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What Went Wrong in East Germany and What Can Be Done?

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PREFACE

"Supergau Deutsche Einheit" – that was the provocative title of a recent bestseller by a German journalist. The book described - in darkest colours - the complete failure of the biggest project of re-united Germany. Sorry, the book said, it did all not happen: the intended transformation of the post-socialist Eastern German economy into a viable capitalist entity, with firms that are highly competitive in world markets, and with a labour force that is fully employed and just as productive as its brethren in the West. One and half decades after political unification, the judgement of the book was clear-cut: a poor performance due to bad politics, a shame for the nation.

Fortunately, academic analysis is different from polemic prose, at least when it comes to such complex matters as the economics of German unification. That was proven once again at the 2006-meeting of the German Economic Association in Bayreuth where two sessions were devoted to this fascinating topic. Of course, the six papers presented did not have a common message on what had gone right or wrong and what could be done better. What the papers and the discussion did achieve, however, was to open the doors to a more refined reinterpretation of eastern German economic growth and labour markets since unification.

As to growth, Burda and Uhlig offered both plausible – though completely different – models to explain why the convergence of eastern productivity to western levels did not yet come about and is unlikely to come about in the near future. Burda stressed the retarding force of adjustment costs to structural change, Uhlig the cementing power of network externalities. Both point to a kind of "natural equilibrium" of the eastern economy, be it due to high capital and labour mobility or to agglomeration effects in the broadest sense. All this rightly leads away from early neoclassical recipes for convergence that were in fashion right after unification.

As to labour markets, the picture is even more diverse. While Ragnitz argues along traditional lines that there still is a human capital gap between West and East, Fuchs-Schündeln and Izem tell a completely different story. Their econometric analysis of neighbouring areas in commuting distance points towards the quality of jobs – and not the quality of the workforce – to be decisive for persistently observed productivity gaps between West and East. As to labour market policies, the remaining papers take a dismal view: Lechner and Wunsch show econometrically that active labour market programmes have virtually no positive economic effects. And Merkl and Snower demonstrate in a model calibration that, once low-employment traps are present, policy effectiveness is severely limited.

All in all, the papers provide ample material to think anew about the history, the economics and the politics of German unification. As to history, it now becomes clear that - right from the start of the 1990s - the challenge of German unification was much greater than even the worst pessimists could have expected. After all, uniting two economies with vastly different productivity levels, but virtually no barriers to mobility between them may be one of the most difficult - and costly – exercises that history has to offer.

As to the economics, the focus begins to shift towards models that analyze German unification not as the mechanical closing of whatever gap of infrastructure, capital quantity or labour quality, but as a complex process of growth and structural change that involves huge adjustment costs, powerful network externalities and high labour mobility. The focus thus returns to the core fields of modern growth theory and empirics. And that is exactly where the focus should be if we want to gain a more fundamental understanding of what German unification really means and what lessons can be drawn from it. And there will be important lessons - despite the fact that, obviously, the fall of the iron curtain was a unique historical event.

As to politics, it is ever more evident that the power of government to push the eastern German economy towards western levels has been and still is much more limited than many positivist observers believed and partly still believe today. After all, steering an evolutionary growth path into the right direction is a much more challenging task than just closing a gap of infrastructure or factor endowment. In the end, complaints about wrong-headed policy decisions in the early 1990s may turn a little bit less loud than they currently are. And the call for whatever change of policy course may became a bit more cautious and differentiated.

This is all the more true because, in the most recent past, there are encouraging signs of growth acceleration in eastern Germany. And this time, it is manufacturing industry that grows strongly, and not construction as in the 1990s. This time, it will not be a temporary bubble blown up by government spending, but a kind of natural growth that is accompanied by a sustainable penetration of world markets by eastern German products and services. Even employment begins to grow again – and unemployment to decline, after a long time first of increase and then of stagnation on a very high level.

As the papers and the discussion in Bayreuth showed, the economics profession is now well equipped to watch and analyze these fascinating developments. Hopefully, more research will be forthcoming. And, if so, more insights will follow.

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PREFACE

More than 15 years after the re-unification of East and West Germany, the economic situation of the formerly separated states differs along some characteristic lines. There is, first of all, quite persistent migration from East to West, in particular of the younger generation. Although net migration from East to West Germany has been highest in the early 1990s, it still stood at about 50,000 annually in the years 2003 and 2004. Still, unemployment is significantly higher in the East than in the West. In 2005, the unemployment rate stood at almost 20% in East Germany and was thus well-above the German average (12%). Labor productivity and wages in the East are below those in the West. Large fiscal transfers from West to East continue.

Why is studying Germany and the adjustment patterns following German re-unification interesting? After all, German reunification has been a very unique event, and potential lessons that can be drawn from it might not be easily transferable. Yet, the papers that are collected in this volume suggest that the German case holds some more general lessons for economic policy as well as for theoretical and for empirical research.

Take the political aspects of the re-unification episode first. Obviously, German politics is under increased pressure to reform fiscal transfer systems, social security systems, and the labor market. While re-unification is not the prime cause for the need to reform, is has certainly aggravated the situation. Hence, policymakers need to know which types of reforms are needed, whether piecemeal reforms are likely to cure the current problems – or whether more encompassing and larger reform packages are needed.

Studying the German post re-unification period is also interesting from a theoretical point of view. The German experience challenges economic theories which predict a quick harmonization of living standards after the lifting of barriers to integration. Instead, the German experience gives support to theoretical models, which stress the presence of agglomeration effects, institutional rigidities, and indirect barriers to integration. Hence, Germany provides an interesting case study for the patterns of regional integration, which holds potentially interesting lessons for other projects such as the European integration process.

For empirical researchers, the reunification period provides an interesting "laboratory experiment". Two regions, which were previously separated by a strictly enforced border,

have now dismantled all formal barriers to integration, have adopted the same currency, and have the same set of institutions. This allows studying the persistence and the causes of border effects in international economics.

The papers collected in this volume study the reunification period from different angles. They differ, first of all, with respect to the possible explanations for the persistence of differences in living standards across regions. The model by Burda stresses adjustment costs following the integration shock. According to this view, more time is needed to close the gap in initial incomes. This neoclassical view emphasizes adjustment costs in otherwise frictionless markets. It disregards the emergence of unemployment during the transition to a new steady state. Uhlig, in contrast, stresses the role of agglomeration forces. According to this view, East Germany is characterized by a weakly networked equilibrium with high unemployment and persistent migration to the West. The third explanation for differences in living standards, which can also explain the emergence of high unemployment, focuses on labor market institutions (Merkl and Snower). The latter two models stress the role of unemployment, but differ with regard to the causes of unemployment persistence. Hiring and firing costs, coupled with a process of wage bargaining are central in Merkl and Snower, while Uhlig stresses the interaction of agglomeration tendencies and unemployment benefits.

It is important to note that all authors of the theoretical models assign a central role to (intra-German) migration. In this regard, these models differ from more traditional models of *international* integration. Typically, models of international integration consider other channels of integration such as trade and capital flows as well, and they assume that labor is immobile internationally. Going beyond their focus on migration as an adjustment mechanism, the exact role of migration for the adjustment process differs across the papers. According to Burda, migration promotes factor price equalization and thus plays a positive role. The models by Uhlig and Merkl and Snower disagree. They would rather suggest that migration promotes agglomeration and further raises unemployment.

A last aspect which distinguishes the three theoretical papers in this volume is the role of economic policy. In Burda's neoclassical model, economic policy may have a role to play in terms of lowering adjustment costs. However, this role is not explicitly modeled. In Uhlig's model, agglomeration forces are hardly affected by economic policy. According to the view put forward by Merkl and Snower, economic policy plays a significant role. Here, labor market rigidities and the welfare state are playing a key role in explaining unemployment.Deep and wide policy measures are needed to solve the labor market problems.

Obviously, the different mechanisms stressed by the theoretical models in this volume and their different implications for economic policy require empirical evidence on the importance of adjustment costs, on agglomeration tendencies, on the importance of labor market institutions, and on the role of international openness. The empirical papers collected in this

volume move into this direction. Fuchs-Schündelen and Izem look at the causes for high differences in labor market productivities in East and West Germany. In particular, they disentangle the effects of workers characteristics and job characteristics in a spatial labor market model. Lechner and Wunsch look at active labour market policies in East Germany. Finally, the paper by Ragnitz focuses on explanations for differences in labor productivity in East and West Germany.

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What kind of shock was it?

Regional Integration and Structural Change in Germany after Unification

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What kind of shock was it?

Regional Integration and Structural Change in Germany after Unification

by

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January 2007

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What kind of shock was it?
Regional Integration and Structural Change in Germany after Unification

Abstract

Eastern Germany's recovery from the "unification shock" has been characterized by deep structural change – with apparent repercussions for the West as well – and an integration process involving both capital deepening (extensive and intensive investment) and labor thinning (net out-migration). I propose a constant-returns neoclassical model of economic integration which can account for these facts. Adjustment costs determine dynamics and steady state regional distribution of production factors. The model also explains persistent wage and capital rate-of-return differentials along the equilibrium path. Under competitive conditions, observed factor price differentials contain information on those adjustment costs.

Keywords: German reunification, regional integration, costs of adjustment, capital mobility, migration

JEL: F2, J61, P23

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1. Introduction

Fifteen years after reunification, the resurrection of the Eastern German economy is hard to overlook. Despite a negative image cultivated by the media, the region has clearly recovered from the devastating "unification shock" of the early 1990s and is well on its way to finding a place in international patterns of trade and specialization. Since 1995, industrial production in the East – excluding construction – has expanded by more than 80%, and by 38% since 2000, a period during which the Western German measure grew cumulatively by only 11%. In terms of value added, total real GDP in Eastern Germany grew by roughly 3.5% annually since 1991, and more than 8% annually in manufacturing industry alone. In the past fifteen years, more than half of the per-capita GDP gap between East and West has been closed, in less than half the time predicted by Robert Barro (1991). For the first time since 1991, an Eastern German state (Thuringia: 13.9%) can boast a lower unemployment rate than a Western one (Bremen: 14%), If the persistence of time series is any guide, some regions of south Eastern Germany are well-poised to displace some counterparts in the West.

It would be false, however, to claim that regional integration has been painless. As Table 1 shows, convergence on a wide array of indicators has been impressive, but most difficult in the labor market. Since 2000, annual net migration from East to West has averaged about 70,000 or 0.5% of the population per annum, and was especially concentrated among youth (see Harald Uhlig 2006). At the same time, new physical capital has moved east – on average 80-90 billion Euros annually, or about 20% of regional GDP. The reallocation of production factors is arguably the most impressive aspect of the German unification episode: in the years 1991-2002, EUR 1.2 trillion of new investment (1995 prices) was undertaken on behalf of about 15 million residents in the East, making this episode one of the most intensive periods of net capital formation in

modern economic history, on a per capita basis. Despite this windfall of economic development, the workforce of Eastern Germany shrank by roughly 1.2 million over the period from 1991 to 2004, or by about 15%, while employment in the West rose by 4.1%.

This pattern of adjustment with factor accumulation in opposite directions is difficult to account for using a simple neoclassical growth framework. To evaluate the aggregate causes and effects of these factor movements, I propose a simple model of economic integration which can account for finite rates of factor movement and convergence, as well as provide a quantification of the costs associated with the integration process. The model is also capable of delivering an estimate of the steady-state size of the Eastern German economy.

<Table 1 here>

It is difficult to imagine such massive movements of factors occurring in the absence of structural change. Indeed, if the aggregate production function is seen as the aggregate output of many sectors, all producing optimally, rather than literally as the output of a single good, structural change and factor mobility are part and parcel of the same process. These changes have remained relatively undocumented over the past fifteen years, so a second task I take up is to show in broad brushstrokes the structural change which can been observed in East Germany. At the same time, East-West migration flows coincide with significant structural change in the West, leading one to suspect that migration may be less structurally neutral than the standard model predicts.

This paper is organized as follows. In Section 2 I document the integration shock and concomitant structural change which has occurred in both parts of Germany since 1990. In Section 3, I propose and discuss a neoclassical model of integration as a benchmark for the factor mobility that would occur under ideal conditions, i.e. under conditions of perfect competition in labor and product markets. Section 4 describes the steady state and dynamic properties of this model and describes an informal calibration

of the model, including the implications for the steady state size of the Eastern German economy. Section 5 concludes.

