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Conference Paper

Technological progress and regional disparities in (un)employment

54th Congress of the European Regional Science Association: "Regional development & globalisation: Best practices", 26-29 August 2014, St. Petersburg, Russia

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Blien, Uwe; Ludewig, Oliver (2014) : Technological progress and regional disparities in (un)employment, 54th Congress of the European Regional Science Association: "Regional development & globalisation: Best practices", 26-29 August 2014, St. Petersburg, Russia, European Regional Science Association (ERSA), Louvain-la-Neuve

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Uwe Blien, Oliver Ludewig:
**Technological progress and regional disparities in
(un)employment**

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Draft of a paper, Nuernberg, 30 Jan 2014

Abstract

One of the key issues in economics is the explanation of unemployment and its variation across different economies. Doing so, modern mainstream macroeconomics refers to the effects of financial crises and to institutional structures and their variation across countries. However, unemployment *within* the European states varies nearly as much as between these countries. In the interior of a country, however, there are only minor differences in institutions. Therefore, the large variation in regional unemployment and in the development of employment is puzzling.

Our explanation of this regional variation of unemployment builds on the regional industry composition and technological progress. It is shown formally that under very general and standard preconditions the elasticity of demand on product markets is decisive: Technological progress leads to an expansion of employment if product demand is elastic. It is accompanied, however, by shrinkage of employment if product demand is inelastic. A transition from the elastic into the inelastic range of the demand function for the most important product(s) can already suffice to plunge a region into crisis.

In our empirical analysis we use industry level time series data on output, prices, employment and national income for Germany provided by the Federal Statistical Office and the OECD. We estimate Marshallian type demand functions using an instrumental variables estimator to derive the price elasticities for different industries and link this information to the regional labour market performance of the respective industries and regions.

Keywords: Structural change; Productivity growth; Labour market dynamics

Q33, R11, J23

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1. Introduction

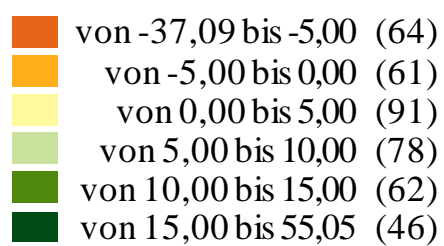
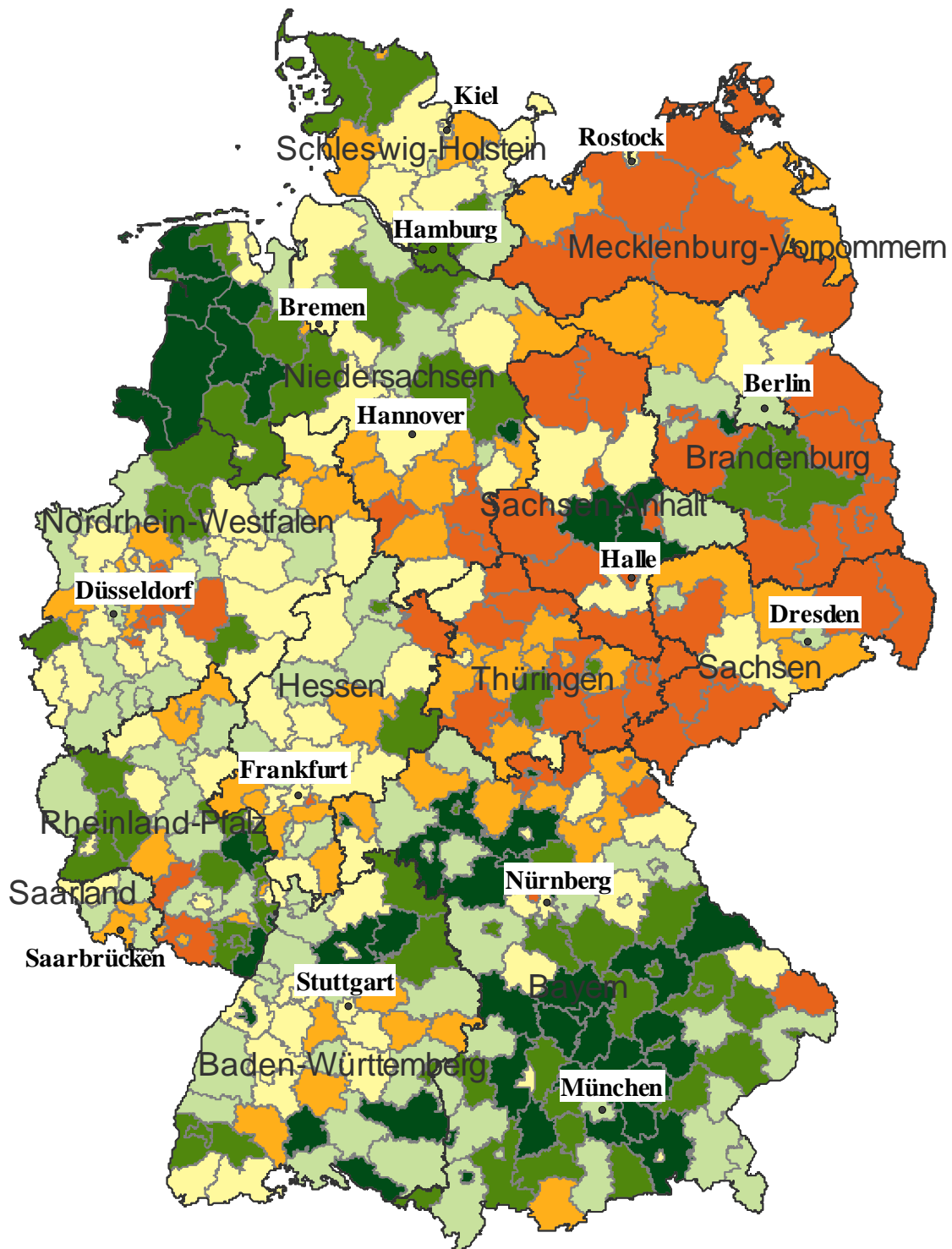
One of the key problems in economics is explaining the level of unemployment. In this paper we contribute a new explanation by looking at the interaction of technological progress and of demand conditions on product markets. Under the condition of technological progress less labour is needed to produce the same amount of products. This points to the possibility of “technological unemployment” (Layard, Nickell 1985). However, since technological progress may also lead to a decrease in price, there is a counteracting force which depends on the demand conditions of product markets. In the following we explore the strengths of the two forces theoretically and on the basis of very reliable data also empirically.

The explanation proposed can be contrasted with those of standard approaches of economics normally used to explain unemployment. Some of these concentrate on the effects of the last crisis in financial markets and show the transmission processes to the labour market (see Blanchard 2008, Krugman 2012 for a popular version). Another explanation provided by “modern mainstream macroeconomics” refers to the nature of institutional structures and their variation across countries. From theoretical models it is derived that countries with more flexible labour markets have relatively low unemployment rates. One prominent “mainstream” explanation of unemployment is the so-called European Labour Market Model of Layard, Nickell & Jackman (2005, cf. Carlin & Soskice 2006 for an integration with traditional macroeconomics). There, unemployment results from the competing claims of groups of economic subjects. The claims of workers and firm owners on the social product are kept in balance by unemployment. In order to increase employment, economic policy therefore has to create institutions which restrain these demands.

