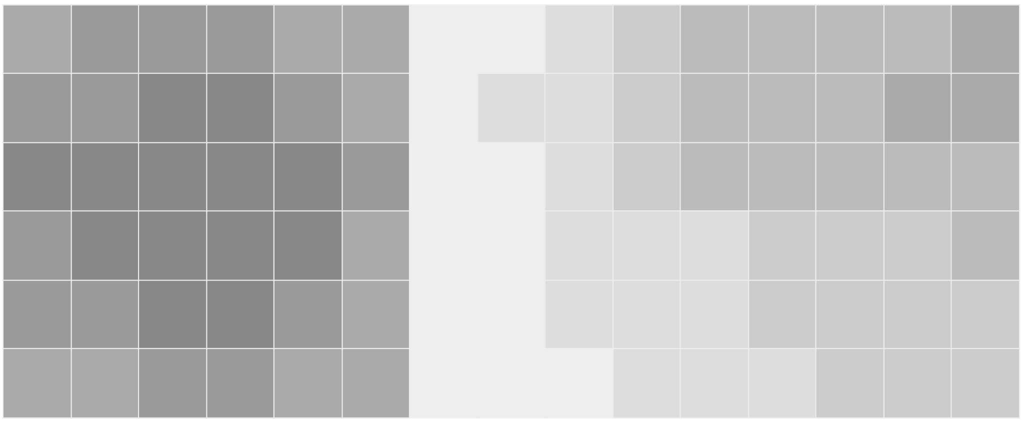
Dark areas = stronger welfare increase

Key words about outcome:

Welfare increase in all WEST regions, reductions outside

Similar to pattern for change in nominal wages

"Agglomeration shadow" with slightly larger welfare reductions in Central Europe



Simulation results — wage gap model

Table C2: Welfare (real wages) – scenario WEST																
Results from numerical model simulations																
Levels (index using average from scenario Europe-4 = 100)																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	95.6	98.0	99.7	100.8	101.7	102.0	98.8	99.1	98.8	101.6	101.5	100.8	99.6	97.7	95.1
	5	97.1	99.7	101.5	102.6	103.6	103.9	100.4	100.8	100.5	103.3	103.2	102.5	101.1	99.1	96.4
	4	97.7	100.4	102.2	103.4	104.4	104.6	101.0	101.4	101.1	103.8	103.6	102.9	101.5	99.5	96.7
	3	97.7	100.4	102.2	103.4	104.4	104.6	101.0	101.4	101.1	100.8	100.2	98.9	97.8	96.2	93.7
South	2	97.1	99.7	101.5	102.6	103.6	103.9	100.4	100.8	100.5	100.2	99.7	98.4	97.3	95.8	93.4
↓	1	95.6	98.0	99.7	100.8	101.8	102.1	98.8	99.1	98.9	98.6	98.0	96.8	95.8	94.3	92.1
		W2			W4			C2			E2			E3		
Change in levels from scenario "base case with no integration"																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	2.8	2.9	3.1	3.2	3.0	2.8	-0.7	-0.6	-0.5	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2
	5	3.0	3.1	3.3	3.5	3.2	2.9	-0.7	-0.6	-0.5	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2
	4	3.2	3.4	3.5	3.7	3.4	3.1	-0.7	-0.6	-0.5	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2
	3	3.2	3.4	3.5	3.7	3.4	3.1	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3
South	2	2.9	3.1	3.3	3.4	3.2	2.9	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3
↓	1	2.8	2.9	3.1	3.2	3.0	2.8	-0.7	-0.6	-0.6	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3
		W2			W4			C2			E2			E3		

Diagram C3: Scenario "Iron curtain (IRON)": Nominal wage changes

Relative change from scenario WEST

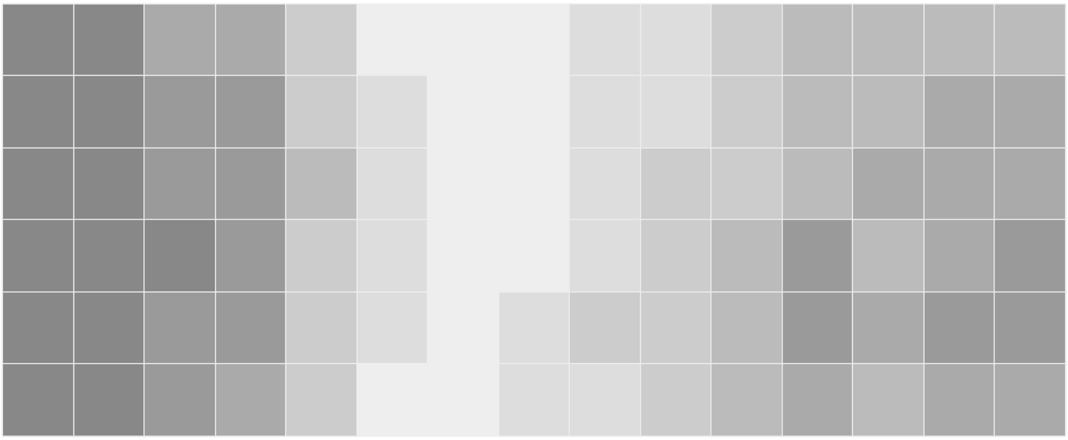
Bright areas = stronger nominal wage decline

Key words about outcome:

Nominal wage reduction close to the iron curtain

Stronger decline east of the iron curtain, especially in Central Europe

Some nominal wage increase in areas far from the iron curtain



Simulation results — wage gap model

Table C3: Nominal wages – scenario "iron curtain (IRON)"																
Results from numerical model simulations																
Levels (percentage deviation from average)																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-0.8	0.1	0.5	0.9	0.7	-0.1	-2.5	-1.6	-1.2	0.0	0.4	0.3	-0.1	-0.8	-1.9
North	5	0.0	1.1	1.5	2.0	1.7	0.8	-1.8	-0.8	-0.4	0.9	1.2	1.2	0.7	-0.1	-1.3
	4	0.4	1.4	1.9	2.3	2.0	1.1	-1.6	-0.6	-0.1	1.2	1.5	1.4	1.0	0.2	-1.1
	3	0.4	1.5	2.0	2.3	2.0	1.1	-1.6	-0.6	-0.1	0.1	0.2	-0.1	-0.8	-1.4	-2.4
South	2	0.1	1.1	1.6	1.9	1.7	0.8	-1.8	-0.8	-0.3	-0.1	0.0	-0.3	-0.9	-1.5	-2.6
↓	1	-0.7	0.2	0.6	1.0	0.7	-0.1	-2.4	-1.5	-1.1	-0.9	-0.8	-1.1	-1.7	-2.2	-3.2
		W2			W4			C2			E2			E3		
Change in levels from scenario WEST																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	0.9	0.8	0.5	0.4	-0.2	-1.1	-1.9	-1.1	-0.6	-0.6	-0.2	0.0	0.2	0.3	0.4
North	5	1.1	1.0	0.7	0.6	0.0	-1.0	-1.9	-1.1	-0.5	-0.5	-0.1	0.2	0.3	0.4	0.5
	4	1.2	1.1	0.7	0.7	0.0	-1.0	-2.0	-1.1	-0.5	-0.4	0.0	0.2	0.4	0.5	0.5
	3	1.2	1.1	0.8	0.7	0.0	-1.1	-2.0	-1.1	-0.5	-0.1	0.3	0.5	0.3	0.5	0.5
South	2	1.2	1.1	0.7	0.6	0.0	-1.0	-1.9	-1.0	-0.4	-0.1	0.3	0.6	0.4	0.5	0.6
↓	1	1.0	0.9	0.5	0.4	-0.2	-1.1	-1.8	-1.1	-0.5	-0.2	0.2	0.5	0.3	0.4	0.5
		W2			W4			C2			E2			E3		