2. East Germany's Integration Shock

2.1. Mechanisms of Integration

Early on, Horst Siebert (1992) presciently characterized the episode as a massive "integration shock," and there is little doubt that unification caught economic agents in the region by surprise. To make my discussion more precise, however, I will use Eichengreen's (1990) definition of economic integration: the achievement of the efficient production pattern by two or more geographic regions made possible by their union. Several mechanisms could be associated with an integration shock. First, internal accumulation of production factors raises output per capita in the poorer region at no expense to the richer one. Second, labor will tend to move from the capital-poor to capital-rich region. Third, capital mobility, either in the form of foreign direct investment will benefit the capital-poor region, financed either by international capital markets or at the expense of the capital-rich one. Fourth, Heckscher-Ohlin trade between incompletely specialized regions can lead to equalization of factor prices. Finally, the backward region can adopt technologies from the leading region, leading to convergence of total factor productivity. In the analysis which follows, I will suppress differences in technologies across regions, as well as the very long-term process of capital accumulation which can bring about integration (Barro and Sala-i-Martin 1990, 1995). I will also ignore the role that factor-proportions trade can play in inducing integration by assuming a single good produced in both regions. My analysis will focus on the movement of factors as well as movements along a stable production technology as prime drivers of integration of Eastern and Western Germany.

2.2. Factor Mobility

As evident from Figures 1 and 2, the intensity of factor reallocation between the two regions was not only high, but also far from constant over the period. In the first two years after unification, more than a million people changed residence on a net basis. Through the early 1990s, this rate declined to a trickle, then rose again after 1995, when growth in the region declined and unemployment rates rose. Similarly, capital investment was highest in the early 1990s, then declining after the mid-decade. In addition, an unusually large fraction (2/3) of the cumulated investment flow in Eastern Germany was dedicated to residential and business structures, compared with about 1/3 in business fixed equipment. The large run-up in investment spending on structures is frequently seen not only as the outcome of distorted investment incentives, but also as having longer run consequences for the structure of output and factor demands (Sinn 1992). Thus, after a very strong start in the 1990s, investment rates in the East have declined significantly and now are hardly different from those in the West (see Table 2).

<Figures 1 and 2 here>

The real recapitalization of the Eastern German economy is a prime determinant of the rapid rise in per employee productivity documented above in Table 1. In some sectors, it may even be the case that capital-labor ratios have overshot western levels. For example, the official estimate of eastern aggregate capital-labor ratio in manufacturing was virtually at par with the West in 2002 at 99%; this conceals variation ranging from 66% in textiles/clothing and 81% in metallurgy to significantly higher values of 125% in chemicals and 122% in automobile production. Many extreme cases can be found in intermediate materials (average 123% of the West, basic chemicals 143%) and mining

and quarrying (184%!).[1] In the next section, I discuss the implications of this development for structural change in Germany.

<Table 2 here>

2.3. Structural Change

The past evolution of eastern Germany, in which factors of production move intensively in opposite directions, is difficult to explain as a reaction to disturbances in technology, preferences, or demand. Moreover, the heterogeneous evolution of sectors in the East documented in the last sections suggests that such massive movements of factors are likely to be accompanied by structural change. If the aggregate production function is seen as the aggregate output of many, many sectors, all producing optimally, rather than literally as the output of a single good, structural change and factor mobility are likely to represent the same underlying economic process. This is the process of adaptation of a region long cut off from economic incentives to the forces of international specialization and trade.

The recovery of economic activity since the early 1990s in the new states has by no means been uniform. This is hardly surprising given the early and remarkably prescient analysis by Akerlof, et al. (1990) immediately following unification; on the basis of internal statistics maintained by the central planners of the German Democratic Republic, only about 20% of industry was internationally competitive at a 1:1 Ostmark-DM exchange rate. The extent of this structural change can be seen in the two panels of Figure 3, which document the relative evolution of industrial production indexes in the periods 1995:1-2001:1 as well as the more relevant German slump period 2001:1-2006:1.

[1] These estimates as well as a detailed description of sectoral convergence are described in Kim (2006).

Note not only is the strikingly uneven recovery of East German industry, but also the extent to which a re-orientation of production appears to be occurring towards the Eastern regions. It is noteworthy that this shift is consistent with at least a partial restoration of the preeminent position held by central Germany in the industrial economy until World War II.

<Figure 3 here>

Naturally, East Germany still accounts for a smaller fraction of total output than its population share, and growth rates will be magnified by the small base at the outset. Yet in manufacturing, the eastern German states excluding Berlin now account for 9% of total German value-added in that sector, up from 7.6% in 2000 and 5.6% in 1995. In striking contrast, the East German value added share in broadly-defined services has hardly risen since 1995 from 11.2% to 11.7%; in construction it fell from 27.8% in 1995 to 16.9% in 2005, and remains considerably oversized compared to its West German counterpart.

Given the extent of the transformation of the Eastern German economy, it is inevitable that this structural change would spill over to the West. Indeed, concomitant with the expansion of manufacturing in the new states is a visible change in economic structures in the old states. The two panels of Figure 4, reproduced from Bachmann and Burda (2006), provide evidence for this claim. The first panel shows how the employment shares in the West began changing significantly after 1900, the year of German unification. Since 1990, the West German economy has lost roughly a fifth of its socially insured employment in industry, while significantly increasing the number of jobs in services, especially business-related services (Bachmann/Burda 2006).

<Figure 4 here>

The second panel shows the evolution of Lillien indexes of disparity in employment growth as described by Lillien (1982). These numbers, which are similar in behavior to weighted standard deviations of employment growth rates, show a marked increase in entropy of sectoral employment. This conjecture appears even more valid when the changes are measured over longer periods, that is, when short term fluctuations are filtered out by measuring employment growth over longer intervals. Note that the increase in the indexes is centered around 1990, the year of German unification.

The preponderance of evidence suggests that the integration shock has had a marked medium term effect on both factor allocations and the division of labor in unified Germany. In the next section, I propose a neoclassical model of regional integration which can help understand and evaluate this episode.

3. A Formal Model of Factor Mobility and Regional Integration

3.1. Model Ingredients

Two regions, East (E) and West (W) produce output Y in time t employing the same neoclassical constant returns production function $Y_t=F(K_t,G_t,L_t)$. Factor inputs consist of two types of capital – equipment (K) employed in production as well as structures (G) used both to shelter enterprises and households. I assume $F_K>0$, $F_G>0$, $F_L>0$, $F_{KK}<0$, $F_{GG}<0$, $F_{LL}<0$, and $\det(\nabla^2 F)=0$. In this paper I also assume that $F_{ij}>0\ \forall i\neq j$. Both types of capital are internationally mobile and depreciate at rates δ_K and δ_G respectively, with $\delta_K>\delta_G$. The world rate of interest is exogenously given at r. While capital services can be imported freely from abroad, labor mobility is only possible between the two regions, and total labor supply is normalized to 1. The population of the East is denoted by L^E, so

under full employment assumptions L^W=1-L^E. The model is deterministic, and secular economic growth is ignored.[2]

Let $f(k,g)\equiv F(K,G,L)/L$ be the intensive form of F with per capita inputs $k\equiv K/L$ and $g\equiv G/L$. With identical technologies in both regions, static efficiency is achieved in the positive orthant of regional (East-West) factor endowments along a ray determined by (k^*,g^*), the solution to $f_k(k,g)=\overline{R}_K\equiv r+\delta_K$ and $f_g(k,g)=\overline{R}_G\equiv r+\delta_G$. This can be thought of as the grand diagonal of a three-dimensional Edgeworth polyhedron with dimensions 1, k^*, g^*. All points along that diagonal are efficient in the sense that the marginal product of either type of capital equals the world interest rate plus its respective economic depreciation; since r is exogenous and given by the rest of the world, $\overline{R}_K$ and $\overline{R}_G$ can be thought of as world user costs of capital for the respective types. The common real wage can be read off the factor price frontier and represents the residual output after capital is paid its gross marginal product in competitive labor markets.

The multiplicity of these efficient allocations in the steady state implies that the output maximizing trajectory for the economy will be determined by factor adjustment costs. The initial conditions of the economy will imply that the East is off this diagonal at t=0, while the West is on the diagonal.[3] I will assume that capital adjustment costs for both types of capital are external and convex in the net change of the capital stock (i.e. not in the gross level of investment expenditures). Similarly, for migration – the movement of labor between regions – I assume convex costs of which are borne fully by migrants (there are no externalities). Quadratic forms are chosen for tractability.[4]

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[2] For simplicity, I assume full employment throughout. This is clearly at variance with the facts but adding labor supply or search will add little to the aspects which I focus on in this paper.

[3] Strictly speaking this is not an Edgeworth box in the traditional sense, since the endowments of the factors which can be accumulated are not fixed – they can be brought in from "abroad." The supply of labor to the two regions is fixed, however.

[4] For more details on adjustment costs, see Abel (2001), Abel and Blanchard (1983), or Lucas (1967).

3.2. Social optimum

Because this economy meets the conditions for the first and second welfare theorems to apply, the optimal allocation chosen by a hypothetical social planner can be supported as a decentralized market equilibrium. This optimal allocation selects migration and investment policies in both regions to maximize the present discounted value of national output (net of migration and capital adjustment costs).[5] More formally, I seek functions of time $t \in [0,\infty)$ – governing investment rates in equipment (I_t^W and I_t^E) and in structures (J_t^W and J_t^E) in the West and East respectively, as well as net migration from West to East (X_t) which maximize

$$(1) \quad \int_0^\infty e^{-rt}\left[F(K^W,G^W,L^W)-I^W-J^W+F(K^E,G^E,L^E)-I^E-J^E-\frac{\psi_I}{2}\left(I^E-\delta_K K\right)^2-\frac{\psi_J}{2}\left(J^E-\delta_G G\right)^2-\frac{\phi}{2}X^2\right]dt,$$

subject to initial conditions, which are the allocations of both capital types and labor in East and West at t=0. Gross and net migration flows are therefore equal; negative values of X imply net migration from West to East. The positive parameters ψ_I, ψ_J and ϕ capture the intensity of adjustment costs. Labor and capital stocks obey the following equations of motion:

$$(2) \quad \dot{K}_t^i = I_t^i - \delta K_t^i \qquad \text{for } i=E,W$$

$$(3) \quad \dot{G}_t^i = J_t^i - \delta G_t^i \qquad \text{for } i=E,W$$

$$(4) \quad \dot{L}_t^E = -\dot{L}_t^W = X_t .$$

[5] Here output is equated with utility. Setting up problem in terms of utility maximization would require an arbitrary weighting of eastern and western citizens' utility. As long as production and consumption decisions are separable and the world interest rate is given, there is no loss of generality by focusing on the production side.

By assuming that adjustment of western capital stocks is costless, I am able to simplify the model considerably and shift emphasis to relative adjustment costs in the East. These are determined by relative legal regulations, conflicting property rights, bureaucracy-related transactions costs related to both private and public infrastructure.

3.3. Planner's optimum as market equilibrium

Define q^E, ρ^E and μ as the shadow values of a marginal unit of capital equipment, structures, or a worker in place in the East, respectively, for the policy that maximizes (1).[6] To simplify notation, superscripts are used to denote regions when arguments of functions are suppressed; time subscripts are suppressed whenever obvious. Necessary conditions characterizing the optimum are, for all $t \geq 0$:

(5) $$I^E = \left(q^E - 1\right)/\psi_I + \delta_K K^E$$

(6) $$J^E = \left(\rho^E - 1\right)/\psi_J + \delta_G G^E$$

(7) $$X = \mu/\phi$$

(8) $$q^W = 1$$

(9) $$F_K^W = \overline{R}_K \equiv r + \delta_K$$

(10) $$F_G^W \equiv \overline{R}_G = r + \delta_G$$

(11) $$\dot{q}^E + F_K^E + \delta_K \psi_I \dot{K}^E = \left(r + \delta_K\right) q^E$$

(12) $$\dot{\rho}^E + F_G^E + \delta_G \psi_J \dot{G}^E = \left(r + \delta_G\right) \rho^E$$

(13) $$\dot{\mu} + (F_L^E - F_L^W) = r\mu,$$

[6] Technically, they are the co-state variables in the dynamic optimization problem, and have analogs to Lagrange multipliers in static maximization analysis.

plus the equations of motion (2), (3), and (4). Equations (5), (6) and (7) relate optimal investment rates in the East and migration *to the East* as positive and linear functions of their respective shadow prices, which are sufficient statistics for determining both activities. The greater the associated adjustment costs, the lower the respective investment rates, *ceteris paribus*. Equations (8) and (9) represents optimal behavior in the absence of adjustment costs; in the West, the static efficiency condition obtains continuously with constant capital-labor ratio k^* and structures-labor ratio g^* defined above. Migrants from the East are equipped upon arrival in the West with the same level of capital used by other western residents, and earn the western wage denoted by $\overline{w} = F_L^W$.