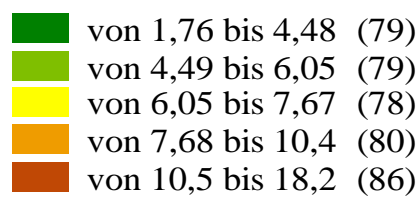
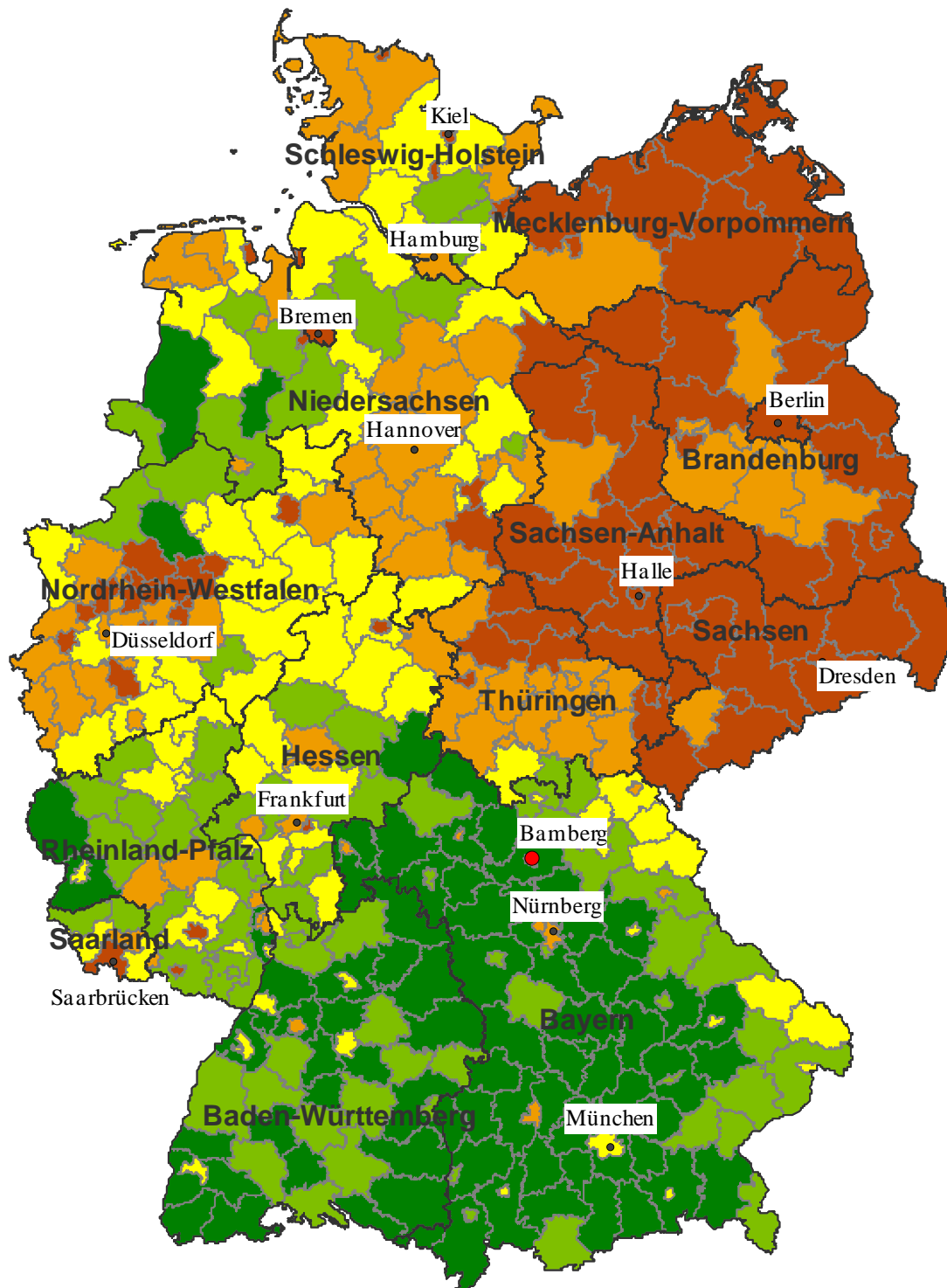
In a review written on the occasion of the new edition of the book by Layard et al., Blanchard (2007) emphasises that the theory contained in the book has been empirically confirmed (also Layard, Nickell & Jackman 2005, introduction). Nonetheless, since the end of the 1990s there has been increasing criticism on the mainstream approaches. For example, some authors state that the empirical basis has been proven to be ambivalent (e.g. Howell et al. 2007).

One major problem of the European Labour Market Model and other macroeconomic approaches (see the Labour Market Matching Model by Mortensen and Pissarides 2011) is their inability to explain the variation of unemployment and of the development of employment within countries. After all, unemployment *within* a nation shows about the same level of variation as it does between countries (Südekum 2005). In Europe only very few countries which were hit especially hard by the Financial Crisis stick out in recent years (Greece and Spain) and are an exception of this rule.

Map 1: Development of employment in Germany 2001 - 2012



Map 2: Unemployment rate March 2013



If, however, within countries only minor differences in the institutions and the relevant macro-economic factors can be found, the huge variation in regional unemployment constitutes a problem for economic mainstream. This is for example true concerning the difference between East and West Germany with unemployment rates of 7.0 and 12.6 % (March 2013). It is also true for regional disparities within these two parts of the country. In Western Germany there are areas with huge differences in employment development (Map1): As a consequence, there is (nearly) full employment like in the region around Munich. As a contrast there are areas with persistent labour market crises like the Ruhr area (see Map 2). These regional disparities can mainly be attributed to different development paths of employment. They are neglected by most theories of (un)employment.

Our own explanation of employment and unemployment development builds on the regional industry composition and technical progress. We do not rely on any technological determinism, but look at the economic conditions shaping the effects of technological change. From this view the most important condition of the effects of technical progress concerns the elasticity of demand on product markets. The price elasticity of demand transmits the effects of technical progress (or productivity increases – we use the terms as synonyms and in a rather broad sense) on employment. To see this we distinguish between two effects of productivity increases.

As the same product can be produced using less labour, technical progress first leads to a drop in the demand for labour for a given quantity. This is the *displacement effect* of technical progress. In addition, however, the reduction in costs as a result of technical progress also leads to a drop in price. This in turn increases demand for the particular product and therefore also demand for workers who are employed in production. Therefore, a *compensation effect* occurs. This effect is the stronger the more price elastic demand is, as can be seen from a simple formal model we present in this paper. If demand is elastic the compensation effect dominates, if is inelastic the displacement effect prevails. This relation between technological progress, demand conditions and employment we call “*the basic theorem of technological change*”.

Recently, there has been a boom of research on the effects of technological progress on employment often influenced by an important paper of Autor, Levy and Murnane (2003). However, this research treats the employment level as given and concentrates on its skill composition (see Autor 2013 for an overview).

In the following we first present the theoretical background on the effects of technological change. Then, in the next part of the paper, we develop a simple theoretical model. Furthermore, we present the design of the empirical research and the results obtained. Finally we conclude.

2. Background

With technological progress many fears and hopes are associated. The idea of a “technological unemployment” comes up because of fears that workers are substituted by machines. Brynjolfsson and McAfee (2011) quote Keynes in this respect and describe a “Race Against The Machine” (booktitle). They see an acceleration of innovation processes and an increasing probability that computers will win the race before workers. Like Autor et al. (2003) they refer to different skill groups of workers but look at the global effect on the labour force too. They describe the currently high levels of unemployment as generated by technological progress: Workers are substituted by machines, which are being innovated at accelerating speed. An objection against this view is that new technologies are introduced due to the calculations of the firms involved. Then, the effect of employment also depends on these calculations. If product demand increases enough no unemployment occurs. The absolute speed of innovations is not decisive. It can be observed that fields with short cycles of innovation, e. g. microelectronics, are not affected by employment problems.

To have an intuition how the balance between labour saving and compensation effect works it is instructive to look at a small but ingeniously constructed macro-model developed by Appelbaum and Schettkat (e. g. 1999, see also Möller 2001). They show that the limiting value for the labour market effect is the direct demand elasticity of one. Employment increases with productivity gains if product demand is elastic and it falls if product demand is inelastic. The model can be used to discuss several important issues, though it has not the levels of micro-foundation and generality that we intend to reach later. It begins with a definition equation for the productivity of labour π in a firm j in which the production quantity Q is related to the level of employment N .

$$\pi_j = \frac{Q_j}{N_j} \quad (1)$$

$$P_j = \frac{z_j W_j}{\pi_j} \quad (2)$$

$$Q_j = f(P_j, y), \quad \text{with} \quad dQ_j/dP_j < 0, \quad dQ_j/dy > 0 \quad (3)$$

The second equation is a price-setting function based on mark-up calculation. The price is P_j , z is the mark-up factor, which also includes expenditures for capital and W_j is the wage rate. Finally, the third equation is a demand function, which falls with the price and rises with the national income y . These equations on levels can be transformed to expressions of growth rates:

$$\hat{N}_j = \hat{Q}_j - \hat{\pi}_j \quad (1)'$$

$$\hat{P}_j = \hat{z}_j + \hat{W}_j - \hat{\pi}_j \quad (2)'$$

$$\hat{Q}_j = \eta \cdot \hat{y} - \varepsilon_j \cdot \hat{P}_j \quad (3)'$$

If $\hat{z} = 0$ from (1)' to (3)' the following expression for a firm's employment development is derived:

$$\hat{N}_j = \eta_j \hat{y} + (\varepsilon_j - 1) \hat{\pi}_j - \varepsilon_j \hat{W}_j \quad (4)$$

In (4) an expression is obtained that includes two elasticities, the income elasticity of demand η_j and the price elasticity ε_j . It is easy to see that the stated properties concerning employment, technological progress and demand elasticity are implied with (4). However, the focus on single firms in the equation is for many purposes not very instructive, since it is not clear, "whether the output and job gains of innovating firms are achieved at the expense of competitors, or whether there is a net effect on aggregate industry employment" (Pianta 2006). The elasticity of demand is different if measured at the level of single firms or at the level of an industry. For the individual firm that is neither a monopolist nor an oligopolist, the behaviour of other firms appears to be given. If the firm lowers its price, demand for its products may increase very strongly because other firms, which maintain their prices, are displaced. If all the firms lower their price, however, the quantity sold may change only slightly. Therefore, elasticities at the firm and at the industry level differ and an interesting conceptual multi-level problem has to be taken into account.