Diagram C4: Scenario "Iron curtain (IRON)": Welfare (real wage) changes

Relative change from scenario WEST

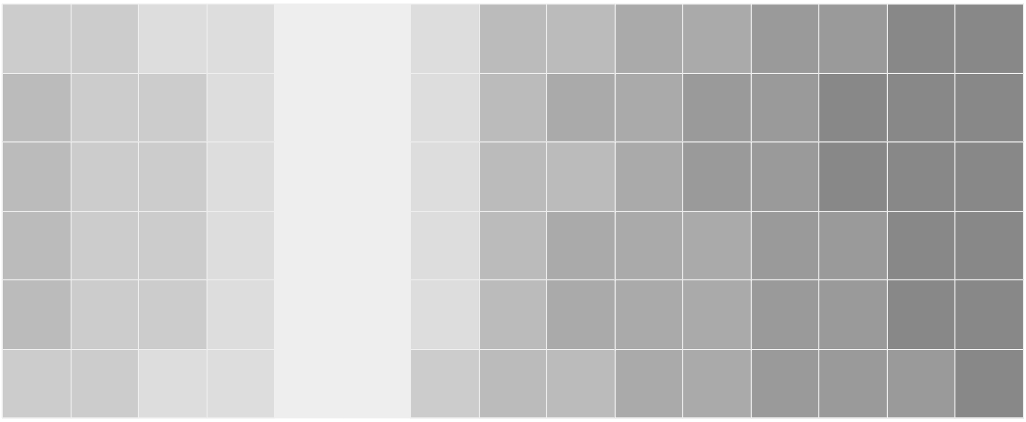
Dark areas = smaller welfare decline

Key words about outcome:

Considerable welfare loss for all regions

Higher welfare loss close to the iron curtain

Blocking east–west trade leads to a price increase and creates new peripheries



Simulation results – wage gap model

Table C4: Welfare (real wages) – scenario "iron curtain (IRON)"

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	85.8	87.5	88.2	88.5	88.0	86.3	87.5	89.3	90.2	93.8	94.7	94.7	94.0	92.5	90.2
	5	87.5	89.4	90.2	90.5	89.9	88.0	88.9	90.9	91.9	95.6	96.4	96.5	95.7	94.1	91.6
	4	88.1	90.2	91.0	91.3	90.6	88.7	89.3	91.4	92.5	96.1	96.9	96.9	96.1	94.5	92.0
	3	88.2	90.2	91.1	91.3	90.6	88.6	89.3	91.4	92.5	93.0	93.4	92.9	92.0	90.8	88.7
South	2	87.5	89.5	90.3	90.5	89.9	88.0	89.0	91.0	92.0	92.5	92.9	92.4	91.6	90.5	88.4
↓	1	85.8	87.6	88.3	88.6	88.0	86.3	87.5	89.4	90.4	90.8	91.2	90.7	89.9	88.9	87.0
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-9.8	-10.5	-11.5	-12.3	-13.8	-15.8	-11.3	-9.8	-8.6	-7.8	-6.9	-6.1	-5.6	-5.2	-4.9
	5	-9.6	-10.3	-11.3	-12.1	-13.7	-15.9	-11.5	-9.8	-8.5	-7.7	-6.7	-6.0	-5.5	-5.1	-4.8
	4	-9.6	-10.2	-11.2	-12.1	-13.8	-16.0	-11.7	-10.0	-8.6	-7.7	-6.7	-6.0	-5.4	-5.0	-4.8
	3	-9.5	-10.2	-11.2	-12.1	-13.8	-16.0	-11.7	-10.0	-8.6	-7.8	-6.8	-6.1	-5.8	-5.3	-5.0
South	2	-9.6	-10.2	-11.2	-12.1	-13.7	-15.9	-11.5	-9.8	-8.5	-7.7	-6.7	-6.0	-5.8	-5.3	-5.0
↓	1	-9.8	-10.4	-11.4	-12.3	-13.8	-15.8	-11.3	-9.7	-8.5	-7.7	-6.8	-6.1	-5.9	-5.4	-5.1
		W2			W4			C2			E2			E3		

Diagram C5: Scenario "WIDER": Nominal wage changes

Relative change from scenario WEST

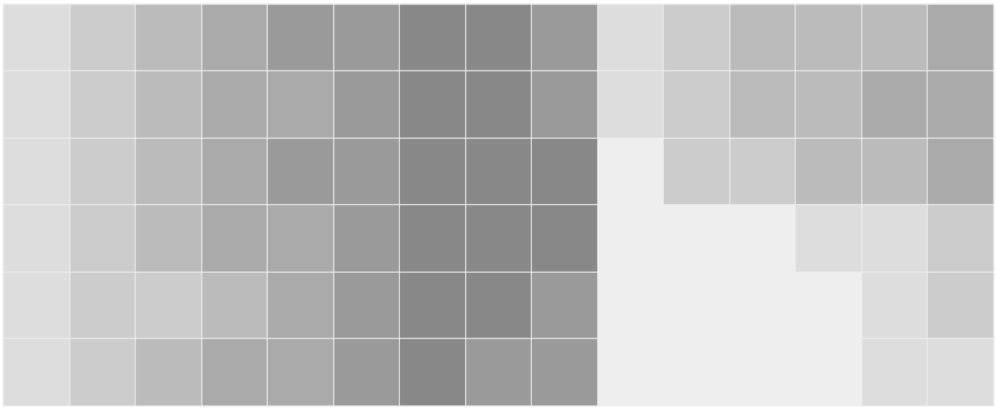
Darkest areas = increase, brighter areas = decline

Key words about outcome:

Considerable nominal increase in new member states

Nominal reductions in old member states, particularly in the west

Stronger decline in "agglomeration shadow" in E1 and E2



Simulation results – wage gap model

Table C5: Nominal wages – scenario WIDER

Results from numerical model simulations

Levels (percentage deviation from average)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-2.2	-1.1	-0.3	0.3	0.8	1.0	1.1	1.0	0.8	0.2	0.2	-0.1	-0.6	-1.4	-2.6
North	5	-1.5	-0.4	0.5	1.1	1.6	1.8	1.9	1.8	1.5	0.8	0.9	0.6	0.1	-0.8	-2.0
	4	-1.3	-0.1	0.8	1.4	1.9	2.1	2.2	2.2	1.9	1.1	1.1	0.8	0.3	-0.6	-1.8
	3	-1.3	-0.1	0.8	1.4	1.9	2.1	2.2	2.1	1.9	-0.6	-0.8	-1.3	-1.6	-2.3	-3.4
South	2	-1.6	-0.4	0.5	1.0	1.5	1.8	1.8	1.8	1.5	-0.9	-1.1	-1.6	-1.8	-2.5	-3.6
↓	1	-2.2	-1.1	-0.3	0.2	0.7	1.0	1.0	1.0	0.7	-1.6	-1.8	-2.3	-2.5	-3.2	-4.2
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-0.5	-0.4	-0.3	-0.3	-0.2	0.0	1.7	1.5	1.4	-0.5	-0.4	-0.4	-0.3	-0.3	-0.3
North	5	-0.5	-0.4	-0.4	-0.3	-0.2	0.0	1.7	1.6	1.4	-0.5	-0.4	-0.4	-0.3	-0.3	-0.3
	4	-0.5	-0.4	-0.4	-0.3	-0.2	0.0	1.8	1.6	1.5	-0.5	-0.5	-0.4	-0.3	-0.3	-0.3
	3	-0.5	-0.4	-0.4	-0.3	-0.2	0.0	1.8	1.6	1.5	-0.8	-0.8	-0.7	-0.5	-0.4	-0.4
South	2	-0.5	-0.4	-0.4	-0.3	-0.2	0.0	1.7	1.5	1.4	-0.9	-0.8	-0.7	-0.5	-0.5	-0.4
↓	1	-0.5	-0.4	-0.4	-0.3	-0.2	0.0	1.6	1.5	1.4	-0.9	-0.8	-0.8	-0.5	-0.5	-0.5
		W2			W4			C2			E2			E3		