The three state variables in the model K^E, G^E and L^E are predetermined at any point in time, evolving according to the differential equations (2), (3) and (4). The co-state variables q, ρ, and μ stand for the respective shadow values of equipment capital, structures and labor in the East, given the economy is on the optimal adjustment path defined above. The dynamics of those shadow prices are governed by equations (11), (12) and (13), which are arbitrage conditions equating total holding returns on each "asset" to its respective opportunity cost. Integrating arbitrage conditions (11), (12), and (13) forward from initial conditions and imposing transversality conditions leads to closed form expressions for each of the shadow prices.[7] As is common in perfect foresight models, shadow prices are present values of the entire path of future returns of the respective "assets," discounted using the world interest rate. In the case of investment in the East, the shadow values q^E and ρ^E reflect the present discounted value of present and future marginal products of one unit of capital installed in the East. The shadow

[7] The transversality conditions prevent co-state variables governed by optimality conditions (11), (12) and (13) from assuming explosive paths (i.e. rising faster than rates $r+\delta_K$, $r+\delta_G$ and r, respectively, forever).

value of a worker in the East, μ, represents the present value of the difference in future marginal products of labor between the East and West. Given that $k^W > k^E$ and $g^W > g^E$ at the outset, μ will be negative throughout. The model thus implies a persistent wage gap between East and West which disappears asymptotically as capital accumulates in the East and labor migrates to the West.

4. Steady State and dynamics

4.1. Steady state

The steady state of the model is given by constancy of the state variables K^E, G^E, and L^E; this implies $q^E = \rho^E = 1 \Leftrightarrow F_K^E = \overline{R}^K, F_G^E = \overline{R}^G$, while $\dot{\mu} = 0 \Leftrightarrow F_L^E = F_L^W = \overline{w}$. Thus in the steady state, both regions' allocations are on the grand diagonal of the Edgeworth box described above. Denoting steady-state values of the endogenous variables by bars, the linearized model around that steady state can be written as:

$$(14) \quad \begin{bmatrix} \dot{q}^E \\ \dot{\rho}^E \\ \dot{\mu} \\ \dot{K}^E \\ \dot{G}^E \\ \dot{L}^E \end{bmatrix} = M \begin{bmatrix} q^E - \overline{q}^E \\ \rho - \overline{\rho}^E \\ \mu - \overline{\mu} \\ K^E - \overline{K}^E \\ G^E - \overline{G}^E \\ L^E - \overline{L}^E \end{bmatrix}, \quad \text{with } M \equiv \begin{bmatrix} r & 0 & 0 & -F_{KK}^E & -F_{KG}^E & -F_{KL}^E \\ 0 & r & 0 & -F_{GK}^E & -F_{GG}^E & -F_{GL}^E \\ 0 & 0 & r & -F_{LK}^E & -F_{LG}^E & -F_{LL}^E \\ \psi_I^{-1} & 0 & 0 & 0 & 0 & 0 \\ 0 & \psi_J^{-1} & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi^{-1} & 0 & 0 & 0 \end{bmatrix}$$

The dynamic properties of the system are encoded in the eigenvalues of the matrix M, $\{\lambda_1, \ldots, \lambda_6\}$. First, note that $\det(M) = \prod_i \lambda_i = 0$ so at least one of them equals zero. Since $tr(M) = \sum_i \lambda_i = 3r$, at least one of the six roots is positive, so at least one variable is not predetermined, i.e. must be forward-looking. In fact, since in theory three of the system's

variables are in fact jumping, forward-looking variables, exactly three roots should exceed zero. The roots have the following analytic form:

$$(15)\qquad \{\lambda_1,...,\lambda_6\}=\left\{\begin{array}{l} 0, r, \frac{1}{2}\left[r+\sqrt{r^2+2\left(A-\sqrt{A^2-4B}\right)}\right], \frac{1}{2}\left[r+\sqrt{r^2+2\left(A+\sqrt{A^2-4B}\right)}\right], \\ \frac{1}{2}\left[r-\sqrt{r^2+2\left(A+\sqrt{A^2-4B}\right)}\right], \frac{1}{2}\left[r-\sqrt{r^2+2\left(A-\sqrt{A^2-4B}\right)}\right] \end{array}\right\},$$

where

$$A = -\left(\psi_I^{-1}F_{KK}^E + \psi_J^{-1}F_{GG}^E + \phi^{-1}F_{LL}^E\right)>0$$

and

$$B=\psi_J^{-1}\phi^{-1}\left(F_{GG}^E F_{LL}^E-\left(F_{GL}^E\right)^2\right)+\psi_I^{-1}\psi_J^{-1}\left(F_{KK}^E F_{GG}^E-\left(F_{KG}^E\right)^2\right)+\psi_I^{-1}\phi^{-1}\left(F_{KK}^E F_{LL}^E-\left(F_{KL}^E\right)^2\right)>0.$$

As long as the inner discriminant (A^2-4B) is nonnegative, the model has meaningful solutions. In that case, is easy to see that all eigenvalues of M are real-valued; three $(\lambda_2,\lambda_3,\lambda_4)$ are greater than zero, while two (λ_5,λ_6) are strictly less than zero. This corresponds to a typical perfect foresight model with saddle-path stability, in which three co-state ("jumping") variables are forward-looking.

The zero root implies hysteresis (path dependence), or that initial conditions of Eastern factor supplies K^E, G^E, and L^E, as well as the constellation of adjustment costs, determine the steady state. In a stochastic version of this model with explicit treatment of uncertainty, temporary disturbances to initial factor allocations, such as migration or privatization policies, would have permanent effects on the region's steady-state size.

4.2. The Central Role of Adjustment Costs

The previous section established that adjustment costs are a key determinant of the resting point of the economy, since the path taken by the eastern capital and labor stocks

depends on the correctly anticipated, future paths of both, but also on the costs of adjustment. By inspection, the two stable (negative) roots are increasing in each of the adjustment cost parameters ψ_I, ψ_J, and φ, approaching zero from below. In the long run, the adjustment speed or persistence is determined by the negative eigenvalue of M with the smallest absolute value, which is increasing in adjustment costs. In addition, adjustment costs enter multiplicatively and amplify each other in determining the size of the stable eigenvalues. Local concavity of the production function, in contrast, works in the opposite direction, accelerating adjustment.

4.3. Implications for Factor Prices and Adjustment Costs

Adjustment costs also have implications for the behavior of observed wages and the rate of return on capital in the integration process. Since factor supplies cannot move instantaneously, the capital-labor ratios in the East k^E and g^E will remain below West levels for some time; during this period wages will be lower and return on capital will be higher. These factor price differentials are transient and consistent with finite factors flows over time. The model also predicts that they will be persistent, disappearing only in the long run. Under competitive factor remuneration in the West ($F_K = r+\delta_K = \bar{R}_K$, $F_G = r+\delta_G = \bar{R}_G$,, $F_L = \bar{w}$), (11), (12) and (13) can be rewritten as

(16) $$R_K^E = \bar{R}_K + \delta_K\left(\frac{q^E - 1}{q^E}\right) + \frac{\dot{q}^E}{q^E}$$

(17) $$R_G^E = \bar{R}_G + \delta_G\left(\frac{\rho^E - 1}{\rho^E}\right) + \frac{\dot{\rho}^E}{\rho^E}$$

(18) $$w^E = \bar{w} + r\mu - \dot{\mu}.$$

Since μ<0 and $\dot{\mu} > 0$, wage differentials are consistent with a persistent wage gap across regions over time ($w^E < \overline{w}$). Similarly, $q^E > 1$, $\dot{q}^E < 0$ and $\rho^E > 1$, $\dot{\rho}^E < 0$ along the adjustment path, so $R_K^E > \overline{R}_K$ and $R_K^E > \overline{R}_K$. These theoretical results can thus reconcile finite rates of factor movements with persistently low wages and high rates of return in eastern Germany.

With some mildly heroic assumptions, the model can also be used for back-of-the-envelope calculations of adjustment costs as well as shadow values associated with the three state variables consistent with recent historical experience. More concretely, it is possible to perform a rough calibration of the model for an assumed convergence path consistent with Eastern Germany in the years following unification; using assumed values for other, less controversial parameters, one can back out the adjustment costs implied by that episode.

As an example, assume that the shadow value of migration at t=0 is given by (13) integrated forward plus an appropriate transversality condition. Further assume that the wage equals marginal product in both regions, and that convergence occurs at constant average rate λ over time.[8] The historical record of Eastern Germany in the 1990s yields values of r=0.03 and λ=0.07 (the latter is roughly the observed rate of subsequent wage convergence). Measuring the eastern wage in units of the western equivalent, w^E_{1991}= 0.50. It follows that μ = -5, i.e., in 1991, i.e., the value of moving a worker from the East to the West in 1991 was roughly 500% of the annual western wage. In the command optimum as well as a competitive decentralized equilibrium, this is the marginal cost of migration. According to the Germany Federal Statistical Office, net migration to Eastern

[8]With initial and terminal conditions w_0 and $\bar{w}$, this approximation implies $w_s^E = w_0^E e^{-\lambda s} + \overline{w}(1-e^{-\lambda s})$, or $w_s^E - \overline{w} = \left(w_0^E - \overline{w}\right)e^{-\lambda s}$ for s≥0 In fact, the model's true adjustment speed will vary depending on the distance from the steady state, since both stable eigenvalues jointly determine the model's persistence.

Germany was roughly -165,000 in 1991.[9] Now use the migration function (7) plus the observed net East-West migration in that year to back out the value of ϕ consistent with that migration flow, 5/165000, or 0.00303% of the annual western wage per person-squared. Put in perspective, by 2004, w^E=0.75, so the wage gap had declined to 25%, implying a shadow value of the marginal migrant of 2.5, or 250% of the western wage. With the 1991 estimate I have chosen for ϕ, the model predicts migration to equal 2.5/(0.0000303)=82,500, compared with the average of 72,000 over the period 2000-2004 (in fact, net migration had declined to 49,000 by 2005).

With additional assumptions, the model could be used to impute a shadow value to installed equipment and structures in eastern Germany, as well as to back out estimates of the investment adjustment cost parameters ψ_I and ψ_J. Unfortunately, independent information on the marginal return to capital in the East is unavailable. In addition, extreme heterogeneity of capital goods and projects renders the average return to capital a poor indicator of the marginal return, which is the decisive measure. Finally, tax treatment of investment was highly distorted over the period (Sinn 1992). Future work will incorporate tracking the rate of return on capital in the East more closely over time.

5. Conclusion

The title of this paper presents eastern Germany as a puzzle. The region was clearly hit by a shock, but hardly by a conventional productivity shock seen in real business cycle models which move total factor productivity, capital and labor together. In the German unification episode, as is the case with other integration episodes observed in Central and

[9] Source: Statistisches Bundesamt, „Abwanderung von Ost- nach Westdeutschland schwächt sich weiter ab“, Pressemitteilung vom 28. September 2005.

Eastern Europe, production factors move in opposite directions, even as output is rising. At the outset of post-unification period, Eastern Germany had been isolated from world trade and was burdened with an outdated capital stock and uncompetitive output structure (Akerlof et al., 1991). The observed path of adjustment has generally involved moving labor away from the East while bringing capital into the region at the same time. This is precisely what has been observed over the past fifteen years. This paper has taken this observation as a starting point, characterizing real regional integration as a mobility race between factors of production, which is decided by costs of moving them, even if these costs are irrelevant for the long run.