To focus on whole markets it is necessary to aggregate all firms of an industry in the basic equations. We assume at the moment that the relevant units are regions, though the model construction is the same for national economies. By aggregating all firms j of a particular industry i in a region r it is assumed that these firms are identical:

$$\hat{N}_{ir} = \eta_i \hat{y}_{ir} + (\varepsilon_i - 1) \hat{\pi}_{ir} - \varepsilon_i \hat{W}_{ir} \quad (5)$$

The model describes productivity gains as Hicks-neutral technical progress, which is defined in such a way that the input ratio of the production factors remains constant. This assumption ensures that shifts in labour demand are not stemming directly from the technological progress itself in a trivial way but that they are the consequence of the market mechanism. Additionally, the assumption simplifies the model structure. The term technological progress is used here and in the following in a wide sense, which includes any outward movement of the production function. For example changes in the organisational practices of a firm, which increase productivity, are included in this definition of technological progress.

As a consequence of technological progress, workers are displaced when product demand is inelastic (i. e. $\varepsilon_{ir} < 1$). When demand is elastic ($\varepsilon_{ir} > 1$) on the other hand, employment increases. This can be seen directly from (5). Therefore the basic theorem of the employment effects of increases in productivity can be derived from this simple model. The water line is the elasticity of unity ($\varepsilon_{ir} = 1$).

There is no reason for optimism like it is nourished by many basic approaches of economics. In modern articles using the Dixit/Stiglitz (1977) model of monopolistic competition, firms always choose a price level located in the elastic part of the product demand curve. Therefore, no problem with employment arises, even if the above mentioned theorem is true. However, the Dixit/Stiglitz model requires rather specialised conditions of the econ-

omy. If they are not met, the model does not hold. Taking a broader view on the topic, it is important to note that in cases in which firms do not have a monopolistic position in the market, elastic demand is not secured. We will show later empirically that this is in fact relevant in a subset of markets.

In (5) income elasticity is also important. When it is high, the demand for a product can increase even under conditions of prices rising secularly. Thus, within the model positive employment effects on industry level can stem from both, high price elasticity and high income elasticity. Furthermore, the model can be used to examine the effect of wage increases. According to (5), in the realistic range of values for the demand elasticity (i. e. for $\varepsilon_{ir} > 0$), wage rises lead to decreasing employment. The effect is stronger the more elastic demand is, as we also know from the Marshall-Hicks-rules. These “rules” of labour demand also establish a link between employment and the price elasticity of demand. However, this link is related to the wage effects on labour demand and not to technical progress.

Neisser (1942: 53) apparently was the first arguing that the elasticity of aggregate demand plays an important role for the balance between displacement and compensating effects. He presented no model, only an argument which is based on an analogy between product and labour markets: If the demand elasticity on the product market is below one then the turnover of the product shrinks and it is assumed that in parallel less work is required in this specific industry.

Neisser’s ideas about technological unemployment were hardly noticed within economics. Appelbaum and Schettkat were the first who came up with a model based formulation. It was, however, a simple macro-model without complete micro-foundation. Next, in their seminal paper about “The dynamics of local employment in France”, Combes, Magnac and Robin (2004) developed a small model starting from the behaviour of individual agents. In this model the compensating effect dominates if the demand elasticity is greater than unity. This model was the foundation of their empirical analyses which became influential in research on local labour markets.

At about the same time in an empirical paper by Cingano and Schivardi (2004) a version of the basic theorem was included. By quoting the result of Combes et al. they derived the theorem en passant in a simple model structure with only one production factor. The authors were interested in the analysis of agglomeration effects on productivity and employment. They argued that agglomeration forces might push these target variables in opposite directions. In the case of inelastic product demand agglomeration effects might increase productivity but decrease employment. Of course there is the possibility that both effects coincide in the case of an industry with elastic demand. In an economy with a mixed industry structure the net employment effect depends on its composition with respect to industries. With regional economies, the net effect depends on the specialization of regions. Cingano and Schivardi presented empirical evidence supporting differing agglomeration effects on productivity and employment.

On the relation between technological progress, demand elasticity and employment a generalized theoretical model is developed by Blien and Sanner (2014). They start from individual behaviour, use homothetic production functions and introduce a large number of

products which could be complements or substitutes. Only the quoted sources are known about the basic theorem on technological progress. In the survey of Pianta (2006: 579) the importance of the price elasticity of demand is mentioned, albeit without knowing the watershed between labour-saving and compensating effects, the elasticity of unity. However, it may be that due to the influential paper by Combes et al. the role of the demand elasticity is registered more and more in the economics profession. It is mentioned by Partridge et al. (2013) with a hint to this paper.

However, the general discussion about the effects of technological progress on employment is much older. The labour displacement effect is obvious and was discussed in Ricardo's (1817) opus magnum and of course also in Marx's writing. Several mechanisms concerning a compensating effect have been discussed extensively. The most important one concerns general equilibrium processes, which are treated under the heading of Say's law or in other terminology: The disequilibrium in the labour market generated by labour displacement is counteracted by a wage reaction strong enough to restore a balanced labour market. Other price reactions point in the same direction.

Neisser (1942) discusses several variants of a compensation effect which are taken up later in the literature. One basic idea is that a reduction of demand measured in terms of money due to a price decrease will generate demand for other products. This is a variant of Say's law. It is not necessary here to discuss at length whether this is sufficient to secure full employment. At least it can be stated that if there is a shift of labour demand between industries and, if there is an uneven distribution of industries, also between regions. If migration between sectors and regions takes time and efforts, regional unemployment is generated. We will address this point again later.

However, the specialization of regions is an interesting condition for the explanation of unemployment. For Krugman (1991: 5) the most striking characteristic of the geography of economic activity is its concentration. Localisation effects lead to the specialisation of regions in a few "preferred" industries. Although this concentration of particular industries in specific regions has declined somewhat in time (cf. for the USA: Krugman 1991: 75ff.; for western Germany: Möller, Tassinopoulos 2000), its extent remains astonishingly. Regions typically specialise in a subset of industries and products. Thus, industry compositions of regions are varying substantially. Consequently some regions have a higher share of high elasticity industries, whereas in other regions industries with low elasticities are dominating. Depending on these differences in the industry composition regional employment will develop differently as the consequence of technical progress. The higher the share of industries with elastic demand, the better is the regional labour market performance.

In the research on specialization often three different effects are mentioned, which were christened the three Marshallian forces, following the major work of Alfred Marshall (1920). These are labour market pooling, forward-backward linkages and knowledge spillovers. There is a variety of theoretical models and a number of empirical papers (Kerr, Kominers 2010, Dauth 2010) showing the effectiveness of these forces. Krugman (1991: 123ff.) derives a theoretical model on labour market pooling as a driving force of regional concentration and specialisation. His fundamental assumption is that the business cycles for different firms do not develop entirely synchronously. Firms are hit by idiosyn-

cratic shocks. It is therefore advantageous for firms and workers to form a joint pool of labour. Firms will settle in places where there are already firms from the same industry in order to be able to hire workers when their own demand is high and that of the other firms is low. Such behaviour reduces unemployment or, in the case of flexible wages, ensures a steady wage development. Krugman's model shows that the advantage associated with this can carry more weight than the deterioration of the competitive position that subsequently results for a firm.