Diagram C6: Scenario "WIDER": Welfare (real wage) changes

Relative change from scenario WEST

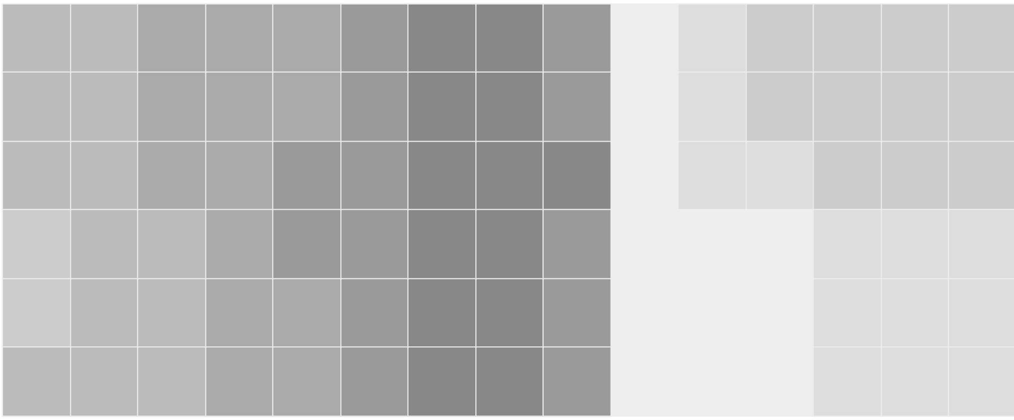
Dark areas = stronger welfare increase

Key words about outcome:

Welfare increase in all west/central regions, reductions outside

Particularly large welfare increases in the new member states, C1 and C2

"Agglomeration shadow" moved eastward into in E1 and E2



Simulation results — wage gap model

Table C6: Welfare (real wages) – scenario WIDER

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	96.3	98.8	100.6	101.9	103.0	103.5	103.7	103.6	103.0	101.2	101.2	100.6	99.3	97.5	94.9
North	5	97.8	100.4	102.4	103.7	104.9	105.4	105.6	105.5	104.8	102.8	102.8	102.2	100.9	99.0	96.3
	4	98.4	101.1	103.1	104.5	105.7	106.2	106.4	106.3	105.6	103.3	103.2	102.6	101.3	99.3	96.6
	3	98.4	101.1	103.1	104.5	105.7	106.2	106.4	106.3	105.6	100.0	99.5	98.3	97.4	95.8	93.4
South	2	97.8	100.4	102.4	103.7	104.9	105.4	105.6	105.5	104.8	99.4	99.0	97.8	96.9	95.4	93.1
↓	1	96.2	98.8	100.6	101.9	103.0	103.5	103.7	103.6	103.0	97.8	97.3	96.2	95.4	94.0	91.8
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	0.6	0.7	0.9	1.0	1.2	1.5	4.9	4.5	4.2	-0.5	-0.4	-0.3	-0.2	-0.2	-0.1
North	5	0.6	0.7	0.9	1.1	1.3	1.5	5.1	4.7	4.3	-0.5	-0.4	-0.3	-0.2	-0.2	-0.1
	4	0.6	0.7	0.9	1.1	1.3	1.6	5.4	4.9	4.5	-0.5	-0.4	-0.3	-0.2	-0.2	-0.1
	3	0.6	0.7	0.9	1.1	1.3	1.6	5.4	4.9	4.5	-0.8	-0.7	-0.6	-0.4	-0.3	-0.3
South	2	0.6	0.7	0.9	1.1	1.3	1.5	5.1	4.7	4.3	-0.8	-0.7	-0.6	-0.4	-0.3	-0.3
↓	1	0.6	0.7	0.9	1.0	1.2	1.5	4.9	4.5	4.1	-0.8	-0.7	-0.6	-0.4	-0.3	-0.3
		W2			W4			C2			E2			E3		

Diagram C7: Scenario "WTO": Nominal wage changes

Relative change from scenario WEST

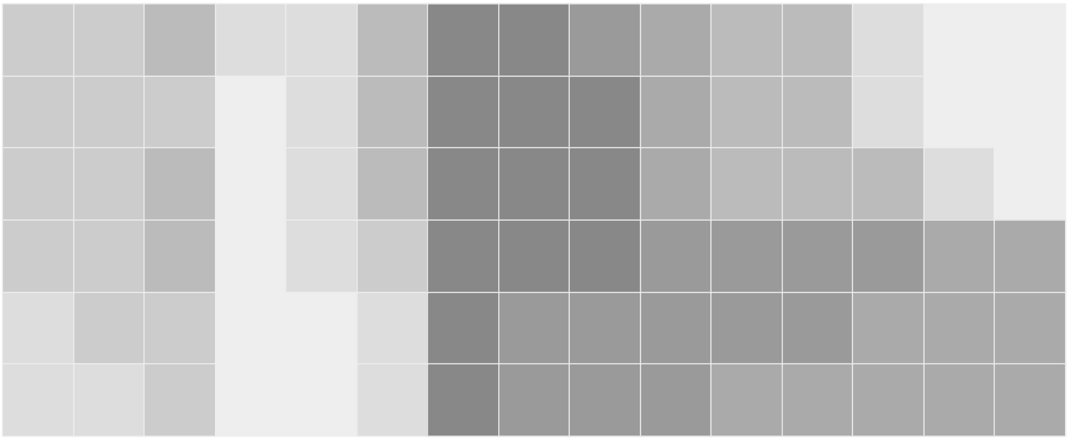
Dark areas = increase, bright areas = decline

Key words about outcome:

Reduction in MFN trade costs leads to "preference erosion"

This leads to a wage increase outside W1—W4, especially in central Europe

Modest nominal wage reduction in W1—W4



Simulation results — wage gap model

Table C7: Nominal wages – scenario WTO

Results from numerical model simulations

Levels (percentage deviation from average)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-1.9	-0.9	-0.1	0.3	0.7	0.8	-0.2	-0.1	-0.3	0.7	0.5	0.1	-0.5	-1.4	-2.6
	5	-1.2	-0.1	0.7	1.1	1.5	1.6	0.6	0.6	0.5	1.4	1.2	0.9	0.2	-0.7	-2.0
	4	-1.0	0.2	1.0	1.4	1.8	2.0	0.9	0.9	0.8	1.7	1.5	1.1	0.4	-0.5	-1.8
	3	-1.0	0.2	1.0	1.4	1.8	2.0	0.9	0.9	0.7	0.5	0.2	-0.4	-0.9	-1.7	-2.9
South	2	-1.3	-0.1	0.7	1.1	1.5	1.6	0.5	0.6	0.4	0.2	-0.1	-0.7	-1.2	-2.0	-3.1
↓	1	-1.9	-0.9	-0.1	0.3	0.7	0.8	-0.2	-0.2	-0.3	-0.5	-0.8	-1.4	-1.9	-2.7	-3.8
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.4	0.4	0.3	0.0	-0.1	-0.2	-0.2	-0.2	-0.3
	5	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.5	0.4	0.3	0.0	-0.1	-0.1	-0.2	-0.2	-0.3
	4	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.5	0.4	0.4	0.1	0.0	-0.1	-0.2	-0.2	-0.2
	3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.1	0.1
South	2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.4	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.0
↓	1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.0	0.0
		W2			W4			C2			E2			E3		

Diagram C8: Scenario "WTO": Welfare (real wage) changes

Relative change from scenario WEST

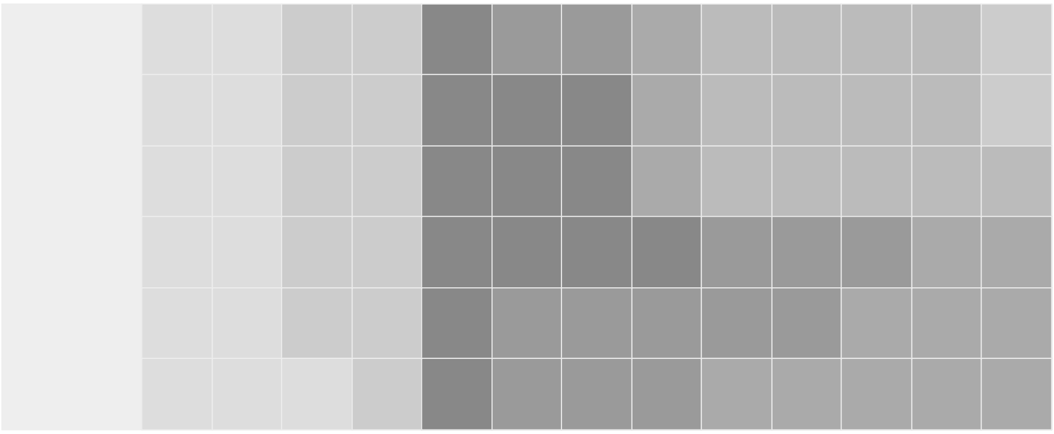
Darker areas = larger increase

Key words about outcome:

Welfare gain for all countries

Larger welfare gain outside W1—W4, due to preference erosion

Welfare gain in W1—W4 in spite of some nominal wage reduction



Simulation results — wage gap model

Table C8: Welfare (real wages) – scenario WTO

Results from numerical model simulations

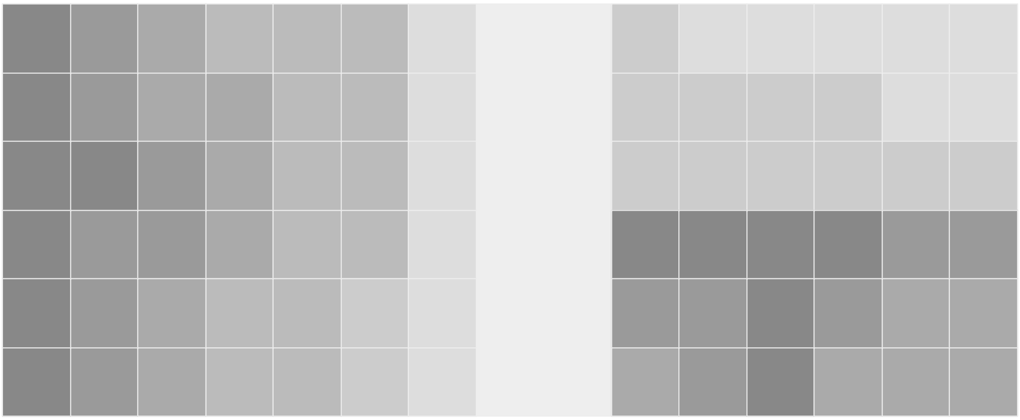
Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	96.6	99.1	100.9	102.1	103.1	103.6	101.8	102.1	101.8	103.9	103.6	102.7	101.3	99.3	96.6
North	5	98.1	100.8	102.7	103.9	105.0	105.4	103.6	103.8	103.5	105.6	105.3	104.4	102.9	100.8	98.0
	4	98.7	101.5	103.4	104.7	105.8	106.2	104.3	104.6	104.2	106.3	105.9	105.0	103.5	101.3	98.4
	3	98.7	101.5	103.4	104.7	105.8	106.2	104.3	104.5	104.2	103.8	103.1	101.8	100.5	98.7	96.0
South	2	98.1	100.8	102.7	103.9	105.0	105.4	103.6	103.8	103.5	103.1	102.5	101.1	99.9	98.1	95.6
↓	1	96.6	99.1	100.9	102.0	103.1	103.6	101.8	102.1	101.8	101.4	100.7	99.5	98.3	96.6	94.2
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	1.0	1.1	1.2	1.2	1.4	1.5	3.1	3.0	3.0	2.3	2.1	1.9	1.7	1.6	1.5
North	5	1.0	1.1	1.2	1.2	1.4	1.6	3.2	3.1	3.1	2.4	2.2	2.0	1.8	1.7	1.6
	4	1.0	1.1	1.2	1.3	1.4	1.6	3.3	3.2	3.2	2.5	2.3	2.1	1.9	1.8	1.7
	3	1.0	1.1	1.2	1.2	1.4	1.6	3.3	3.2	3.2	3.1	2.9	2.9	2.7	2.5	2.3
South	2	1.0	1.1	1.2	1.2	1.4	1.5	3.1	3.0	3.0	2.9	2.8	2.7	2.6	2.4	2.2
↓	1	1.0	1.1	1.2	1.2	1.3	1.5	3.0	2.9	2.9	2.8	2.7	2.6	2.5	2.3	2.1
		W2			W4			C2			E2			E3		

Diagram C9: Scenario "EAST (Eastern integration)": Nominal wage changes
Relative change from scenario WEST
Dark areas = increase, brighter areas = reduction
Key words about outcome:
Leads to a wage increase for smaller participants but a slight decrease for E1
For Central Europe, there is some nominal wage reduction
The decrease in Central Europe corresponds to a gain further west



Simulation results — wage gap model

Table C9: Nominal wages – scenario Eastern integration (EAST)

Results from numerical model simulations

Levels (percentage deviation from average)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	1.3	0.2	-0.4	-0.8	-1.0	-1.0	1.3	1.3	1.6	-0.5	-0.4	-0.1	0.5	1.4	2.5
North	5	0.5	-0.6	-1.3	-1.6	-1.8	-1.8	0.6	0.6	0.9	-1.3	-1.2	-0.8	-0.2	0.7	1.9
	4	0.2	-0.9	-1.6	-1.9	-2.2	-2.1	0.3	0.3	0.6	-1.6	-1.5	-1.1	-0.5	0.4	1.7
	3	0.2	-0.9	-1.6	-1.9	-2.2	-2.1	0.4	0.4	0.7	-0.7	-0.5	-0.1	0.5	1.4	2.6
South	2	0.5	-0.6	-1.3	-1.6	-1.8	-1.8	0.7	0.7	0.9	-0.4	-0.2	0.3	0.8	1.7	2.8
↓	1	1.3	0.2	-0.4	-0.7	-1.0	-0.9	1.4	1.4	1.7	0.4	0.6	1.1	1.6	2.4	3.5
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	0.5	0.5	0.4	0.2	0.1	0.0	-0.7	-0.8	-0.9	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
North	5	0.5	0.5	0.4	0.2	0.1	0.0	-0.7	-0.9	-1.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
	4	0.5	0.5	0.4	0.3	0.1	0.0	-0.7	-0.9	-1.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	3	0.5	0.5	0.4	0.3	0.1	0.0	-0.8	-0.9	-1.0	0.5	0.6	0.7	0.6	0.5	0.4
South	2	0.5	0.5	0.4	0.2	0.1	0.0	-0.8	-0.9	-1.0	0.4	0.5	0.6	0.5	0.4	0.3
↓	1	0.5	0.5	0.4	0.2	0.1	-0.1	-0.8	-0.9	-1.0	0.4	0.4	0.5	0.4	0.3	0.2
		W2			W4			C2			E2			E3		

Diagram C10: Scenario "EAST (Eastern integration)": Welfare (real wage) changes

Relative change from scenario WEST

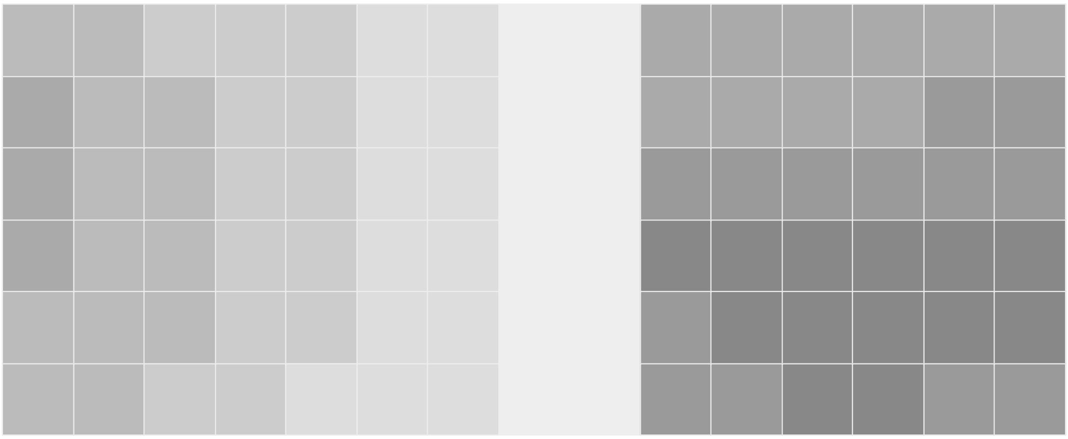
Dark areas = increase, bright areas = reduction