It is important to stress that there is no role for policy under conditions considered in this paper. If externalities were to arise from migration and are not reflected in market incentives, an investment subsidy in the East could be rationalized – as could a bribe for workers to stay in the East. This would have to be worked out formally, since it is not a direct implication of the current model. Steady-state production has constant returns to scale, and agglomeration effects are excluded *a priori*.

Central to my analysis are adjustment costs of moving factors across regions. While much attention has been paid to agglomeration effects, adjustment costs associated with moving factors of production across space have been neglected in the formal study of economic integration.[10] If these costs are relevant at all, they must be so for the massive redeployment of labor and capital associated with the reconstruction of Germany. Unlike the economic integration of US, Canada and Mexico or the EU, German reunification also involves significant redeployment of labor, as well as capital mobility and international trade. Barriers related to language, institutions, and culture in

[10] See Peter Neary (2001).

unified Germany are negligible; convergence of behavior in the past 15 years has been so significant that one can really speak of a common representative agent.[11]

This paper has abstracted from a number of important dimensions of the German reunification episode. The assumption of perfectly competitive product and labor markets is clearly violated. Despite the convergence of labor supply behavior implied by Table 1, the fact that unemployment is higher in the East suggests that labor markets are not functioning properly – not enough jobs have been created at current wages, wages are not set at market-clearing levels, or labor and product market rigidities prevent adjustment.[12] In addition, adjustment costs of moving factors within regions across sectors are bound to be significant, and probably increased by labor market policies such as unemployment insurance and job protection. A model with search and unemployment is likely to introduce a second brake on the integration process as declining industries fail to free up sufficient labor and capital for growing sectors.[13] Despite these abstractions, the model gives an opportunity to study German integration through the lens of a particular vision of economic integration which stresses migration and capital flows in determining the efficient speed of the process. It also gives clear justification for finite rates of migration and investment observed in practice, despite substantial differentials in observed factor prices during the adjustment process.

[11] Recent research by Burda and Hunt (2001), Fuchs-Schuendeln (2004), and Dohmen et al. (2005) suggest convergence in the behavior of eastern and western Germans over time.
[12] See for example Merkel and Snower (2006) and Fuch-Schündeln (2006).
[13] Rogerson (2005) has applied this type of analysis to the phenomenon of structural change. .

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Table 1. East German Convergence, 1991-2005 (% of West German value)

Year	Consumption	Nominal Wages	Labor Productivity	GDP per capita	Unemployment rate	Nonemployment rate	Participatio rate
1991	74	50	44	49	170	103	137
1992	74	65	57	53	261	112	121
1993	76	71	67	60	240	111	111
1994	78	72	70	64	224	108	108
1995	81	74	71	66	206	106	108
1996	83	72	72	67	198	106	106
1997	82	76	72	67	206	106	107
1998	82	76	70	66	207	107	107
1999	83	76	71	66	211	107	106
2000	83	73	72	66	233	109	104
2001	83	74	72	65	248	110	102
2002	82	74	73	66	243	110	102
2003	83	75	73	67	236	110	101
2004	83	75	75	67	231	109	100
2005	na	74	79	69	211	116	103

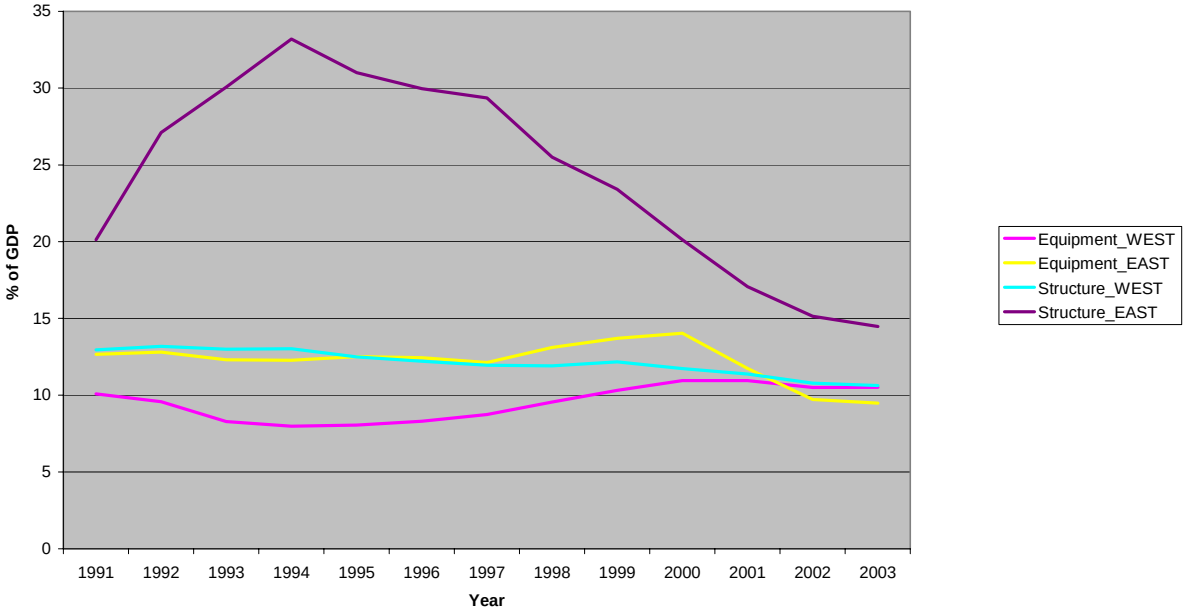
Source: Statistisches Bundesamt

Table 2. Capital formation in East and West, 1991-2004

	Investment rate (% of GDP)		*Annual investment per capita (EUR, 2000 prices)*		*Cumulative Investment (bill.EUR,2000 prices)*	
Region	*Equipment*	*Structures*	*Equipment*	*Structures*	*Equipment*	*Structures*
East	12.1	23.6	1807.1	3486.7	795.3	854.5
West	9.6	11.9	2236.2	2736.8	2016.4	2463.1

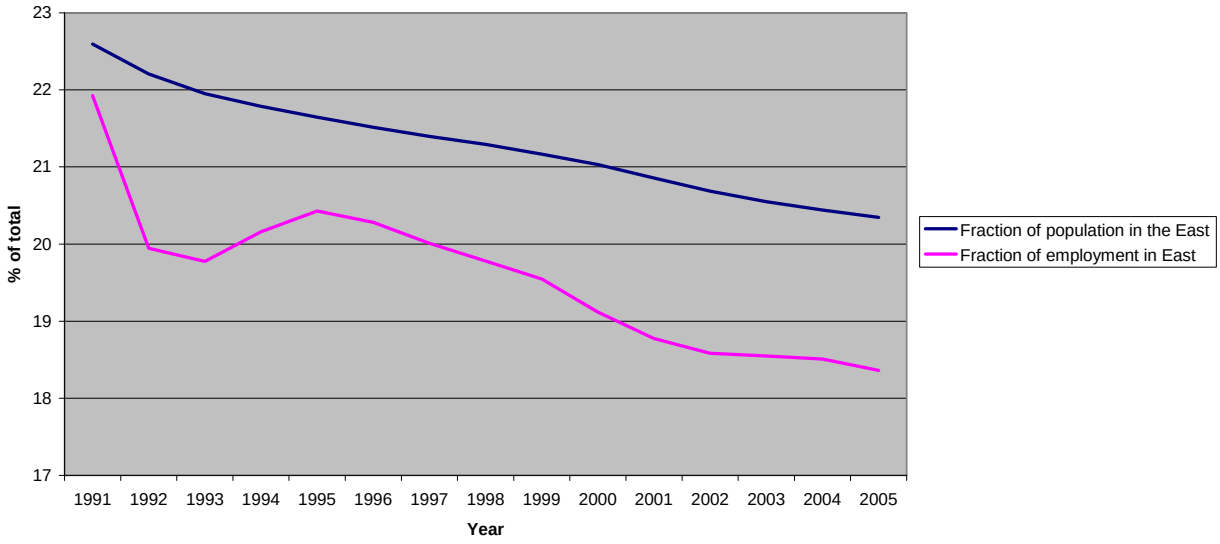
Source: Statistisches Bundesamt

Figure 1. Investment in East and West Germany



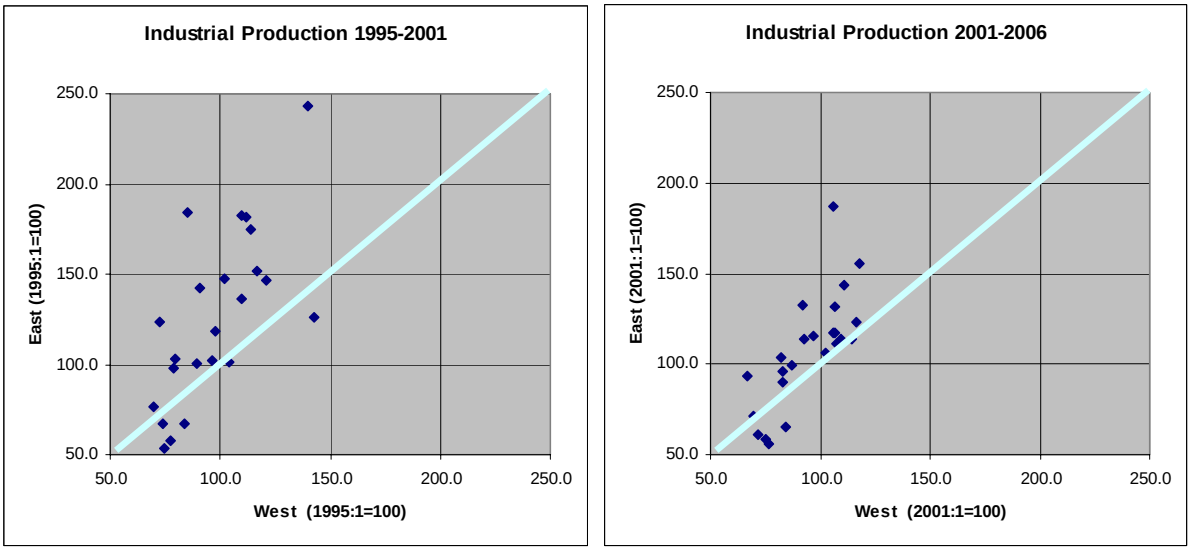
Source: Statistisches Bundesamt

Figure 2. German Employment and Population in East



Source: Statistisches Bundesamt

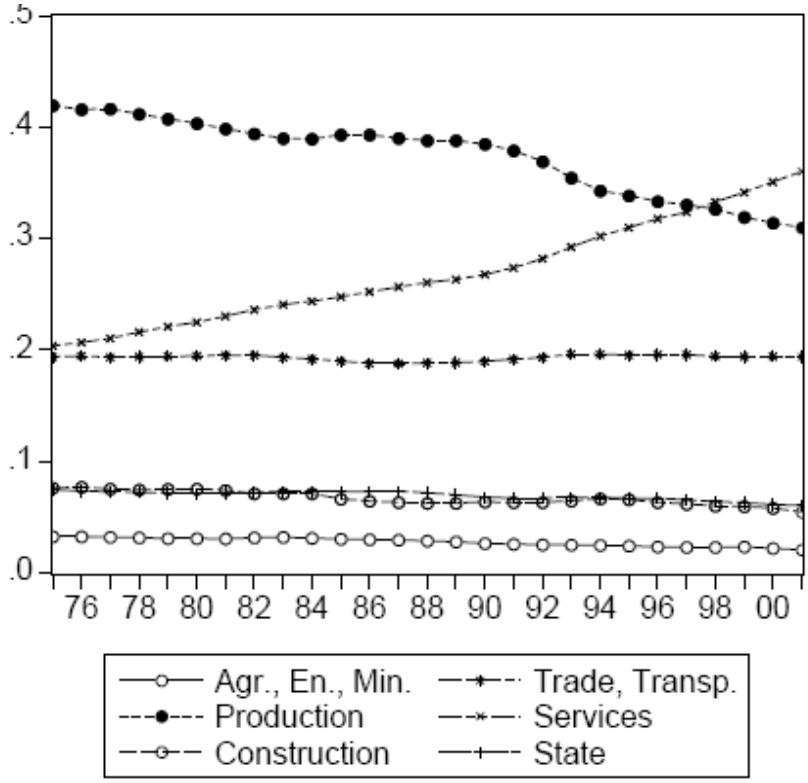
Figure 3. East-West Shifts in Industrial Production, 1995-2006