Specialisations are important at national level, too. The developed economies produce clearly different national product mixtures as put forward in the varieties of capitalism approach (Hall, Soskice 2001; Paunescu, Schneider 2004). If, for example, the production of the German economy is compared with that of other developed countries, a disproportionately large specialisation can be seen in the area of manufacturing. In addition many high-quality goods are manufactured in relatively small series. In order to explain this specialisation of nations, usually the theory of comparative advantages or the New Trade Theory is used.

However, such a specialisation can also be explained by the German institutional structure generating a specific production system. Streeck (1991, 1997) and Sorge and Streeck (1988) described this system and named it diversified quality production. This production system requires among other things particularly highly skilled workers. In Germany the institutional pre-requisite for this is the so-called "dual system of vocational training". This system (with firms and schools as learning places) is geared mainly towards occupations in the manufacturing industry.

In general the "Varieties of Capitalism" literature suggests that institutional settings across a broad set of subsystems like the educational system, the financial system and the labour market are gearing economies towards specific industry compositions. For example coordinated market economies like Germany are expected to have their strengths in sophisticated but not too innovative manufacturing industries. Liberal market economies like the Anglo-Saxon countries are expected to be strong in new services and innovative high tech manufacturing (Hall, Soskice 2001).

3. The labour market model of structural change

In the last section we gave an outline of the Appelbaum-Schettkat model of technological progress. In order to obtain statements about unemployment a richer model is now developed which explicitly contains the labour market. The change in employment is modelled in the usual way as the development of labour demand. This is a main difference to the models developed by Combes et al. and by Blien and Sanner. It has the additional advantage that a wage reaction like the one described in the European Labour Market Model or in the wage curve research can also be included. Since technological progress leads to growth or shrinkage of employment in the respective industry, the model is called the "Labour market model of structural change".

3.1 Fixed wage

We begin with a case in which we treat the wage as fixed. As already mentioned a very broad view of technological progress is addressed, since all positive influences on a general “technology” parameter A in a production function Q are described as technological progress.

$$Q = AL^{1-\beta}K^\beta \quad \text{production function, with } 0 < \beta < 1, K \text{ fixed} \quad (6)$$

$$Q = Q(P) \quad \text{product demand} \quad (7)$$

Like Combes et al. we use a Cobb-Douglas type production function in (6). In addition we start out from the assumption of price-setting with perfect competition. With the function for product demand (7) we abstract at the moment from national income, but we will include it later. The equations are formulated for individual firms, but the subscript is dropped here. The cost function c (e.g. according to Varian 1992: 54f.) shows the minimal-cost factor combinations at given factor prices. For this it is necessary to determine in each case the quantity of a production factor that is necessary for a certain production level (L : labour, K : capital, A : technology factor, c : costs, W : wages; r : interest).

$$c(r, W, Q) = \min(rK + WL) \quad \text{s.t. : } Q = AK^\beta L^{1-\beta} \quad (8)$$

$$= \min \left(rK + WA^{\frac{1}{\beta-1}} K^{\frac{\beta}{\beta-1}} Q^{\frac{-1}{\beta-1}} \right)$$

$$\frac{\partial c}{\partial K} = r + \frac{\beta}{\beta-1} WA^{\frac{1}{\beta-1}} Q^{\frac{-1}{\beta-1}} K^{\frac{1}{\beta-1}} = 0$$

The demand function for capital with a given production quantity and given factor prices (conditional demand function) is then:

$$K(r, W, Q) = \left[\frac{\beta W}{(1-\beta)r} \right]^{1-\beta} A^{-1} Q \quad (9)$$

The corresponding demand function for labour takes the following form:

$$L(r, W, Q) = \left[\frac{(1-\beta)r}{\beta W} \right]^\beta A^{-1} Q \quad (10)$$

It then follows for the cost function with (maximum-profit) demand quantities inserted:

$$c(r, W, Q) = rK(r, W, Q) + WL(r, W, Q)$$

$$c = \beta^{-\beta} (1-\beta)^{\beta-1} W^{1-\beta} r^\beta A^{-1} Q \quad (11)$$

The price is equal to the marginal costs (with $\mu = \beta^{-\beta} (1-\beta)^{\beta-1}$):

$$P = \frac{\partial c(W, r, Q)}{\partial Q} = \frac{\partial(\beta^{-\beta} (1-\beta)^{\beta-1} W^{1-\beta} r^{\beta} A^{-1} Q)}{\partial Q} = \frac{\partial(\mu W^{1-\beta} r^{\beta} A^{-1} Q)}{\partial Q}$$

$$P = r^{\beta} W^{1-\beta} \mu A^{-1} \quad (12)$$

We derive via (12) the change in labour demand resulting from technological progress:

$$L = A^{-1} \left(\frac{\beta W}{(1-\beta)r} \right)^{-\beta} Q(P(A)) \quad \text{labour demand}$$

$$\frac{dL}{dA} = - \left(\frac{K^{\beta} L^{1-\beta}}{A} \left(\frac{\beta W}{(1-\beta)r} \right)^{-\beta} \right) \cdot \left(1 + \frac{P}{Q} \frac{dQ}{dP} \right) \quad (14)$$

Equation (14) yields directly the fundamental theorem on the employment effects of technological progress. The employment response to productivity increases is positive if the elasticity of demand is greater than 1. However, this is always fulfilled for individual firms under perfect competition ($\eta \gg 1$). If the firms of an industry are aggregated, however, the employment in an industry can be related to the overall demand for this aggregate. Then equation (14) applies for the entire industry. The aggregation is possible since the production function shows constant economies of scale.

3.2 Reaction of wages to unemployment

In the following we start out from the (extreme) simplification that the economy only produces one single good. This assumption allows establishing a connection with the labour market, because now the function for labour demand depicts the overall demand on a labour market. The aim of the following analysis is to construct a model that is similar to a certain degree to that of Layard et al. Since the formalization is standard, only some basic equations are given. Here we do not bother with the microfoundations of the model.

For reasons of simplification, in the following employment L is measured as a share of the active population, which is in turn standardised to 1 ($N = 1$). Unemployment results accordingly with $U = 1 - L$. In the spirit of the work by Layard, Nickell & Jackman (2005) and Carlin, Soskice (2006) for the national level and by Blanchflower, Oswald (1994, 2005, see Baltagi, Blien, Wolf 2009 for Germany) for the regional level, it is assumed that the wage responds inversely to regional or national unemployment (wage-setting curve or wage curve). In order to make the calculations easier it is assumed that the wage curve is not semi-logarithmic but linear. The following expression results:

$$W = \gamma' - \tau U \quad (15)$$

$$= \gamma' - \tau \frac{1-L}{1}$$

$$= \gamma' - \tau + \tau L$$

$$W = \gamma + \tau L \quad (16)$$

The rationale behind this formalisation is quite analogous to that of Layard et al. The wage (setting) curve can be derived concerning efficiency wage approaches and wage negotia-

tion models. The fact that a linear and not a log-linear formulation is adopted here does not constitute a limitation. Empirical studies on the regional wage curve do not clearly favour either of the two formulations over the other (Blien 2001). In the following the wage is endogenised, using (10) and (16):

$$L = A^{-1} \left(\frac{\beta(\gamma + \tau L)}{(1-\beta)r} \right)^{-\beta} Q \quad (17)$$

$$L = A^{-1} \beta^{-\beta} (\gamma + \tau L)^{-\beta} (1-\beta)^{\beta} r^{\beta} Q$$

Implicit function:

$$G = L(\gamma + \tau L)^{\beta} - A^{-1} \beta^{-\beta} (1-\beta)^{\beta} r^{\beta} Q = 0 \quad (18)$$

$$\frac{dL}{dA} = - \frac{\partial G / \partial A}{\partial G / \partial L} = - \frac{\left(\frac{K^{\beta} L^{1-\beta}}{A} \right) \left(\frac{\beta}{(1-\beta)r} \right)^{-\beta} \left(1 + \frac{PdQ}{QdP} \right)}{(\gamma + \tau L)^{\beta} + \beta L (\gamma + \tau L)^{\beta-1} \tau - \frac{\partial Q}{\partial P} A^{-2} \left(\frac{(1-\beta)r}{\beta} \right)^{\beta} r^{\beta} (1-\beta) (\gamma + \tau L)^{-\beta} \tau \mu} \quad (19)$$

Difference between (14) and (19):

$$= \frac{(\gamma + \tau L)^{\beta}}{(\gamma + \tau L)^{\beta} + \beta L \tau (\gamma + \tau L)^{\beta-1} - \frac{\partial Q}{\partial P} A^{-2} r^{\beta} \tau \mu \left(\frac{(1-\beta)r}{\beta} \right)^{\beta} \frac{(1-\beta)}{(\gamma + \tau L)^{\beta}}} = S \quad (20)$$

with $0 < S < 1$ if $\frac{\partial Q}{\partial P} < 0$

Thus, the effect of increases in productivity is weaker in the case of endogenous wages. However, the turning point of the development, i. e. the elasticity of one, remains the same. Thus the previous finding, that employment on industry level depends on the price elasticity of demand and that consequently the regional development of employment is depending on the industry composition is still holding.