Key words about outcome:

Eastern integration leads to a gain for the participants

For Central Europe, there is a "shadow" effect

The loss in Central Europe corresponds to a gain further west



Simulation results — wage gap model

Table C10: Welfare (real wages) – scenario Eastern integration (EAST)

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	96.0	98.4	100.0	101.0	101.8	102.0	98.2	98.4	98.0	102.9	102.8	102.2	100.9	99.0	96.4
	5	97.5	100.1	101.8	102.8	103.7	103.8	99.9	100.1	99.7	104.7	104.6	104.0	102.7	100.6	97.9
	4	98.1	100.8	102.6	103.6	104.5	104.6	100.5	100.7	100.2	105.5	105.4	104.7	103.3	101.2	98.4
	3	98.1	100.8	102.6	103.6	104.5	104.6	100.4	100.6	100.2	103.6	103.3	102.3	101.1	99.2	96.6
South	2	97.5	100.1	101.8	102.8	103.7	103.8	99.8	100.0	99.6	102.9	102.5	101.6	100.4	98.6	96.0
↓	1	96.0	98.4	100.0	101.0	101.8	102.0	98.2	98.4	98.0	101.1	100.7	99.8	98.6	96.9	94.5
		W2			W4			C2			E2			E3		
Change in levels from scenario WEST																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	0.4	0.4	0.3	0.2	0.1	0.0	-0.6	-0.7	-0.8	1.3	1.3	1.3	1.3	1.3	1.3
	5	0.4	0.4	0.3	0.2	0.1	0.0	-0.6	-0.7	-0.8	1.4	1.5	1.5	1.5	1.5	1.5
	4	0.4	0.4	0.3	0.2	0.1	0.0	-0.6	-0.7	-0.8	1.6	1.7	1.8	1.8	1.8	1.7
	3	0.4	0.4	0.3	0.2	0.1	0.0	-0.6	-0.8	-0.9	2.9	3.1	3.4	3.3	3.1	2.9
South	2	0.4	0.4	0.3	0.2	0.1	-0.1	-0.6	-0.8	-0.9	2.7	2.9	3.2	3.0	2.8	2.7
↓	1	0.4	0.3	0.3	0.2	0.1	-0.1	-0.6	-0.8	-0.9	2.5	2.7	2.9	2.8	2.6	2.5
		W2			W4			C2			E2			E3		

Diagram C11: Scenario "SPATIAL": Nominal wage changes

Relative change from scenario WEST

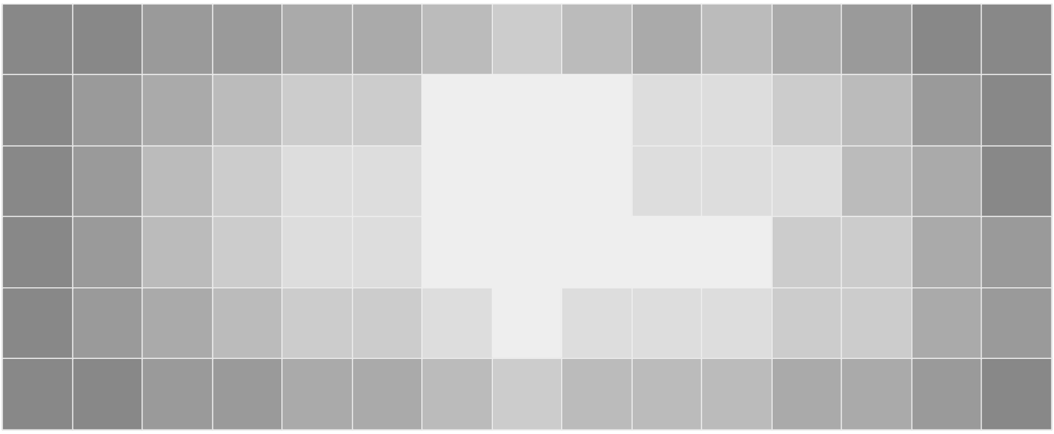
Darkest areas = increase, bright areas = reduction

Key words about outcome:

Reduced transport costs is generally good for the European peripheries

The smaller is the market potential, the larger is the increase

In geographically central areas, there is some nominal wage decline



Simulation results — wage gap model

Table C11: Nominal wages – scenario SPATIAL (reduced spatial trade costs)																
Results from numerical model simulations																
Levels (percentage deviation from average)																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-0.6	0.1	0.5	0.8	1.0	1.1	-0.8	-0.7	-0.8	0.7	0.6	0.4	0.0	-0.5	-1.2
North	5	-0.2	0.5	0.9	1.2	1.5	1.5	-0.4	-0.3	-0.4	1.0	1.0	0.7	0.3	-0.2	-0.9
	4	0.0	0.6	1.1	1.4	1.7	1.7	-0.2	-0.2	-0.3	1.2	1.1	0.8	0.4	-0.1	-0.8
	3	-0.1	0.6	1.1	1.4	1.7	1.7	-0.2	-0.1	-0.2	-0.3	-0.5	-0.9	-1.4	-1.9	-2.5
South	2	-0.2	0.5	0.9	1.2	1.5	1.5	-0.4	-0.3	-0.4	-0.5	-0.7	-1.0	-1.5	-2.0	-2.6
↓	1	-0.6	0.1	0.5	0.8	1.0	1.1	-0.7	-0.7	-0.8	-0.9	-1.1	-1.4	-1.9	-2.3	-2.9
		W2			W4			C2			E2			E3		
Change in levels from scenario WEST																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	1.2	0.7	0.5	0.3	0.1	0.1	-0.2	-0.2	-0.2	0.0	0.0	0.1	0.3	0.6	1.1
North	5	0.9	0.4	0.1	-0.1	-0.2	-0.3	-0.5	-0.6	-0.5	-0.3	-0.4	-0.3	-0.1	0.3	0.8
	4	0.7	0.2	-0.1	-0.3	-0.4	-0.4	-0.6	-0.7	-0.6	-0.4	-0.5	-0.4	-0.1	0.2	0.7
	3	0.7	0.2	-0.1	-0.3	-0.4	-0.4	-0.6	-0.6	-0.6	-0.6	-0.5	-0.3	-0.3	0.0	0.4
South	2	0.9	0.4	0.1	-0.1	-0.2	-0.3	-0.5	-0.5	-0.5	-0.5	-0.4	-0.2	-0.2	0.1	0.5
↓	1	1.2	0.7	0.4	0.3	0.1	0.1	-0.1	-0.2	-0.1	-0.1	-0.1	0.1	0.1	0.4	0.8
		W2			W4			C2			E2			E3		

Diagram C12: Scenario "SPATIAL": Welfare (real wage) changes

Relative change from scenario WEST

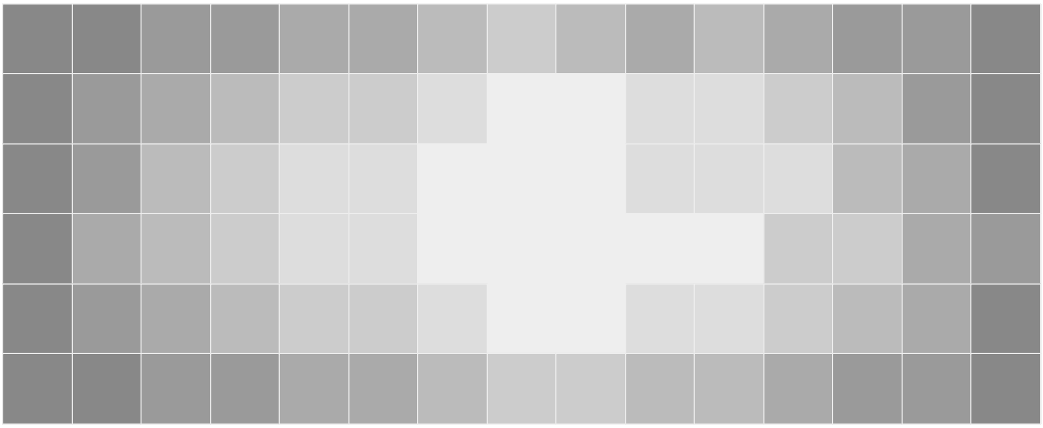
Darker areas = larger increase

Key words about outcome:

Reduced transport costs creates considerable welfare gain for all regions

There is a particularly high gain for European peripheries

The patterns for nominal wages and welfare are similar



Simulation results — wage gap model

Table C12: Welfare – scenario SPATIAL (reduced spatial trade costs)

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	103.6	105.1	106.2	107.0	107.6	107.8	103.9	104.1	103.9	107.2	107.0	106.5	105.7	104.4	102.9
North	5	104.5	106.1	107.2	108.0	108.6	108.9	104.8	105.0	104.8	108.1	108.0	107.4	106.5	105.2	103.6
	4	104.8	106.4	107.6	108.4	109.1	109.3	105.2	105.4	105.2	108.4	108.2	107.7	106.8	105.5	103.8
	3	104.8	106.4	107.6	108.4	109.1	109.3	105.2	105.4	105.2	105.0	104.5	103.7	102.8	101.7	100.2
South	2	104.5	106.1	107.2	108.0	108.6	108.9	104.8	105.0	104.9	104.6	104.2	103.4	102.5	101.4	100.0
↓	1	103.6	105.1	106.2	107.0	107.6	107.9	103.9	104.1	103.9	103.7	103.3	102.5	101.7	100.7	99.2
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	8.0	7.1	6.5	6.2	5.8	5.8	5.1	5.0	5.1	5.6	5.5	5.7	6.1	6.8	7.8
North	5	7.4	6.4	5.7	5.3	5.0	5.0	4.4	4.2	4.3	4.9	4.8	5.0	5.4	6.1	7.2
	4	7.1	6.1	5.4	5.0	4.7	4.7	4.1	4.0	4.1	4.6	4.6	4.8	5.2	6.0	7.0
	3	7.1	6.1	5.4	5.0	4.7	4.7	4.2	4.0	4.1	4.2	4.3	4.8	5.0	5.5	6.5
South	2	7.3	6.3	5.7	5.3	5.0	5.0	4.4	4.2	4.4	4.4	4.6	5.0	5.2	5.7	6.6
↓	1	8.0	7.1	6.5	6.1	5.8	5.8	5.1	5.0	5.1	5.1	5.3	5.7	5.9	6.3	7.2
		W2			W4			C2			E2			E3		

Diagram C13: "EAST—WEST": Nominal wage changes

Relative change from scenario WIDER

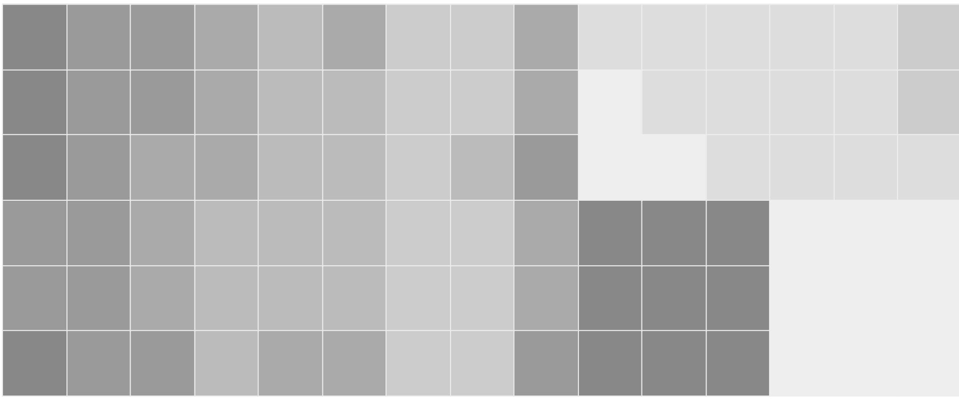
Dark areas = increase, bright areas = decline

Keywords about outcome:

Strong nominal wage increase in E2

Some reduction in surrounding countries, especially E3 and E1

Slight positive impact in western—most Europe



Simulation results — wage gap model

Table C13: Nominal wages – scenario EAST-WEST																
Results from numerical model simulations																
Levels (percentage deviation from average)																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	-2.1	-1.0	-0.2	0.2	0.7	1.0	1.0	1.0	0.8	-0.6	-0.5	-0.7	-1.2	-2.0	-3.1
North	5	-1.5	-0.3	0.5	1.0	1.5	1.8	1.7	1.8	1.6	0.0	0.1	-0.1	-0.5	-1.3	-2.5
	4	-1.2	0.0	0.9	1.4	1.9	2.1	2.1	2.1	1.9	0.1	0.2	0.0	-0.5	-1.3	-2.4
	3	-1.2	0.0	0.8	1.4	1.9	2.1	2.1	2.1	1.9	1.9	1.5	0.9	-2.6	-3.2	-4.2
South	2	-1.5	-0.3	0.5	1.0	1.5	1.7	1.7	1.7	1.6	1.6	1.3	0.6	-2.8	-3.4	-4.4
↓	1	-2.2	-1.0	-0.3	0.2	0.7	1.0	0.9	0.9	0.8	0.9	0.5	-0.1	-3.6	-4.1	-5.0
		W2			W4			C2			E2			E3		
Change in levels from scenario WIDER																
		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑	6	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.8	-0.7	-0.7	-0.6	-0.5	-0.5
North	5	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.8	-0.8	-0.7	-0.6	-0.6	-0.5
	4	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.9	-0.9	-0.8	-0.7	-0.6	-0.6
	3	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	2.5	2.3	2.2	-1.0	-0.9	-0.8
South	2	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	2.5	2.3	2.2	-1.0	-0.9	-0.8
↓	1	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	2.5	2.3	2.2	-1.0	-0.9	-0.8
		W2			W4			C2			E2			E3		

Diagram C14: "EAST—WEST": Welfare (real wage)changes

Relative change from scenario WIDER

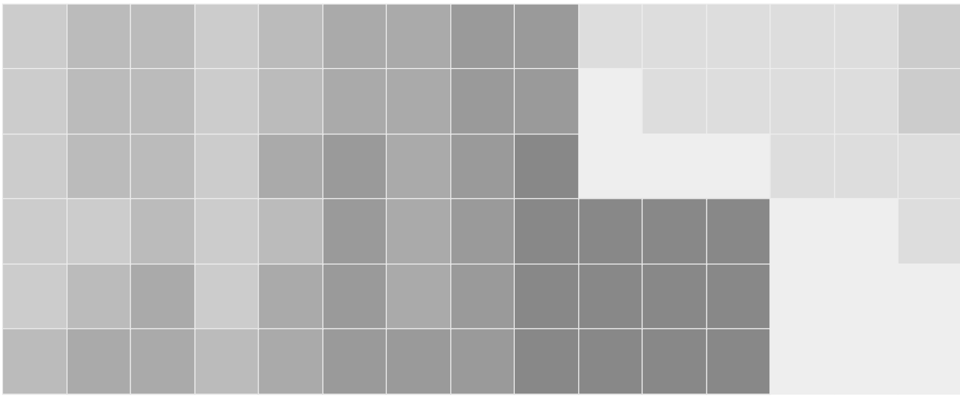
Darker areas = larger increase, very bright area = decline

Keywords about outcome:

With the exception of E3, all other countries and regions gain

The gain is particularly large for the new participant E2

W1—W4 and C1—C2 also gain, in spite of a nominal wage reduction in some regions



Simulation results — wage gap model

Table C14: Welfare (real wages) – scenario EAST-WEST

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	96.7	99.2	101.0	102.3	103.4	104.0	104.2	104.2	103.7	100.6	100.6	100.1	98.9	97.1	94.6
	5	98.2	100.9	102.8	104.1	105.3	105.9	106.1	106.1	105.5	102.1	102.2	101.6	100.5	98.6	95.9
	4	98.8	101.6	103.6	104.9	106.1	106.7	106.9	106.9	106.4	102.5	102.5	101.9	100.8	98.9	96.2
	3	98.8	101.6	103.6	104.9	106.1	106.8	106.9	106.9	106.4	103.0	101.7	99.9	96.6	95.2	92.8
South	2	98.2	100.9	102.8	104.1	105.3	105.9	106.1	106.1	105.7	102.5	101.2	99.4	96.1	94.7	92.4
↓	1	96.7	99.2	101.1	102.3	103.5	104.1	104.2	104.3	103.9	100.8	99.6	97.9	94.5	93.2	91.1
		W2			W4			C2			E2			E3		