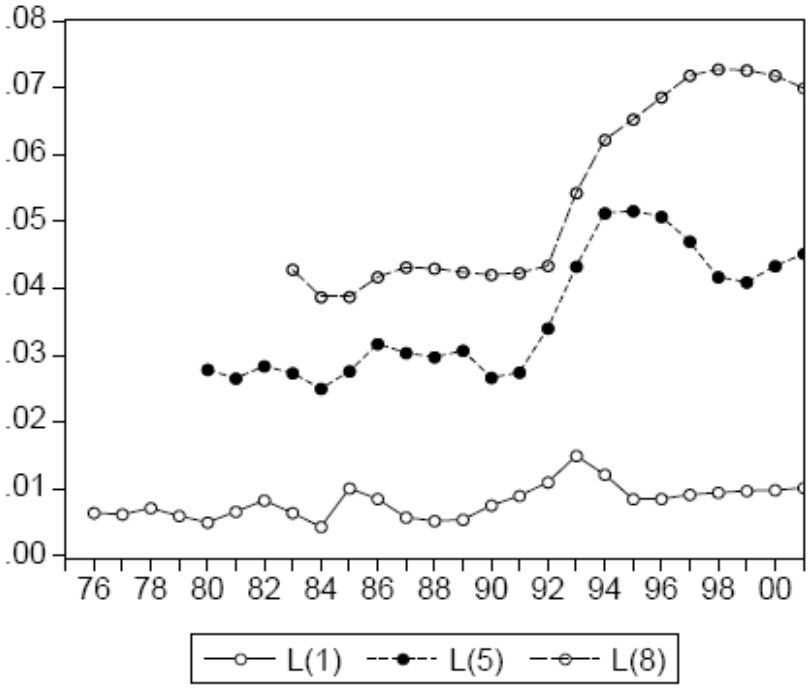
Note: Each point corresponds to one of the following industrial sectors: energy production; mining and quarrying; coal mining, peat, oil and gas production; food processing and tobacco; textiles and clothing; leather; wood products excluding furniture; paper and printing; coke and oil refining; chemical manufactures; rubber and plastic products; glass, ceramics and processing of stone; metal production and processing; machinery and machine tools; office equipment, data processing and electronics; automotive and automobile production; furniture, jewelry and musical instruments; energy and water provision, building construction; civil engineering/public works.
Source: Statistisches Bundesamt

Figure 4. Indicators of Structural Change in West

Sectoral fraction of socially insured employment



Lillien index of employment growth turbulence at different lags



Source: Bachmann and Burda (2006)

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Explaining the Low Labor Productivity in East Germany - A Spatial Analysis -

by

Nicola Fuchs-Schündeln and Rima Izem

January 2007

Nicola Fuchs-Schündeln and Rima Izem (Harvard University) *

Explaining the Low Labor Productivity in East Germany
- A Spatial Analysis -

Abstract

This paper presents a spatial analysis of unemployment rates in Germany. The goal of this analysis is to explain the stubbornly low labor productivity and high unemployment rates in Eastern Germany. We build a model of commuting to distinguish between worker and job characteristics as the main causes of the low labor productivity, and use the method of simulated moments to estimate the East-West ratios of worker and job characteristics. The "slope" of the unemployment rate across the former East-West border serves as the main identification of the model. The preliminary results suggest that East and West German skills are very similar, while job characteristics differ significantly between East and West.

Keywords: Transferability of Human Capital, Spatial Allocation of Labor

JEL: C15, J24, J61.

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1 Introduction

Since German reunification in 1990, unemployment rates in East Germany have been stubbornly high. Figure 1 shows the mean unemployment rates by county (*Kreis*) between 1998 and 2004, as well as the former East-West border.[1] There are 439 counties in Germany, of which 326 belong to the former West. The average population size of a county is 188,000. On average, unemployment rates in the East are around twice as high as in the West.

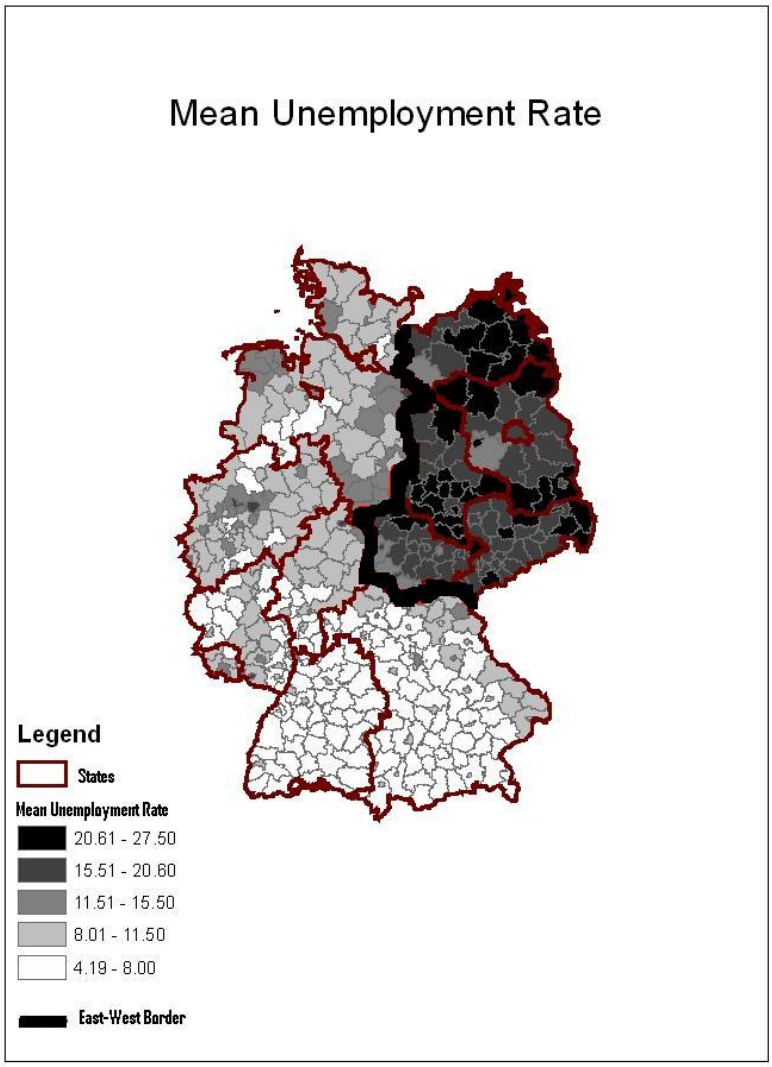

Figure 1: Mean Unemployment Rates in German Counties, from 1998 to 2004.

By now, it is well established that the major cause of the high unemployment rates in the

[1] These data come from the Institut für Arbeitsmarkt- und Berufsforschung (IAB), and are the data that we use in our estimation.

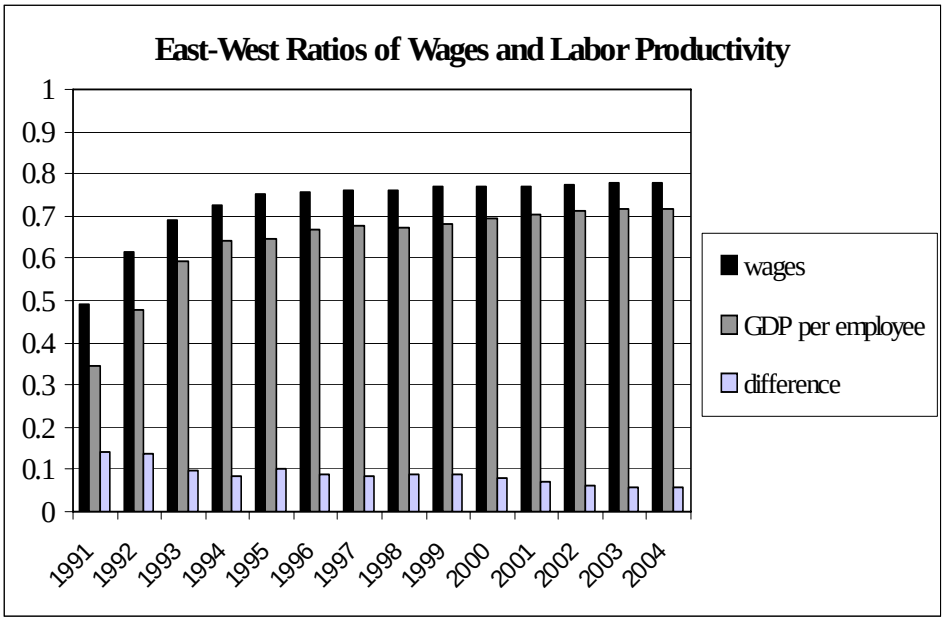

Figure 2: East-West wage and labor productivity gap, 1991-2004

East lies in wages exceeding labor productivity (see e.g. Burda and Hunt, 2001). Figure 2 shows the East-West ratios of wages in addition to the East-West ratios of labor productivity from 1991 to 2004. The trend in both ratios has been remarkably similar. There is rapid convergence between East and West until 1995, and from then on convergence has slowed down significantly, or even come to a halt. Most importantly, the East-West ratio of wages is always larger than the East-West ratio of labor productivity, and there is only a small and slow decline in the difference between both. Thus, it seems that wages in the East are too high relative to wages in the West, given the lower labor productivity.[2]

While the gap between wages and labor productivity has been established as the main reason for the high unemployment rates in the East, there is no consensus as to *why* labor productivity remains low in the East. Two different strands of explanations have been brought forward, and the goal of this paper is to differentiate between these two different explanations. The first set of hypotheses has to do with job characteristics, i.e. reasons outside the influence of an individual worker. Possible explanations range from firm sizes (Beer and Ragnitz, 1997), branch structure (Rothfels, 1997), the heterogeneity of factor endowments (Dietrich, 1997), agglomeration effects

[2] Ragnitz (2006) shows that a similar East-West gap exists when using alternative measures of productivity. Funke and Rahn (2002) provide a detailed analysis of the efficiency of firms in East Germany, and find that they are significantly less efficient than West German firms.

(Yellen, 2001), R&D spending (Felder and Spielkamp, 1998), and network effects (Uhlig, 2006), to managerial and organizational deficiencies (Yellen, 2001; Mallok, 1996; Bellmann and Brussig, 1998; Ragnitz et al., 1998; Müller et al., 1998).

A completely different explanation sees the reason for the lower labor productivity in East Germany in worker characteristics. Formal educational levels in the GDR exceeded those of West Germans (see e.g. Klodt, 2000). Yet, it might be that there are unobserved differences in human capital between East and West German workers. Firm-specific or occupation-specific human capital might have depreciated at reunification since it did not match the skill requirements of firms using technologies typically used in West Germany (Ragnitz, 2006). Canova and Ravn (2000) assume that skill levels are on average lower in the East than in the West, based on the observation that much of the workers' human capital in the East was organization-specific.

We propose a novel method for differentiating between these two explanations, i.e. differences in worker characteristics or differences in job characteristics. Since skills and job characteristics are hard to quantify, they are to be estimated in our model. We estimate the East-West ratios of these unobservable characteristics by fitting a spatial economic model to the data. The model predicts the working and commuting behavior of individuals given the unobservables.[3] More precisely, it models the effects of skills, job characteristics, and commuting on the individual labor productivity, and the unemployment rate on the level of the county. We are able to differentiate between worker and job characteristics as the causes for the low labor productivity because the predictions for commuting across the border differ under both hypotheses, resulting in different slopes of the unemployment rate across the former border. Essentially, if only worker characteristics cause the low labor productivity, then any unemployed worker in the East would not be able to find a job in the West either. On the other hand, if only job characteristics are less favorable in the East, then unemployed East Germans who live close to the border can commute to work in the West, thus depressing the unemployment rates in Eastern border counties, and increasing the unemployment rates in Western border counties. Figure 3 shows the county unemployment rates as a function of the distance to the former border. This distance is measured as a negative number for West German counties, and as a positive number for East German counties. The graph clearly shows that Western counties have lower unemployment rates than Eastern counties. Most importantly, counties at the former East-West border seem to have intermediate unemployment rates.