In the model of Combes et al. (2004) the labour market is also included, but in a different way. In their case the supply elasticity of labour is regarded. If this elasticity is infinite, the effect of productivity changes is like the one in the model without labour market. If the supply elasticity of labour is smaller the productivity effect is dampened as in our model.

Finally, we could also include the income level of the relevant market areas for which the products are addressed. This income level influences total demand of the respective product. Therefore (17) could be written with respect to the social product Y :

$$L = A^{-1} \beta^{-\beta} (\gamma + \tau L)^{-\beta} (1-\beta)^{\beta} r^{\beta} Q(Y) \quad (21)$$

The consequence of this extension is that the social product has the effect of an additional shift parameter in the equation for labour demand. The social product influences product demand and thereby also labour demand.

4. Empirical Analysis

Our model links the price elasticity and the income elasticity directly to labour market outcomes. In order to establish this link empirically we have to derive in a first step these elasticities from industry level data. In a second step we use the elasticities to explain the performance of different labour markets like regional or industrial labour markets.

4.1. Empirical strategy

4.1.1. Identifying elasticities

Despite the theoretical simplicity of the price elasticities of demand its empirical identification faces some challenges (Möller 2001). For example, estimating a classical Marschallian demand function for a specific good would require the inclusion of a vector of the prices of all other goods or at least of all other industries. This is, however, hardly feasible because of the limited numbers of observation available.

Following Möller (2001) we assume that products of each industry are substituted against a composite good, which is representing the product mixture of all other goods. Additionally we assume that the respective industries are small compared to the total economy yielding the following Marshallian type demand function:

$$q_{it} = \beta_{oi} + \beta_{1i}(p_{it} - p_t) + \beta_{2i}y_t + u_{it} \quad (22)$$

where q_{it} is the industry real output, y_t is the real national income, p_{it} is the industry price level and p_t the national price level. All variables are in logarithms, thus $p_{it}-p_t$ is giving the price of industry i relative to the general price level p_t . Estimates for β_{1i} provide the price elasticities on industry level and those for β_{2i} give the income elasticities (η). This specification implies also that domestic and foreign consumers are identical and that the income elasticity concept is also applying to intermediate goods.

As in our theoretical model we define the price elasticity ε positively and multiply β_{1i} with -1. Thus ε should be negative with inelastic demand between 0 and 1. Demand is price elastic if $1 \leq \varepsilon$ holds. Industries with $\eta > 1$ face income elastic demand. They are producing superior goods; those with $0 \leq \eta \leq 1$ are selling relative inferior products and those with $\eta < 0$ offer absolute inferior ones. In our first step we estimate equation 22 and get estimates for the price and income elasticities. These are then entered into our second step which establishes the link between elasticities and labour market development.

4.1.2. Elasticities and employment

Our model states that the employment response to productivity increases is positive (negative) if demand is price elastic (inelastic). Lacking appropriate productivity measures we assume that there are productivity increases in each industry without quantifying them. Thus we expect that industries with $1 \leq \varepsilon$ have better labour market performance than those with $1 > \varepsilon$. The bigger the share of industries with elastic demand in any administrative unit (e.g. county, national state) the better will be the labour market performance of the respective unit. Thus we have two different units of analysis: industries and some geographical defined administrative unit. We use German NUTS-III Regions (Kreise) as administrative unit. This gives us three different levels of analysis, industries, industries within different regions and regions. We define labour market performance as the change in employment within a specific period of time.

We begin with a descriptive analysis. That is, we compare the mean of relative employment change in price elastic industries and in inelastic industries. Then we proceed with regression analysis. We regress the development of employment on the two elasticities, which were derived in the first step:

$$\Delta L_i = \alpha_0 + \alpha_1 \varepsilon_i + \alpha_2 \eta_{2i} + \alpha_3 X_i + v_i \quad (23a)$$

In our second approach we estimate the same regression function for industry in each region.

$$\Delta L_{i,r} = \alpha_0 + \alpha_1 \varepsilon_i + \alpha_2 \eta_i + \alpha_4 X_{i,r} + \alpha_5 X_r + v_i + \varphi_r + u_{i,r} \quad (23b)$$

Finally we aggregate the relevant information on regional level. We calculate the average elasticities for each region by weighting the industry specific elasticities with the employment share of the respective industries in the specific region. The sum of these weighted elasticities in a region gives the employment weighted average regional price and income elasticity.

$$\Delta L_r = \alpha_0 + \alpha_1 \hat{\varepsilon}_r + \alpha_2 \hat{\eta}_r + \alpha_5 X_r + \varepsilon_r \quad (23c)$$

For all approaches we expect from our model that the more price elastic demand is, the better the employment development will be. Thus we expect positive signs for α_1 and α_2 .

4.2. Data

One main source of data is the national account of Germany from the German Federal Statistical Office.¹ The national accounts provide information for gross value added on industry level (two digit) and the national GDP. The industry value added is given in nominal and real terms which allow calculating industry specific price indices. The federal statistical office is also providing the national consumer price index, which we take as an approximation of the national price level. All these variables are indexed with the base year 2000

¹ To be more precise it is the "Fachserie 18 Reihe 1.4".

(index value = 100). The national accounts also include the wage bill for each industry and the number of employed. We use this data to calculate the deflated wage per capita.

The data of the Federal Statistical Office is in principle available for a rather long time period. However, almost all economic data on Germany is suffering from the structural break caused by the unification. For this reason we skip data before 1994 resulting in a observation period ranging from 1994 to 2007.

Another data set is taken from the employment statistics of the German Federal Employment Agency.² It covers all employees who are subject to the social insurance system and it provides a rich set of information on these employees. Fulltime equivalents are calculated by weighting part-time employed by 0.5.

In contrast to the information of the Statistical Office the data of the employment agency is available on regional level but has no information on industry prices and industry production. Thus the data of the Statistical Office is used to estimate our first step and equation 23a. The data from the Employment agency is used to estimate equations 23b and 23c.

The data from the employment agency is only available from 1996 onwards, because of some problems with the industry classification. Thus, we are estimating the elasticities for a period a bit longer than we can calculate the employment change. Synchronizing both observation periods by cutting of the first years off the national account data would reduce the degrees of freedom of the elasticity estimation. This seems to us a price too high to pay. Additionally using different data sources and different observation periods can provide a first robustness check.

While our industry cycle argument is based on changing elasticities this is holding for long periods and is less relevant for the short periods we use for estimation. Thus we are not estimating time varying elasticities but constant ones. We are not capturing the industry life cycle by investigating the changing elasticities for each industry across time but by analyzing elasticities across 50 industries at various stages of the life cycle.

We calculate the percentage change in employment for the period from 1994 to 2006 for the industry level data from the Statistical Office. This serves as dependent variable in estimating equation 23a. The same is done for the period 1996 to 2007 for the industry employment in each region and the aggregated regional employment using the data of the Employment Agency.

Our model is based on market mechanisms. Thus we exclude state driven industries (Agriculture; Fishing; Mining and quarrying; Public administration and defence; Compulsory social security; Activities of households as employers of domestic staff) from the analysis.

² Beschäftigungsstatistik der Bundesagentur für Arbeit, February 2009

4.3. *Estimating elasticities*

We estimate the elasticities using equation 22. q_{it} is approximated by the real gross added value on industry level, the industry price level (p_{it}) is derived by dividing the real gross added value by the nominal gross added value. p_t is approximated by the consumer price index and y_t by the real GDP. Remember, all values are indexed with the base year 2000 (100) and logarithms are taken.