Change in levels from scenario WIDER

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.7	-0.6	-0.5	-0.5	-0.4	-0.3	-0.3
	5	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.7	-0.7	-0.6	-0.5	-0.5	-0.4	-0.3
	4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.6	0.8	-0.8	-0.8	-0.7	-0.5	-0.4	-0.4
	3	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.6	0.8	3.0	2.2	1.5	-0.8	-0.7	-0.6
South	2	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.6	0.9	3.0	2.3	1.6	-0.9	-0.7	-0.6
↓	1	0.4	0.4	0.5	0.4	0.5	0.6	0.5	0.7	0.9	3.0	2.3	1.7	-0.9	-0.7	-0.6
		W2			W4			C2			E2			E3		

Diagram C15: Scenario "EASTOPEN": Nominal wage changes

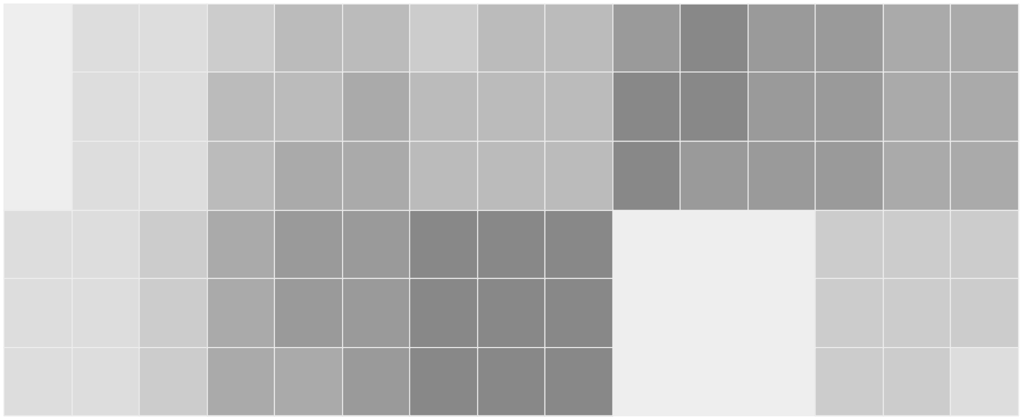
Relative change from scenario WEST

Dark areas = increase, brightest areas = reduction

Key words about outcome:

Strong nominal wage reduction in E2

Modest wage increase in all other countries and regions



Simulation results — wage gap model

Table C15: Nominal wages – scenario EASTOPEN

Results from numerical model simulations

Levels (percentage deviation from average). NB: Levels with unilaterally higher barriers!

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-2.0	-0.9	-0.2	0.1	0.5	0.6	-1.0	-0.9	-1.0	0.1	0.1	-0.2	-0.8	-1.6	-2.7
	5	-1.3	-0.2	0.6	0.9	1.3	1.4	-0.3	-0.1	-0.3	0.8	0.8	0.5	-0.1	-1.0	-2.2
	4	-1.0	0.1	0.9	1.3	1.6	1.7	0.0	0.1	0.0	1.1	1.0	0.7	0.1	-0.8	-2.0
	3	-1.0	0.1	0.9	1.2	1.6	1.6	-0.2	-0.1	-0.2	3.7	3.6	3.0	-1.4	-2.2	-3.3
South	2	-1.3	-0.2	0.5	0.9	1.2	1.3	-0.5	-0.3	-0.4	3.6	3.5	3.0	-1.6	-2.4	-3.4
↓	1	-2.0	-0.9	-0.2	0.1	0.4	0.5	-1.2	-1.0	-1.2	2.9	2.8	2.3	-2.3	-3.0	-4.0
		W2			W4			C2			E2			E3		

Change in levels from high barriers in E2 to scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.4
	5	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
	4	0.2	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.4
	3	0.2	0.3	0.3	0.5	0.5	0.5	0.6	0.6	0.5	-3.5	-3.6	-3.6	0.3	0.3	0.3
South	2	0.2	0.3	0.3	0.5	0.5	0.5	0.6	0.6	0.5	-3.6	-3.8	-3.8	0.3	0.3	0.3
↓	1	0.2	0.3	0.3	0.5	0.5	0.5	0.6	0.5	0.5	-3.7	-3.8	-3.8	0.3	0.3	0.3
		W2			W4			C2			E2			E3		

Diagram C16: Scenario "EASTOPEN": Welfare (real wage) changes

Unilateral liberalisation in E2

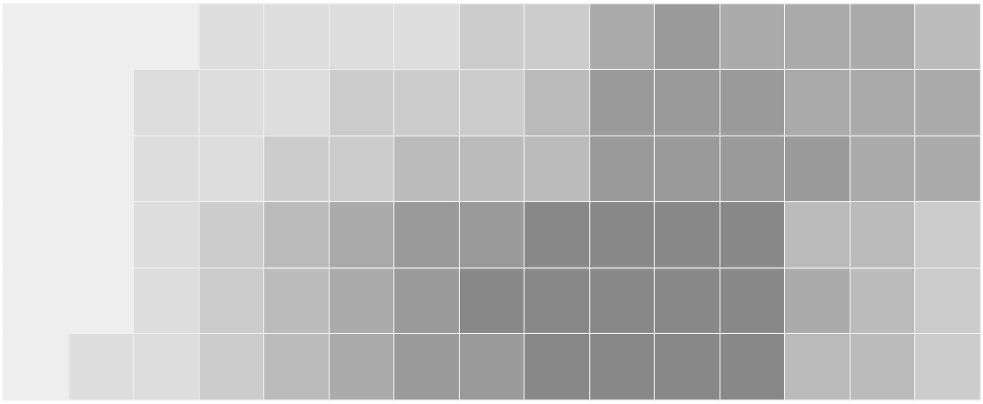
Relative change from high barriers in E2 to scenario WEST

Darker areas = larger increase

Keywords about outcome:

Strong welfare gain in E2 in spite of nominal wage reduction

Modest welfare gain in all other countries and regions, declining with distance



Simulation results – wage gap model

Table C16: Welfare (real wages) – scenario EASTOPEN

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	95.6	97.9	99.6	100.6	101.5	101.8	98.5	98.8	98.5	101.2	101.1	100.4	99.2	97.3	94.7
	5	97.1	99.6	101.3	102.4	103.3	103.5	100.1	100.4	100.1	102.8	102.7	102.0	100.7	98.7	96.0
	4	97.7	100.3	102.1	103.2	104.1	104.3	100.7	101.0	100.7	103.3	103.2	102.4	101.1	99.1	96.4
	3	97.6	100.3	102.1	103.1	104.0	104.3	100.6	100.9	100.6	94.2	93.9	92.8	97.5	95.8	93.4
South	2	97.0	99.6	101.3	102.3	103.2	103.5	99.9	100.3	100.0	93.9	93.7	92.6	97.0	95.4	93.1
↓	1	95.5	97.9	99.6	100.5	101.4	101.7	98.3	98.6	98.3	92.6	92.3	91.3	95.5	94.0	91.8
		W2			W4			C2			E2			E3		

Change in levels from high barriers in E2 to scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3
	5	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.4	0.4	0.4
	4	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4
	3	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.5	6.6	6.3	6.2	0.4	0.3	0.3
South	2	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.5	6.3	5.9	5.8	0.4	0.3	0.3
↓	1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.5	6.0	5.7	5.6	0.4	0.3	0.3
		W2			W4			C2			E2			E3		