[3] Importantly, the model abstracts from migration. This assumption is discussed in detail in section 2.

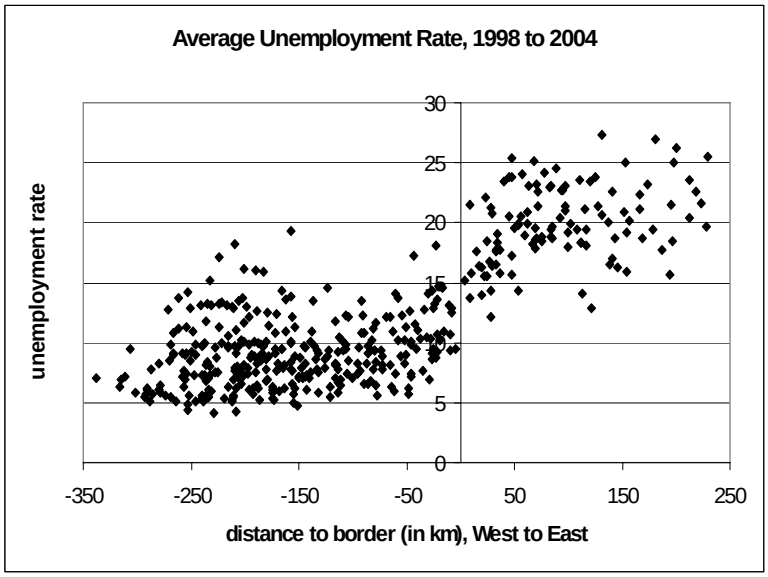

Figure 3: County unemployment rates as a function of distance to border. Negative distance indicates location west of the former border, positive distance indicates location east of the former border.

Our model relates to the literature that takes the location of jobs and workers in different markets into account.[4] Tobin (1972) refers to "obsolescent industries and declining areas" when explaining why vacancies and unemployment coexist. Shimer (2006) analyzes the geographical and skill mismatch of unemployed workers and vacancies in a model in which wages adjust to clear regional labor markets, and firms decide how many vacancies to post, but movement of workers between the markets is exogenous. Taking the opposite approach, Lagos (2000) builds a model of the taxicab market in which the spatial location of demand and supply arises endogenously, but prices are exogenously fixed.

Like Lagos (2000), we assume that wages are exogenous. This seems reasonable in the context of Germany, due to the high rate of unionization and the political pressure to increase wages in the East quickly after reunification (see e.g. Snower and Merkl, 2006). While we assume that the number of jobs and the number of labor force participants in any county is fixed, regional labor supply is still an endogenous variable through the commuting decision of workers.

Our preliminary results indicate that the East-West ratio of job characteristics is smaller than

[4] While our model refers purely to geographic labor markets, the literature often refers in addition to markets for different skill levels.

the East-West ratio of worker characteristics. In fact, skills do not differ significantly between East and West, while job characteristics in the East are significantly less favorable than those in the West, in both economic and statistical terms. The model captures the spatial trend of the unemployment rate fairly well.

The model is presented in Section 2. That section also explains how we solve and calibrate the model, and introduces our estimation methodology, namely the method of simulated moments. Preliminary results of the estimation are shown in Section 3. Section 4 rules out some alternative explanations for the observed slope of the unemployment rate along the border. Finally, Section 5 concludes.

2 The Model

The model assumes that labor productivity depends on workers' skills s_i and counties' job characteristics I_j, where subscript i indicates an individual, and subscript j a county. Skill and job characteristic distributions are the same for all counties in the East and all counties in the West, but they potentially differ between East and West. Specifically, we assume that individual skill levels s_i are independent and normally distributed, but truncated at 0, with mean S_E in East, S_W in West, and the same variance σ_S^2. Counties' job characteristics I_j are constant, and equal to I_E in the former East and I_W in the former West. Wages w are homogeneous, exogenous, and the same in East and West.

Whether an individual i is qualified to work in any county j will depend on the marginal product of labor. The marginal product of labor of person i in county j is a function of worker and job characteristics. It is defined as

$$\text{mpl}_{ij} = \text{mpl}(s_i, I_j) = s_i * I_j,$$

Firms in county j will not be willing to employ individual i if

$$\text{mpl}_{ij} < w.$$

The model abstracts from migration, implicitly assuming that migration costs are prohibitively high. Massive migration from the East to the West took place in the early 1990s. Yet, since then migration flows have been relatively small. It is well established that unobserved migration costs seem to be high in Germany, given that in general we do not observe significant migration flows in response to economic conditions (e.g. Schündeln, 2005, and Decressin, 1994). If we find

significant differences in worker characteristics between East and West, these could be caused either by the different educational backgrounds, or by self-selected migration of high-skilled East German workers into the West.

Commuting is possible but costly in the model. The cost of commuting of person i from home county h to county j is a function of the commuting distaste θ_i and the pairwise distance between counties h and j, d_{hj}. We assume $\theta_i \sim U[1,2]$. The cost of commuting is defined as

$$c_{i,hj} = c(\theta_i, d_{hj}) = (\alpha + \beta d_{hj})\,\theta_i$$

where α and β are two parameters to be calibrated. An individual is willing to commute if the cost of commuting plus the wage is smaller than the unemployment benefit, which is equal to a fraction λ of the wage

$$c_{i,hj} < (1-\lambda)\,w.$$

With this setup, we propose a static model that puts a limit on the number of jobs available in each county, and incorporates competition on workers' skills. Each firm prefers a higher skilled over a lower skilled worker, and each worker prefers a job in a closer county to one further away. The number of jobs in each county is exogenously fixed, as is the number of individuals in the labor force in each county. We discussed the assumption of no migration above; given fixed costs of investment, the assumption of a fixed number of jobs seems reasonable for a relatively short-term model like ours. Let $p_{i,hj}$ be the probability of an individual i living in county h to get a job in j, with a total number of jobs n_j available in j, then

$$\begin{aligned}
p_{i,hj} &= 1 - q_{i,hj} \\
q_{i,hj} &= P\left[C^c_{i,hj} \cup \left(C_{i,hj} \cap \sum_k \mathbb{I}(C_{k,hj} \cap D_{ki}) \geq n_j\right) \cup_l \left(C_{i,hl} \cap E_{i,hjl} \cap \sum_k \mathbb{I}(C_{k,hl} \cap D_{ki}) < n_l\right)\right], \text{ where} \\
C_{i,hj} &= \{\text{mpl}_{ij} \geq w \text{ and } c(\theta_i, d_{hj}) \leq 1\} \\
D_{ki} &= \{s_k \geq s_i\} \\
E_{i,hjl} &= \{c(\theta_i, d_{hj}) > c(\theta_i, d_{hl})\}
\end{aligned}$$

Summarizing, a person is qualified to work in a county if her marginal product of labor there is higher than the wage. She is willing to work in that county if the cost of commuting is not prohibitive. Among qualified individuals willing to commute, jobs are filled on a more skilled to less skilled order as long as there are vacancies in that county. All individuals seek to minimize the cost of commuting, and hence prefer a job in a county closer to home to one in a county

further away. Thus, an individual i from county h will not be employed in county j if either the individual is not qualified to work there or not willing to commute there ($C^c_{i,hj}$), or the individual is qualified and willing, but all jobs are taken already by higher skilled individuals ($C_{i,hj} \cap \sum_k \mathbb{I}(C_{k,hj} \cap D_{ki}) \geq n_j$), or the individual could work in j, but finds employment in a county closer to home ($C_{i,hl} \cap E_{i,hjl} \cap \sum_k \mathbb{I}(C_{k,hl} \cap D_{ki}) < n_l$).

Note that in this model a qualified individual is not guaranteed to work in her home county. It might be that either there are not enough jobs available for all qualified individuals living there, or that there are too many higher skilled workers in neighboring counties that would like to commute into the home county. This can generate commuting within the West and within the East. In addition, under the assumption that $I_E < I_W$, the model will result in commuting from the East to the West across the former border. This commuting occurs because some relatively high skilled individuals in the East cannot find a job there since their marginal product of labor is lower than the wage as a result of the unfavorable job characteristics. Yet, these individuals are skilled enough to find a job in the West, where the job characteristics are better. As a consequence, we also see more commuting in the westward direction within the East and within the West. The westward commuting within the West occurs because more skilled eastern workers fill western jobs, and less skilled western job seekers have to find a job further into the West. The westward commuting within the East occurs because the westward commuting of eastern workers close to the border opens vacancies there for eastern workers living further into the East.

2.1 Solving the model

Deriving the closed form of the distribution of the unemployment rate is not trivial in this case. However, the model can be solved numerically given the parameters of the unobservables. Given $I_E, I_W, S_E, S_W, \sigma^2_S$ and a matrix of pairwise driving times D between the counties, let N_W be the number of western counties, and N_E the number of eastern counties, and let l_j be the number of individuals in the labor force of county j. The algorithm is as follows:

1. Draw $\sum_{j=1}^{N_W} l_j$ independent s_i's in West and $\sum_{j=1}^{N_E} l_j$ independent s_i's in East from the appropriate distributions.

2. Draw $\sum_{j=1}^{N_W} l_j + \sum_{k=1}^{N_E} l_k$ independent θ_i's from Uniform [1,2].

3. Rank individuals from higher to lower skills.

4. For each individual, rank counties from smallest cost of commuting to highest cost.

5. Iterate the following steps:

   (a) Individual gets the job in closest county which has available job and where individual is willing and qualified to work.

   (b) Update the number of jobs available.

6. Compute UR_j's by summing up the number of individuals in county j that could not find a job, divided by the total number of individuals in county j.

2.2 Calibration

We set the wage equal to $w = 1$, the unemployment replacement ratio equal to $\lambda = 0.5$, and the variance of the skill distribution equal to $\sigma_S^2 = 1$. The total number of available jobs per county is equal to the number of people employed in each county in 2001, plus three times the number of vacancies posted at the employment agency for the respective county.[5] The number of vacancies corresponds to vacancies posted at the employment office, and the IAB estimates that roughly a third of all vacancies are posted that way. The total number of people in the labor force per county is set equal to the labor force in each county, i.e. people living in each county who either work or are registered as unemployed.[6]

The distance between two counties is measured as the driving time between the closest points on a road to the centroids of the most populated *Gemeinden* of every county.[7] All interstates (*Autobahnen*) and larger roads (*Bundesstrassen*) are taken into account in this calculation. We assume that the average driving speed on an interstate is 100 km/h, and on the other roads 60 km/h.[8] With this measure of distance, we calibrate the cost of commuting to take the following form

$$c(\theta_i, d_{hj}) = 0.25\theta_i \left[1 + \frac{d_{hj} - d_{\min}}{d_{\max} - d_{\min}}\right]$$

where $d_{\min}$ corresponds to the minimum one-way driving time everyone is willing to commute, and $d_{\max}$ to the maximum driving time beyond which nobody is willing to commute.[9] We calibrate $d_{\min} = 15$ minutes and $d_{\max} = 100$ minutes based on the reported willingness to commute from

[5] The data of people employed in each county, which includes employees, self-employed, and civil servants, as well as the data of vacancies was made available to us by the IAB.

[6] Again, the number of people working includes employees, self-employed, and civil servants.

[7] There are between 6 and 235 *Gemeinden* in a county (*Kreis*).

[8] Note that the average speed is smaller than the legal speed limit.

[9] Thus, an individual is willing to commute if $0.25\theta_i \left[1 + \frac{d_{hj} - d_{\min}}{d_{\max} - d_{\min}}\right] < 0.5 \Leftrightarrow 0.5\theta_i \left[1 + \frac{d_{hj} - d_{\min}}{d_{\max} - d_{\min}}\right] < 1$.