We estimate four different specifications. The first variation is, that we substitute p_t for p_{it} - p_t . Thus we are not solely looking at the relative prices but also at the absolute price levels in each industry. The two resulting specifications are then estimated using OLS and an instrumental variable estimator. We suspect that the prices might suffer from endogeneity. To account for this problem we instrument p_t and p_{it} - p_t with the lagged values of q_{it} , p_{it} and p_t . While we prefer the instrumental variable estimator of the original equation, we give also the results of the other three specifications in Table 1 in order to check the stability of results. In our view the table indicates a high stability of results (signs and magnitude) if the small number of observations is taken into account.

Additionally, we define a dummy that is one if the industry production level is price elastic. That is, if β_1 is not significantly different from 1 or significantly greater than 1. These dummies and the estimation results are then used in our second step to test whether price elastic industries have a better labour market performance or not.

Table 1: Estimated price elasticities of the four specifications

	OLS				IV			
	ρ_{it}		$\rho_{it}-\rho_t$		ρ_{it}		$\rho_{it}-\rho_t$	
	Elasticity	p-value	Elasticity	p-value	Elasticity	p-value	Elasticity	p-value
Manufacture of food products and beverages	0.711***	0.000	0.685***	0.001	0.456**	0.005	0.313	0.236
Manufacture of tobacco products	1.403**	0.003	1.284*	0.011	1.307**	0.002	1.110*	0.022
Manufacture of textiles	1.053	0.085	0.304	0.541	0.070	0.922	-0.543	0.253
Manufacture of wearing apparel; dressing and dyeing of fur	0.692	0.273	0.082	0.850	-0.729	0.479	-0.573	0.254
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.964	0.167	0.229	0.792	1.874*	0.023	0.624	0.629
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.530	0.342	-0.440	0.225	-1.001	0.190	-0.527	0.146
Manufacture of pulp, paper and paper products	0.807***	0.000	0.711***	0.000	0.645***	0.000	0.541***	0.000
Publishing, printing and reproduction of recorded media	0.293	0.661	-0.345	0.543	0.757	0.284	-0.334	0.588
Manufacture of coke, refined petroleum products and nuclear fuel	1.014***	0.000	1.008***	0.000	-3.076	0.869	-4.454	0.870
Manufacture of chemicals and chemical products	1.440*	0.049	1.378**	0.001	3.503*	0.010	1.674***	0.000
Manufacture of rubber and plastic products	1.119**	0.002	1.002***	0.000	1.932**	0.001	1.210***	0.000
Manufacture of other non-metallic mineral products	-0.101	0.817	-0.175	0.568	-0.542	0.283	-0.339	0.250
Manufacture of basic metals	0.363***	0.000	0.397***	0.000	0.341***	0.000	0.382***	0.000
Manufacture of fabricated metal products, except machinery and equipment	1.769**	0.004	1.012	0.063	2.601*	0.025	0.529	0.497
Manufacture of machinery and equipments n.e.c.	0.718	0.142	1.903***	0.000	0.697	0.111	2.529***	0.000
Manufacture of office machinery and computers	0.932***	0.000	0.906***	0.000	0.955***	0.000	0.920***	0.000
Manufacture of electrical machinery and apparatus n.e.c.	4.067**	0.004	1.799	0.080	1.666	0.235	0.449	0.600
Manufacture of radio, television and communication equipment and apparatus	1.100***	0.000	1.060***	0.000	0.986***	0.000	0.946***	0.000
Manufacture of medical, precision and optical instruments, watches and clocks	0.972	0.343	3.010**	0.005	-0.168	0.837	1.942*	0.028
Manufacture of motor vehicles, trailers and semi-trailers	0.432	0.567	1.135	0.071	0.675	0.428	1.669*	0.012
Manufacture of other transport equipment	3.755*	0.011	3.038*	0.039	0.395	0.914	0.889	0.686
Manufacture of furniture; manufacturing n.e.c.	2.533***	0.000	2.495**	0.007	2.653***	0.000	2.787***	0.001
Recycling	0.949***	0.000	0.988***	0.000	0.994***	0.000	1.048***	0.000
Electricity, gas, steam and hot water supply	-0.138	0.564	-0.091	0.732	-0.383	0.113	-0.377	0.176
Collection, purification and distribution of water	0.002	0.995	-0.092	0.825	-0.759*	0.049	-0.966**	0.008
Construction	0.546	0.290	-0.321	0.634	1.163	0.073	-0.252	0.786
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	1.018*	0.022	1.069**	0.001	1.394**	0.003	1.319***	0.000
Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.002	0.993	-0.020	0.916	0.116	0.608	0.011	0.951

Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	-0.051	0.861	-0.373	0.143	-0.096	0.865	-1.067*	0.010
Hotels and restaurants	0.706**	0.007	0.524	0.162	0.699***	0.001	0.573	0.152
Land transport; transport via pipelines	0.775***	0.000	0.726**	0.002	0.753**	0.005	0.405	0.245
Water transport	0.692*	0.031	0.690*	0.020	1.241**	0.003	1.075***	0.001
Air transport	0.104	0.848	-0.003	0.995	-0.792	0.299	-0.690	0.259
Supporting and auxiliary transport activities of travel agencies	-0.049	0.925	0.716	0.190	-0.883*	0.045	0.384	0.557
Post and telecommunications	0.213	0.677	0.700	0.213	-0.042	0.956	1.431	0.136
Financial intermediation, except insurance and pension funding	0.190	0.126	0.202	0.152	0.188	0.120	0.224	0.124
Insurance and pension funding, except compulsory social security	0.595***	0.000	0.615***	0.000	0.528***	0.000	0.549***	0.000
Activities auxiliary to financial intermediation	0.575***	0.000	0.612***	0.000	0.506***	0.000	0.561***	0.000
Real estate activities	0.867	0.106	1.261**	0.002	0.429	0.418	1.117***	0.000
Renting of machinery and equipment without operator and of personal and household goods	2.380*	0.013	1.423	0.089	2.041	0.103	0.783	0.368
Computer and related activities	0.786	0.499	-0.110	0.881	1.269	0.347	-0.210	0.771
Research and development	1.768	0.057	2.689	0.225	1.931*	0.013	6.437*	0.036
Other business activities	0.470*	0.011	0.800***	0.001	0.347*	0.021	0.731***	0.000
Public administration and defence; compulsory social security	0.220	0.235	-0.239	0.290	0.349**	0.009	-0.312	0.270
Education	-0.086	0.721	-0.319	0.306	-0.174	0.395	-0.869*	0.047
Health and social work	0.093	0.906	1.782*	0.025	-1.037	0.410	3.347***	0.001
Sewage and refuse disposal, sanitation and similar activities	0.843*	0.019	1.060**	0.002	0.809*	0.014	1.139***	0.000
Activities of membership organizations n.e.c.	0.513	0.355	-1.007	0.310	0.591	0.202	-1.781	0.111
Recreational, cultural and sporting activities	0.795	0.151	0.005	0.994	1.313	0.231	-2.564	0.090
Other service activities	-0.235	0.378	0.463	0.273	-0.376	0.104	0.027	0.953

4.4. Elasticities and labour market performance

First evidence on the relationship between the price elasticity and labour market performance is given by the comparison of the mean employment change of elastic industries and non-elastic industries. The results are shown in Table 2. Price elastic and inelastic industries are defined as described above. For our preferred elasticity estimation (IV-estimator and using relative prices) we find that the reduction in employment was substantially smaller (by about 4.2 percentage points) for the elastic industries than for inelastic industries. This finding is holding for two other estimations as well. Only the elasticities derived from the OLS estimator using the price level is indicating that the inelastic industries are better performing.

For the results in the lower part of Table 2 we attempt to adjust for the quality of the point estimators of the price elasticity. For this purpose we derive the width of the 95% confidence interval and use its inverse as weights for the industries. The results stay basically the same.

Table 2: Mean employment change for elastic and inelastic industries

Estimator	Price measure	Price elastic	Price inelastic	Difference (inelastic- elastic)
OLS	Level	-8.73	-4.57	4.16
OLS	Relative	-4.24	-6.44	-2.20
IV	Level	-3.37	-6.54	-3.17
IV	Relative	-2.70	-6.91	-4.21
Adjusted for the quality of the elasticity estimate				
OLS	Level	-7.72	-4.26	3.46
OLS	Relative	-4.68	-4.94	-0.26
IV	Level	-3.58	-5.11	-1.53
IV	Relative	-.79	-6.42	-5.63

Elaborating our industry level analysis a bit further we use again the industry level information on employment change. But now we are putting it in a regression framework. We estimate equation 23a using three different estimators. The first one is plain OLS. The second estimator is an outlier robust regression, which is weighting the different industries in an iterative process with the inverse of the residual. As final variation we weight the industries in the OLS estimator by the width of the 95% confidence interval of the point estimates of the price elasticity. In order to control some basic intervening factors we put in the estimation function the income elasticity and the change in wages.