Diagram C17: Scenario "CAPITAL": Nominal wage changes

Relative change from scenario WEST

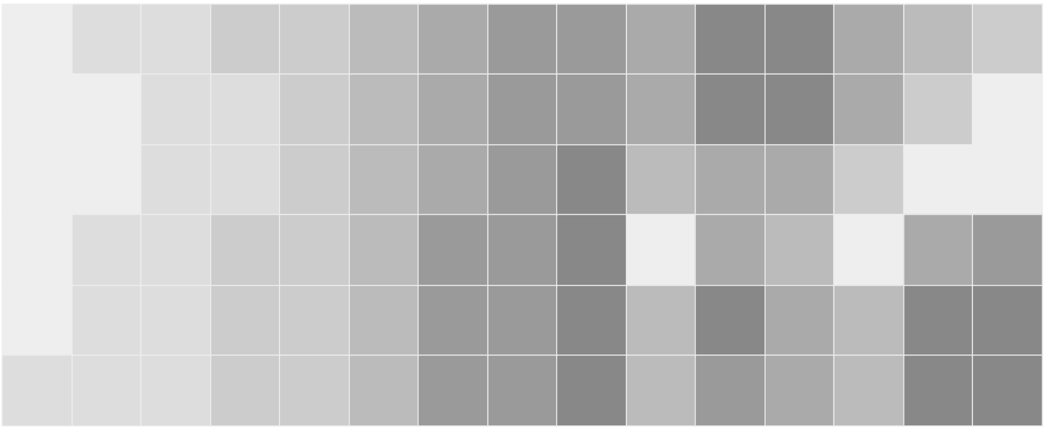
Dark areas = increase, bright areas = decline

Keywords about outcome:

Increase for the eastern capital regions

Uneven for eastern peripheries, increase for north west E1 and east E3

Some increase for Central Europe, some reduction for Western Europe



Simulation results — wage gap model

Table C17: Nominal wages – scenario CAPITAL

Results from numerical model simulations

Levels (percentage deviation from average).

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-2.3	-1.2	-0.4	0.1	0.6	0.8	-0.3	0.0	-0.1	1.0	1.4	0.9	-0.1	-1.3	-2.6
	5	-1.6	-0.5	0.4	0.9	1.4	1.6	0.5	0.7	0.6	1.7	2.7	1.7	0.5	-0.8	-2.3
	4	-1.4	-0.2	0.7	1.3	1.7	1.9	0.8	1.0	0.9	1.5	1.9	1.4	0.3	-0.9	-2.3
	3	-1.4	-0.2	0.7	1.3	1.8	2.0	0.8	1.0	0.9	-0.4	-0.1	-0.8	-1.7	-1.7	-2.5
South	2	-1.6	-0.4	0.4	1.0	1.4	1.6	0.5	0.8	0.7	-0.2	0.7	-0.5	-1.4	-0.9	-2.3
↓	1	-2.3	-1.2	-0.4	0.2	0.7	0.9	-0.2	0.0	-0.1	-0.9	-0.6	-1.2	-2.1	-2.1	-2.9
		W2			W4			C2			E2			E3		

Change in levels from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-0.6	-0.5	-0.5	-0.4	-0.3	-0.2	0.4	0.4	0.5	0.4	0.8	0.7	0.2	-0.1	-0.3
	5	-0.6	-0.6	-0.5	-0.4	-0.3	-0.2	0.4	0.4	0.5	0.4	1.4	0.7	0.1	-0.4	-0.6
	4	-0.6	-0.6	-0.5	-0.4	-0.3	-0.2	0.4	0.5	0.5	-0.1	0.4	0.2	-0.2	-0.6	-0.7
	3	-0.6	-0.5	-0.5	-0.4	-0.3	-0.2	0.4	0.5	0.6	-0.6	-0.1	-0.2	-0.6	0.2	0.4
South	2	-0.6	-0.5	-0.5	-0.4	-0.3	-0.2	0.4	0.5	0.6	-0.1	0.9	0.4	-0.1	1.1	0.9
↓	1	-0.5	-0.5	-0.4	-0.3	-0.2	-0.1	0.4	0.5	0.6	-0.1	0.4	0.4	-0.1	0.6	0.8
		W2			W4			C2			E2			E3		

Diagram C18: Scenario "CAPITAL": Welfare changes

Relative change from scenario WEST

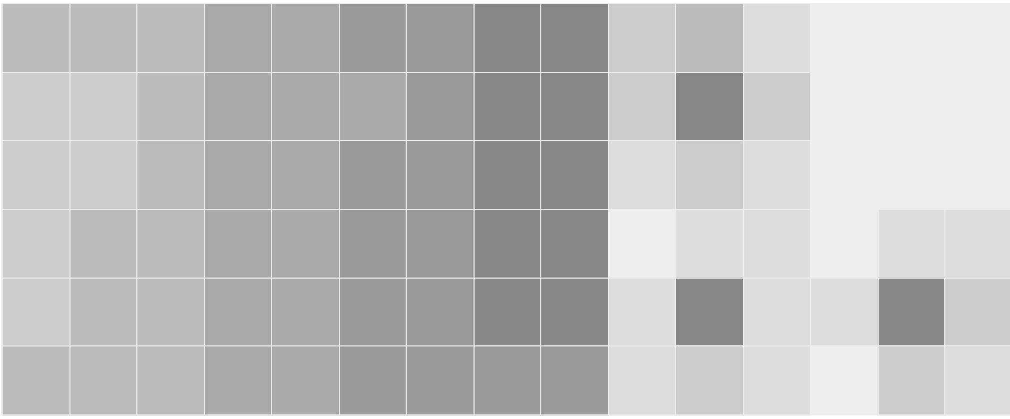
Dark areas = increase, bright areas = decline

Keywords about outcome:

Gain for the capital hubs, loss for eastern peripheries

Big loss for Eastern E1

Slight gain for Central Europe, loss for Western Europe



Simulation results — wage gap model

Table C18: Welfare (real wages) – scenario CAPITAL

Results from numerical model simulations

Levels (index using average from scenario WEST = 100)

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	95.1	97.5	99.2	100.3	101.3	101.7	98.8	99.1	98.9	100.5	101.0	99.5	96.9	93.9	90.6
	5	96.6	99.1	100.9	102.1	103.1	103.5	100.4	100.8	100.5	102.5	104.3	101.4	98.4	95.1	91.6
	4	97.2	99.8	101.7	102.9	103.9	104.3	101.0	101.4	101.2	102.1	102.6	101.0	98.3	95.2	91.7
	3	97.2	99.8	101.7	102.9	103.9	104.3	101.0	101.4	101.2	98.4	98.6	96.8	95.1	94.5	91.9
South	2	96.6	99.2	101.0	102.2	103.2	103.5	100.4	100.8	100.6	98.6	100.1	97.1	95.5	96.0	92.4
↓	1	95.1	97.5	99.2	100.4	101.4	101.7	98.8	99.2	98.9	96.7	96.9	95.3	93.8	93.2	90.9
		W2			W4			C2			E2			E3		

Change in levels from from scenario WEST

		← West														East →
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		W1			W3			C1			E1					
↑ North	6	-0.5	-0.5	-0.5	-0.5	-0.4	-0.4	0.0	0.0	0.1	-1.2	-0.5	-1.3	-2.7	-3.8	-4.5
	5	-0.6	-0.6	-0.5	-0.5	-0.5	-0.4	0.0	0.1	0.1	-0.8	1.1	-1.0	-2.8	-4.0	-4.8
	4	-0.6	-0.6	-0.5	-0.5	-0.5	-0.4	0.0	0.0	0.1	-1.7	-1.0	-1.9	-3.2	-4.3	-5.0
	3	-0.6	-0.6	-0.5	-0.5	-0.4	-0.4	0.0	0.1	0.1	-2.4	-1.6	-2.1	-2.7	-1.7	-1.8
South	2	-0.5	-0.5	-0.5	-0.5	-0.4	-0.4	0.0	0.0	0.1	-1.6	0.4	-1.3	-1.8	0.2	-1.0
↓	1	-0.5	-0.5	-0.5	-0.4	-0.4	-0.4	0.0	0.0	0.0	-1.9	-1.1	-1.6	-2.1	-1.1	-1.2
		W2			W4			C2			E2			E3		