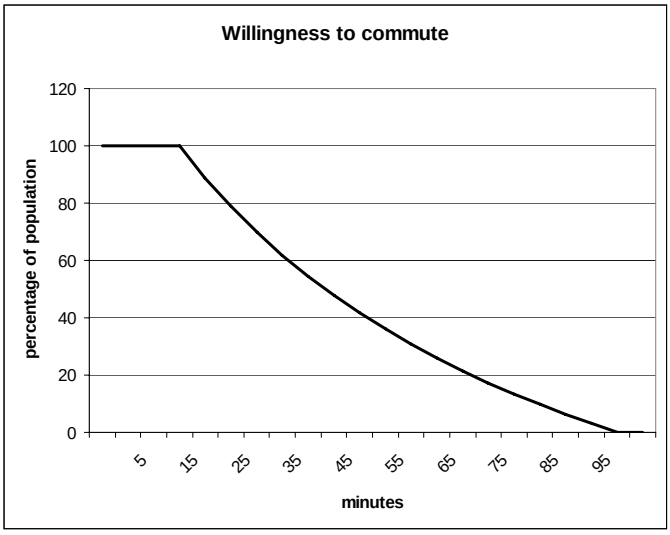

Figure 4: Percentage of population willing to commute a certain number of minutes (one-way)

two German surveys. One of those surveys (McKinsey et al., 2005) asks whether a respondent would be willing to commute up to 2 hours per day (i.e. two-way), and 31% of the respondents answer positively. In the other survey, conducted by the internet portal meinestadt.de in 2005, the mean one-way distance individuals are willing to commute corresponds to 41 km. 75% of respondents are willing to commute up to 20 km, 50% up to 30 km, 25% up to 50 km, and 10% up to 70 km.[10] Figure 4 shows the percentage of the population willing to commute a certain amount of time under our calibration, and it matches the numbers from the surveys very well.

2.3 Identification and estimation

We estimate the model using the method of simulated moments. For normalization purposes, we fix $I_W = 1$. The parameters to be estimated are the skill ratio $\frac{S_E}{S_W}$, the job characteristics ratio $\frac{I_E}{I_W}$, and also the mean skills in the West S_W. Thus, our parameter vector β comprises $\beta = \left\{ S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W} \right\}$.

The identification of the model comes from the regional behavior of the unemployment rate, and especially the behavior of the unemployment rate around the border. Given I_W, S_W pins down the average unemployment rate in the West. Any decrease in the East-West worker or job characteristic ratios leads to an increase in the difference of the mean unemployment rates between

[10] This survey question was answered by 10,006 respondents. The survey from Perspektive Deutschland was answered by 510,000 individuals.

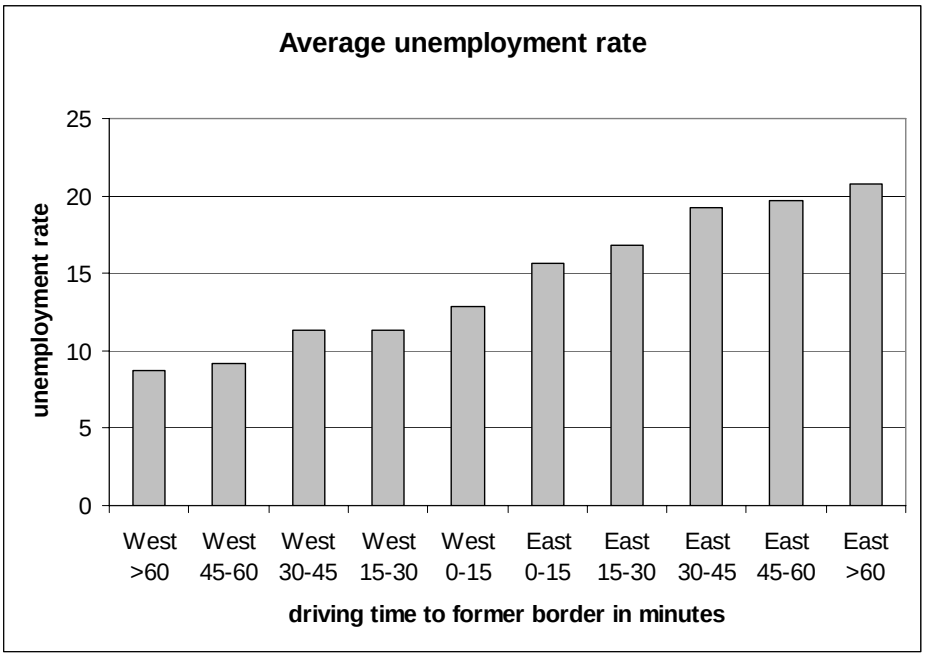

Figure 5: Average unemployment rates of different regions, constructed according to driving time to former border

East and West. However, a decrease in the East-West skill ratio leads to a *sharper* increase in unemployment rates at the border, while a decrease in the East-West ratio of job characteristics leads to a *flatter* increase; i.e. the effect on the slope of the unemployment rate across the border goes in different directions.

Given this identification, we choose to approximate the slope of the unemployment rate along the border through a step function, and to match the average unemployment rates of 10 regions. For East and West separately, we construct the average unemployment rate of all counties within 15 minutes driving time to the border, those with a driving time to the border between 15 and 30 minutes, between 30 and 45 minutes, between 45 and 60 minutes, and all counties with a driving time to the border of more than an hour.[11] Figure 5 shows the average unemployment rates of these regions; they are monotonically increasing as one moves from West to East.

Let $UR^t\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)$ be the average unemployment rate of region t, and let UR_j^t be the unemployment rate of county j in region t. Moreover, $S_{W0}, \frac{I_E}{I_W}_0, \frac{S_E}{S_W}_0$ are the true parameter

[11] Since there is not much variation in the average unemployment rates further than 60 minutes away from the border, and since most of our identification comes from the border area, we choose not to break down the region beyond 60 minutes from the border into further subregions.

values. For every region t, the following moment condition holds

$$E\left(UR_j^t - UR^t\left(S_{W_0}, \frac{I_E}{I_{W\,0}}, \frac{S_E}{S_{W\,0}}\right)\right) = 0$$

We use the method of simulated moments to find the parameter estimates that minimize

$$\min_{S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}} \widehat{M}\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)' W \widehat{M}\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)$$

where $\widehat{M}\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)$is a column vector of size t, and each element of $\widehat{M}$ equals the empirical counterpart $\widehat{M}^t = \frac{1}{N^t}\sum_{j \epsilon t}\left(UR_j^t - \widehat{UR}_S^t\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)\right)$ of the above stated moment condition. N^t is the number of counties in region t, and $\widehat{UR}_S^t\left(S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}\right)$ is the vector of average simulated regional unemployment rates, given the parameters $S_W, \frac{I_E}{I_W}, \frac{S_E}{S_W}$.

We apply a two-step procedure. In the first step, the weight matrix is equal to the identity matrix, $W = I$. This step provides us with first consistent estimates of our parameter vector. Moreover, it allows us to construct an estimate of the variance-covariance matrix $\widehat{\Omega}$. In the second step, we use the inverse of this matrix as the weight matrix, $W = \widehat{\Omega}^{-1}$, reoptimize, and get efficient estimates of our parameter vector. Using the matrix $\widehat{\Omega}$ and the numerical derivatives $\frac{\partial \widehat{UR}_S^t}{\partial \beta}$, we can also construct standard errors for our estimates.

We currently solve the model by using a gridsearch over our parameter vector β with 10 simulations at each gridpoint.[12] We divide both the number of jobs and the number of people in the labor force by 1000. The grid is still quite coarsely uniformly spaced with step sizes of 0.01. Given the coarse grid and the small number of simulations, our results should be seen as preliminary.

3 Preliminary results

Table 1 presents our preliminary results. The East-West skill ratio amounts to 1.06. Thus, it is even slightly larger than 1, though clearly not statistically significantly so. We do not want to reach any conclusions whether this ratio is slightly above or below 1 until we increased the precision of the point estimates.

[12] We plan to increase the number of simulations after optimizing the simulation algorithm, which currently takes 90 seconds to solve. We also plan to use a direct search mechanism instead of grid search. While the criterion function of this problem is convex, it is not continuous due to the discretization into counties, which complicates the choice of a minimization algorithm.

	coeff.	std. error
S_W	2.45	0.111
$\frac{I_E}{I_W}$	0.67	0.218
$\frac{S_E}{S_W}$	1.06	0.124

Table 1:

Preliminary results

In contrast, the East-West ratio of job characteristics lies at 0.67, and is significantly different from 1 not only in a statistical, but also in an economic sense. Hence, our current results indicate that unfavorable job characteristics in the East seem to be the main driving force of the low labor productivity there. The magnitude of the job characteristic differences between East and West is surprisingly high. Yet, we want to stress again that "job characteristics" in our model capture everything that has a positive influence on labor productivity, but cannot be directly influenced by the worker (e.g. infrastructure, managerial quality, physical capital, network effects between firms). Clearly, several of these factors could be at play, and could together explain the large difference. Maybe somewhat surprisingly, worker characteristics in East and West are indistinguishable in our sample period. Thus, either human capital accumulated in the East did not depreciate at reunification, or public policies with regard to retraining seem to have been very successful. On the other hand, the large financial subsidy programs encouraging firms to settle in the East somehow seem to have failed to produce the same quality of jobs there than in the West. Early retirement policies after reunification probably make the picture more favorable for skill differences than it would otherwise have been. On the other hand, selected migration might have lowered the mean skills in the East (Hunt, 2006). We provide further discussion of the preliminary results in the conclusion.

Figure 6 shows the resulting simulated unemployment rates for the counties based on 50 simulations, plotted against the driving time to the border, as well as the actual unemployment rates from the data. Our model matches the slope fairly well, but fails to produce enough variation in the Western counties more than 100 minutes away from the border. This is not surprising, given that in the model the only heterogeneity of counties within the East or within the West arises through the calibrated number of jobs and number of people in the labor force.

We want to stress again that these results are preliminary, since we have to increase the number of simulations, as well as the precision of the minimization algorithm. Moreover, we will

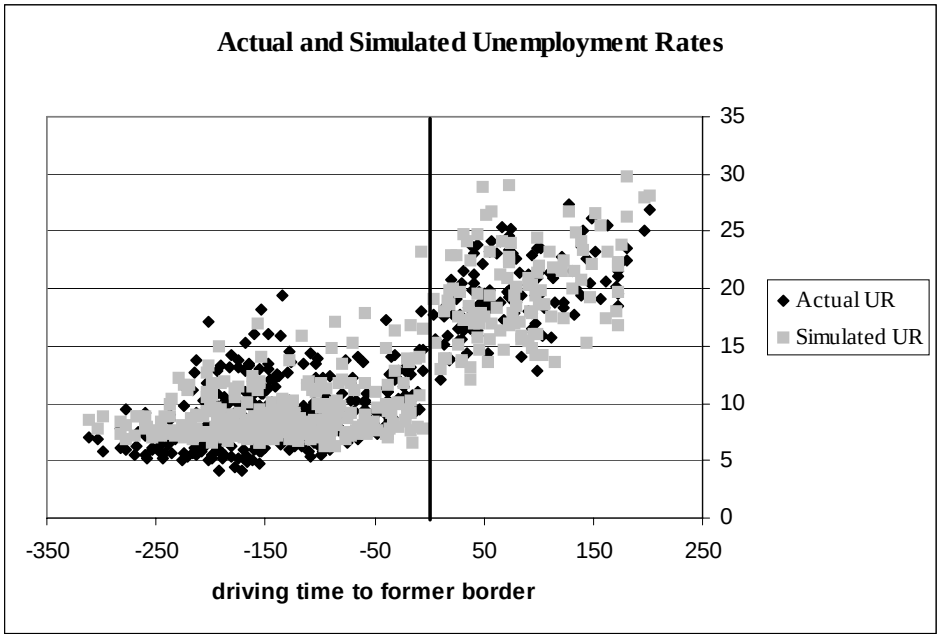

Figure 6: Actual and simulated unemployment rates as a function of driving time to former East-West border

do sensitivity analyses with respect to the calibration and functional form assumptions. Yet, the results are fairly robust in the sense that clearly the ratio of job characteristics has to be smaller than 1 in order to replicate the observed slope of the unemployment rate along the former border.