The results are mixed (Table 3) but still pointing in the expected direction. The coefficient of the price elasticity has a positive sign, which is expected because. However, the effect of the

price elasticity is only significant in the outlier robust estimation with the elasticities derived with OLS, which is not our preferred model. Adjusting for the quality of the elasticity estimates (not shown in the table) is not changing the results. The weak significance level might be due to the small number of observations. However, taking this small number of observations into account, the consistently positive sign of the coefficient of the price elasticity and one significant result are reassuring. The coefficient for the income elasticity has the expected sign and it is in most cases significant.

Table 3: Effects of price elasticity on employment change on industry level

	Elasticity estimates with OLS	
	Second stage: OLS	Second stage: Outlier robust estimator
Price elasticity	2.51 (2.68)	4,85** (2.28)
Income elasticity	6.27*** (1.20)	4.14*** (1.02)
Adjusted R ² / F- Tes	0.35	F(3, 46) = 7.49 ***
	Elasticity estimates with IV	
	Second stage: OLS	Second stage: Outlier robust estimator
Price elasticity	0.76 (2.09)	2.25 (1.50)
Income elasticity	0.53 (0.50)	4.37*** (1.11)
Adjusted R ² / F- Test	-0.02	F(3, 45) = 6.22***

Control variable: wage change 1996-2007 Number of observations: 50

standard errors in parenthesis * p<.1; ** p<.05; *** p<.01

We can overcome the problems associates with the small number of observations by looking at industries in regions for all regions. This is increasing the number of observations by more than the factor 300. However, looking at regions is not priceless. It is giving rise to at least two problems.

Firstly, some industries in some regions are rather small. In such a case employment change might be primarily due to some happy or unhappy coincidence (or decision) in one or two establishments. Thus we add a substantial source of noise to our data. To control this we reestimate our specification after successively excluding industries with less than 25, 50, 100, 250, 500, 1000, 2500 and 5000 employees.

Secondly, there might be some region specific effects on the employment development. To control for these we insert some regional control variables. The wage variable becomes now the median wage of an industry in a region. Additionally we add the interquantiles range of industry wages in a region. We put dummies for the “siedlungstrukturelle Kreistypen”, a widely used classification of German districts (Goermar and Irmen 1991) provided by the

Federal Office for Building and Regional Planning (BBSR), in our estimations. Finally we control for the effects of regional density using the inhabitants per square kilometre and the distance to the next motorway (accessibility).

We again estimate three different specifications: OLS, an outlier robust regression and OLS with industries weighted by the inverse of the width of the 95% confidence interval of the point estimates of the price elasticity.

The results in Table 4 are supporting the findings of our model. The coefficients of the price elasticity as well as for the income elasticity are positive across all estimates. All coefficients are significant. These results suggest that the employment growth over the observation period in an industry with the $\varepsilon=1$ is two to ten percentage points higher, than the employment growth in an industry with $\varepsilon=0$.

However, the explanatory power of some specifications, expressed by the adjusted R^2 , is rather weak for some estimates. This seems to be due to the white noise mentioned above, because the R^2 increases with the threshold. The R^2 becomes satisfactory at the threshold of 1000.

Finally we aggregate employment change, elasticity and wages at the regional level. Accounting for the white noise problem from above we have three versions of this aggregation, which are again excluding industries below the 1000, 2500 and 5000 thresholds. The results are given in table Table 5. For the estimates with the aggregate above the 1000-threshold the effect of the price elasticity is insignificant. The income elasticity has the right sign and is significant. When increasing the threshold the coefficients of the price elasticity become negative and significant.

Table 4: Effects of price elasticity on employment change on industry and regional level

	Threshold 10	Threshold 25	Threshold 50	Threshold 100	Threshold 250	Threshold 500	Threshold 1000	Threshold 2500	Threshold 5000
	OLS								
Price elasticity	3.89*** (1.02)	3.36*** (0.88)	2.54*** (0.64)	1.96*** (0.53)	3.02*** (0.46)	4.76*** (0.44)	6.85*** (0.48)	7.19*** (0.58)	9.34*** (0.86)
Income elasticity	3.90*** (0.44)	3.10*** (0.39)	2.66*** (0.31)	2.69*** (0.27)	2.65*** (0.23)	2.16*** (0.24)	2.49*** (0.32)	1.06*** (0.36)	3.52*** (0.92)
Adjusted R ²	0.03	0.04	0.05	0.08	0.13	0.19	0.25	0.27	0.34
	Outlier Robust Estimator								
Price elasticity	1.55*** (0.32)	1.85*** (0.32)	1.94*** (0.31)	2.57*** (0.31)	3.80*** (0.31)	5.32*** (0.32)	7.24*** (0.33)	7.36*** (0.41)	8.55*** (0.71)
Income elasticity	6.34*** (0.14)	6.24*** (0.14)	6.17*** (0.15)	5.86*** (0.16)	5.91*** (0.16)	5.31*** (0.17)	4.77*** (0.22)	3.94*** (0.26)	3.19*** (0.75)
Adjusted R ²	F(15, 13255) = 305.71***	F(15, 12470) = 308.26***	F(15, 11470) = 266.33***	F(15, 10160) = 239.16***	F(15, 8007) = 240.53***	F(15, 5954) = 201.06***	F(15, 3769) = 142.10***	F(15, 1571) = 63.63***	F(15, 552) = 18.53***
	OLS weighted by the quality of the price elasticity point estimator								
Price elasticity	9.24*** (1.69)	8.57*** (1.36)	7.30*** (1.05)	6.55*** (1.02)	6.43*** (0.72)	7.61*** (0.71)	8.48*** (0.79)	8.67*** (0.96)	10.38*** (1.39)
Income elasticity	11.44*** (0.72)	7.97*** (0.62)	5.24*** (0.54)	4.70*** (0.58)	6.24*** (0.48)	4.80*** (0.52)	3.29*** (0.63)	1.74** (0.81)	-1.43 (1.12)
Adjusted R ²	0.05	0.05	0.06	0.06	0.16	0.24	0.27	0.32	0.39
Observations	13271	12486	11486	10176	8023	5970	3785	1587	568

Control variables: wage change 1996-2007, 8 different dummies for region types, accessibility, inhabitant density

standard errors in parenthesis * p<.1; ** p<.05; *** p<.01

Table 5: Effects of price elasticity on employment change on regional level

	Threshold 1000	Threshold 2500	Threshold 5000
	OLS		
Price elasticity	-3.31 (3.16)	6.93*** (2.21)	8.66** (3.74)
Income elasticity	5.84*** (1.93)	-0.04 (1.41)	6.04** (2.65)
Adjusted R ²	0.09	0.04	0.09
	Outlier Robust Estimator		
Price elasticity	-4.06 (2.76)	7.28*** (1.81)	6.13* (3.15)
Income elasticity	4.09** (1.69)	-1.96* (1.15)	3.13 (2.23)
F-Test	F(13, 310) = 5.18***	F(13, 248) = 2.15**	F(13, 131) = 2.29***
Observations	324	262	145

Control variables: wage change 1996-2007, 8 different dummies for region types, accessibility, inhabitant density
standard errors in parenthesis * p<.1; ** p<.05; *** p<.01

Thus the sum of the empirical evidence is suggesting, that the more price elastic the demand of a region or industry is the better labour demand develops. The employment growth of region with $\varepsilon=1$ is between six and seven percentage points higher than that of a region with $\varepsilon=0$. To term it differently, the predictions from our theoretical model are empirically supported

5. Conclusions

In this paper we have presented research on the theorem about the employment effects of productivity growth under different conditions of product demand. In a first step we have developed a simple theoretical model establishing the relationship between technological progress and employment. This model has then been generalized taking the labour market explicitly into account which allows explaining unemployment and endogenising wages. We have derived empirical evidence in two steps. First, we have estimated price and income elasticities for 50 industries in Germany. The results have then been used in a second step to assess the impact of different product demand conditions on labour market performance.

We look at the employment change on the industrial and regional level. Our findings indicate that indeed regional employment develops the better the higher the share of industries with elas-

tic demand is. Technical progress in these industries has favourable consequences for employment, whereas it has detrimental effects in industries with inelastic demand. Thus, we provide an alternative explanation of unemployment compared to the usual macroeconomic and institutional approaches. This alternative can explain the regional variation in unemployment through the regional industry specialisation while the common approaches cannot explain regional disparities due to their focus on national parameters. The distribution in labour market performance as it is shown in Maps 1 and 2 can be understood by our model.

Additionally, our model can also explain the cross-national variation caused by the broader set of institutions. This cross-national variation is in our view not only influencing the labour market directly through labour market institutions as proposed by the European Labour Market Model or by other modern approaches but also by the product mix resulting from the broad set of institutions. The higher the share of ‘young’ products with elastic demand, the better is the labour market performance.

From these differences in explanations, there follow also different policy implications. While the European Labour Market Model concentrates solely on the labour market and its institutions our labour market model of structural change directs the attention also to the product market conditions and innovation friendly policies in general – including the educational and financial system. Additionally, in the macroeconomic approaches there is no scope for regional measures. Our alternative approach instead highlights the importance of regional activities. In fact, it is crucial that a region is able to attract industries with innovative products which generate a strong reaction in demand.

The labour market model of structural change is – of course – related to structural change and the respective theoretical concepts. These connections are at least threefold. Firstly, the starting point of a specific regional or national mixture of industries is a result of the previous processes of structural change. Secondly, the mechanisms describing and driving the labour market outcome are in general determining industry growth and decline, thus they are determining and describing structural change. Following from this, thirdly, the main variables of the labour market model of structural change, that is productivity, price elasticity and income elasticity, are also important explanatory variable in theoretical concepts of structural change.

References:

- Appelbaum, Eileen; Schettkat, Ronald (1999): "Are Prices Unimportant?", in: *Journal of Post-Keynesian Economics* 21/3: 387-398
- Baltagi, Badi H.; Blien, Uwe; Wolf, Katja (1009): "New evidence on the dynamic wage curve for Western Germany: 1980-2004", in: *Labour Economics* 16/1: 47-51
- Blanchard, Olivier (2007): "A Review of Richard Layard, Stephen Nickell, and Richard Jackman's Unemployment: Macroeconomic Performance and the Labour Market", in: *Journal of Economic Literature*: 45/2: 410-418
- Blanchard, Olivier J. (2008): "The Crisis: Basic Mechanisms, and Appropriate Policies", MIT Dept. of Economics Working Paper
- Blanchflower, David G.; Oswald, Andrew (2005): "The wage curve reloaded", NBER Working Paper 11338

- Blanchflower, David G.; Oswald, Andrew J. (1994): "The Wage Curve", Cambridge (Mass.), London: MIT Press
- Blien, Uwe (2001): "Arbeitslosigkeit und Entlohnung auf regionalen Arbeitsmärkten", Heidelberg: Physica
- Blien, Uwe; Sanner, Helge (2014): "Technological Progress and Employment", *Economics Bulletin*, forthcoming
- Brynjolfsson, Erik; McAfee, Andrew (2011): "Race Against the Machine. How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy", Lexington (Mass.): Digital Frontier
- Carlin, Wendy; Soskice, David (2006): "Macroeconomics. Imperfections, Institutions and Policies", Oxford: Oxford University
- Cingano, Federico; Schivardi, Fabiano (2004): "Identifying the Sources of Local Productivity Growth", in *Journal of the European Economic Association* 2/4: 720-742
- Combes, Pierre-Philippe; Magnac, Thierry; Robin, Jean-Marc (2004): "The Dynamics of Local Employment in France", in: *Journal of Urban Economics* 56: 217-243
- Dauth, Wolfgang (2010): "The Mysteries of the Trade: Interindustry Spillovers in Cities. Analyzing the Causes of MAR-Externalities using Spatial Econometric Techniques", IAB Discussion Paper
- Dixit, Avinash; Stiglitz, Joseph E. (1977): "Monopolistic competition and optimum product diversity", in: *American Economic Review* 67/3: 297-308
- Görmar, Wilfried; Irmen, Eleonore (1991): Nichtadministrative Gebietsgliederungen und -kategorien für die Regionalstatistik. Die siedlungsstrukturelle Gebietstypisierung der BfLR, In: *Raumforschung und Raumordnung*, 49/6, pp. 387-394.
- Gort, Michael; Klepper, Stefan (1982): "Time Paths in the Diffusion of Product Innovations", in: *The Economic Journal*, Vol 92, No. 367, pp. 630-653.
- Hall, Peter A.; Soskice, David (2001): "An Introduction to Varieties of Capitalism", in: Hall, Peter A.; Soskice, David (eds.): "Varieties of Capitalism", Oxford: 1-68
- Howell, David R.; Baker, Dean; Glyn, Andrew; Schmitt, John (2007): "Are Protective Labor Market Institutions at the Root of Unemployment? A Critical Review of the Evidence", in: *Capitalism and Society*, Vol. 2, No. 1, pp., Art. 1
- Kerr, William R.; Kominers, Scott D. (2010): "Agglomerative Forces and Cluster Shapes", US Census Bureau Center for Economic Studies Paper
- Klepper, Steven (1996): "Entry, Exit, Growth and Innovation over the Product Life Cycle", in: *American Economic Review*, Vol. 86, No. 3, pp. 562-583
- Krugman, Paul (1991): "Geography and Trade", Cambridge (Mass.) etc.: MIT Press
- Krugman, Paul (2012): "End This Depression Now!", New York, London: Norton
- Layard, Richard; Nickell, Stephen (1985): "The Causes of British Unemployment", in: *National Institute Economic Review*
- Layard, Richard; Nickell, Stephen; Jackman, Richard (2005): "Unemployment. Macroeconomic Performance and the Labour Market" (new edition, first edition 1991), Oxford: Oxford University Press
- Marshall, Alfred (1997): "Principles of Economics" (originally published 1920), Amherst: Prometheus Books
- Möller, Joachim (2001): "Income and Price Elasticities in Different Sectors of the Economy. An Analysis of Structural Change for Germany, the UK and the US", in: ten Raa, Schettkat (2001)
- Möller, Joachim; Tassinopoulos, Alexandros (2000): "Zunehmende Spezialisierung oder Strukturkonvergenz? Eine Analyse der sektoralen Beschäftigungsentwicklung auf regionaler Ebene", in: *Jahrbuch für Regionalwissenschaft* 20/1: 1-38

- Mortensen, Dale T.; Pissarides, Christopher A. (2011) (ed.): "Job Matching, Wage Dispersion, and Unemployment", Oxford: Oxford University
- Neisser, Hans P. (1942): "'Permanent' Technological Unemployment. 'Demand for Commodities is Not Demand for Labor'", in: American Economic Review: 50-71
- Paunescu, Mihai; Schneider; Martin (2004): „Wettbewerbsfähigkeit und Dynamik institutioneller Standortbedingungen: Ein empirischer Test des „Varieties-of-Capitalism“-Ansatzes.“ in: Schmollers Jahrbuch, Vol. 124, No. 1, pp. 31-59.
- Raa, Thijs ten; Schettkat, Ronald (2001) (ed.): "The Growth of Service Industries. The Paradox of Exploding Costs and Persistent Demand", Cheltenham, Northampton: Edward Elgar
- Ricardo, David (1921): "Principles of Political Economy and Taxation", Amherst: Prometheus (originally published 1817)
- Sorge, Arndt; Wolfgang Streeck (1988): "Industrial Relations and Technical Change. The Case for an Extended Perspective", in: Hyman, Richard; Wolfgang Streeck (eds.): New Technology and Industrial Relations. Oxford: Basil Blackwell: 19-47.
- Streeck, Wolfgang (1991): "On the Institutional Conditions of Diversified Quality Production." In: Matzner, Egon; Wolfgang Streeck (eds.): Beyond Keynesianism: The Socio-Economics of Production and Employment. London: Edward Elgar, pp. 21-61.
- Streeck, Wolfgang (1997): "German Capitalism: Does it Exist? Can it Survive?" In: New Political Economy, vol. 2, no. 2, pp. 237-256.
- Südekum, Jens (2005): "Increasing Returns and Spatial Unemployment Disparities", in: Papers in Regional Science 84/2: 159-181
- Varian, Hal (1992): "Microeconomic Analysis" (3rd edition): W.W. Norton