4 Alternative Hypotheses

Our model explains the slope of the unemployment rate along the border through commuting behavior. However, one could potentially imagine other reasons for the gradual increase in the unemployment rates along the former border.

4.1 Market Access

Redding and Sturm (2005) stress the importance of market access in explaining differences in economic performance. They find that, after separation, West German cities close to the East-West border grew significantly slower than other Western German cities, and argue that this is due to the cut-off of market access after 1945. The market access hypothesis could explain why unemployment rates are increasing from West to East in Germany, since trade barriers are smaller

within Germany or between Germany and the EU neighbors on the West than between Germany and the Eastern European countries which only became members of the EU in 2004.[13]

One can test for this hypothesis by analyzing unemployment rates before reunification, when the border between East and West was insurmountable. The market access hypothesis implies that the increase in the unemployment rate in West Germany as one moves towards the border should already have existed and should have been even more dramatic before reunification. While implications of this hypothesis cannot be tested for East Germany, in which unemployment was largely hidden, we can analyze the spatial behavior of the unemployment rate in West Germany *before* reunification. To this end, we use the average unemployment rates of the years 1987 and 1988 on the county level. Figure 7 shows the average unemployment rates plotted against the distance to the border, in 1987 to 1988 and 1998 to 2004, respectively.[14] Eyeballing these scatter plots, an increase in the unemployment rate close to the border is apparent in the figure for 1998 to 2004, but not in 1987 to 1988.

To test whether the unemployment rate is indeed significantly increasing towards the border in 1998 to 2004, but not in 1987 to 1988, we run two regressions separately for both time periods. In the first, we regress the unemployment rate on a constant and a border dummy, which takes on the value of 1 if the county lies within 75 km of the East-West border.[15] In the second, we regress the unemployment rate on a constant and on the distance to the former border.[16] The results are shown in table 2. While the border dummy and the distance to border variable both have highly significant coefficients with the expected sign in 1998 to 2004, indicating an increase in the unemployment rate as one moves towards the border, both variables are insignificant in the regressions for 1987 to 1988. Thus, the border area suffers from higher unemployment rates than the rest of West Germany in the time period 1998 to 2004, but not in the years immediately prior to reunification. This makes it unlikely that market access can explain this phenomenon.[17]

[13] However, one might still think that trade barriers are lowest within Germany, and slightly higher between Germany and its EU-neighbors. That should lead to slighlty higher unemployment rates along the Western border as well.

[14] As in figure 3 above, the distance is expressed negatively, such that the "border" is located at the right ("Eastern") axis.

[15] This threshold is the same one as used by Redding and Sturm (2005). There are 60 counties within 75 km of the border.

[16] Note that, in contrast to the figures, distance is a positive number in the regressions.

[17] The former border areas (*Zonenrandgebiete*) received special federal subsidies before reunification. It could be that these subsidies were so effective that they completely took care of the negative effect of the lack of market access. Yet, Redding and Sturm (2005) find that they were not effective enough to overcome the negative effect on

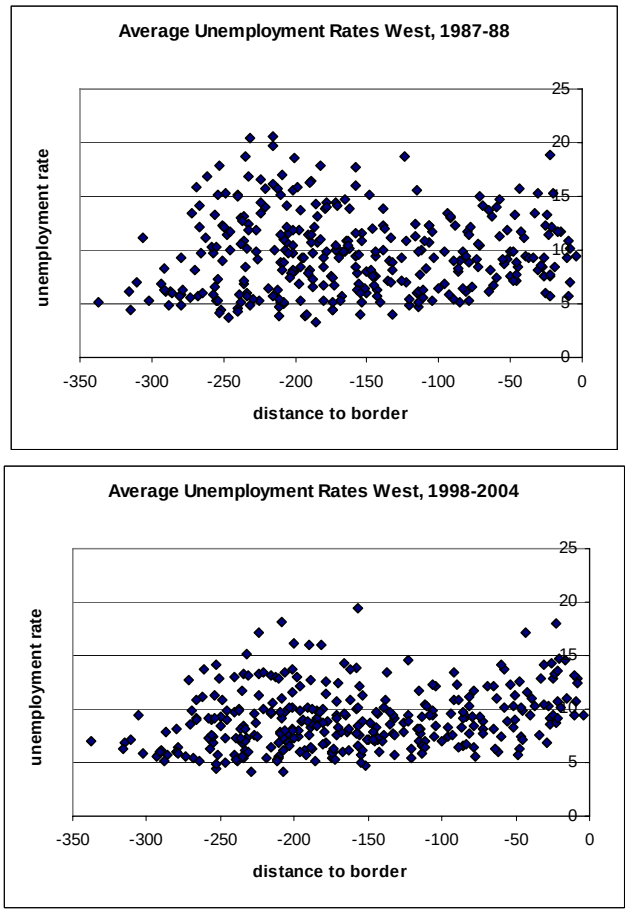

Figure 7: Average unemployment rates of West German counties as a function of distance to East-West border, 1987 to 1988 and 1998 to 2004

Dependent variable:	1987-1988				1998-2004			
unemployment rate	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.
border dummy	0.687	0.521			1.837***	0.389		
distance to border			-0.002	0.003			-0.009***	0.002
constant	9.545***	0.223	9.988***	0.458	8.707***	0.166	10.515***	0.340
R-squared	0.005		0.002		0.06		0.07	

*** indicates significant at the 1% significance level

Table 2:

Regressions of West county unemployment rates on distance to border (measured as a positive number), 1987-1988 and 1998-2004.

4.2 Migration and Investment

Two other alternative hypotheses have to do with the spatial allocation of factors of production. Note especially that our model so far assumes that everyone living in East Germany between 1998 and 2004 is an "East German" in the sense that he or she lived in the German Democratic Republic before 1990, and the other way round for West Germany. It could be possible that either human capital or physical capital are allocated in Germany such that the level and quality is gradually decreasing as one moves from West to East. In that case, the unemployment rate would gradually increase even if all factors of production are only employed in the home county, and thus there is no commuting.

With regard to human capital, this would mean that skill levels are not only higher in West Germany than in the East, but gradually increasing as one crosses the border. Under the assumption that Eastern skills depreciated somewhat at reunification, for the Eastern side of the border this would mean that either more "West Germans", i.e. individuals who acquired human capital in the West, are settled there than in the rest of the East, or on average higher skilled people are settled there than in the rest of the East. For the Western side of the border, this would mean that either more "East Germans", i.e. individuals who acquired human capital in the GDR, or lower skilled people, settled there than in the rest of the West.

To get some insights into the issue of migration and the allocation of skills, we analyze data from the 2001 round of the German Socio-Economic Panel.[18] From the German Socio-Economic Panel, we get information for every county about the estimated percentage of the population that is originally from East Germany. We identify a person as someone who lived in East Germany before 1990 if the person either belongs to the "East Germany" sample that was added to GSOEP in the spring of 1990, or if the person reports having a GDR-education. Moreover, we derive the highest educational degree of the respondent, analyzing the categories college, vocational training, secondary schooling, and no school degree, and then calculate the percentage of respondents within a county belonging to each educational category. We regress both the East/West composition and the educational attainment on border dummies, as well as on distance to border. Analogous to our calibration above, distance to border is now defined as driving time.[19] We separately create a West border dummy for counties within 60 minutes driving time to the West of the former border,

population growth in the border area.

[18] The 2001 round is used since this is the midpoint of the time period under consideration in our paper.

[19] Results are qualitatively similar if we measure distance in kilometers, and define the border dummies as above.

and an East border dummy for counties within 60 minutes driving time to the East. Tables 3 and 4 show the results.

As table 3 shows, a relatively higher percentage of the population in the Western border counties is from the former East Germany, and the percentage of the population from the former West is generally increasing as one moves away from the border in the West. However, in East Germany the composition of the population does not seem to be influenced by the distance to the border. Moreover, table 4 shows that the skill composition is not significantly different in the border areas from the rest in either East or West. We test this by analyzing the percentage of the population with college degree, but similar results arise if we group people with college or vocational degree together, or if we separately analyze college degrees received in the former East Germany and those received in West Germany. Summarizing, there is only weak evidence that the skill composition differs between counties, and any evidence comes from West Germany alone. However, even in West Germany the quantities are relatively small: while 95.6% of the population living in West German counties is from the former West, this percentage declines to 91.5% in the Western border counties.

Last, we assume that job characteristics are homogeneous within East and West. It could however be that investment behavior was heterogeneous, and hence the quantity and quality of physical capital is increasing gradually along the border. Yet, there should be a reason for this, and hence this hypothesis is confounded with the hypothesis of market access above.[20]

[20] Investment subsidies were generally quite homogeneous across East Germany.

Dependent variable:	West Germany				East Germany			
% of West Germans	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.
West border dummy	-0.041***	0.012						
East border dummy					-0.042	0.029		
time to border$(*10^3)$			0.207***	0.061			-0.011	0.011
constant	0.956***	0.004	0.921***	0.010	0.117***	0.018	0.080***	0.013
R-squared	0.035		0.034		0.018		0.001	

*** indicates significant at the 1% significance level

Table 3:

Regressions of percentage of West Germans in population on distance to border (measured as a positive number in both East and West), 2001.

Dependent variable:	West Germany				East Germany			
% college degree	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.	coeff.	std.err.
West border dummy	-0.007	0.019						
East border dummy					-0.020	0.024		
time to border$(*10^3)$			0.044	0.096			0.116	0.238
constant	0.167***	0.007	0.154***	0.015	0.234***	0.014	0.215***	0.023
R-squared	0.001		0.001		0.007		0.002	

*** indicates significant at the 1% significance level

Table 4:

Regressions of percentage of population with college degree on distance to border (measured as a positive number in both East and West), 2001.

5 Conclusion

This paper presents a novel method for estimating the gap in East-West worker and job characteristics. We build a model of commuting and differentiate between both hypotheses by analyzing the behavior of the unemployment rate across the former East-West border. The preliminary estimation results suggest that the lower labor productivity in the East can be explained by significantly less favorable job characteristics, but that worker characteristics do not differ significantly between East and West. While it might be reasonable to assume that human capital depreciated somewhat at reunification, it seems that 8 to 14 years were enough to overcome the differences in human capital. Some people, e.g. Canova and Ravn (2000), conjectured that it would take much longer than this. Our estimate is however in line with the view of the Deutsche Bundesbank (1996), which suggested that the retraining period for the East German workforce would be approximately 12-14 years.

The estimates also suggests that a significant part of the human capital accumulated in the GDR was transferable, and not organization-specific or firm-specific. Thus, our model also sheds some light on the more general question of the specificity or transferability of human capital. To the extent that general education teaches problem solving skills that can then be applied in vastly different environments, one might not have expected a difference in East and West skills, given the on average even slightly higher number of years of education in the former GDR. To the extent that human capital is mostly specific to an occupation or even a firm, the depreciation of East Germans' human capital at reunification should have been significant.

Our preliminary results hence suggest that reasons outside the individual worker's responsibilities in the East are to blame for the low labor productivity. These include factors in the influence of a single firm (e.g. managerial quality, investment in physical capital), as well as factors that are in the realm of public policy (e.g. public infrastructure), or that need some form of implicit or explicit cooperation between firms (e.g. network effects). Clearly, several of these factors could be at play, and could together explain the large East-West difference of job characteristics. Differentiating between these reasons is necessary for further policy conclusions, and constitutes a very important research agenda.

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Active Labour Market Policy in East Germany:

Waiting for the Economy to Take Off

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Active Labour Market Policy in East Germany: Waiting for the Economy to Take Off

by

Michael Lechner and Conny Wunsch

January 2007

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Active Labour Market Policy in East Germany: Waiting for the Economy to take off

Abstract

We investigate the effects of the most important East German active labour market programmes on the labour market outcomes of their participants. The analysis is based on a large and informative individual database coming from administrative data sources. Using matching methods, we find that over a horizon of 2.5 years after programme start the programmes fail to increase the employment chances of their participants in the regular labour market. However, the programmes may have other effects for their participants that may be considered important in the especially difficult situation experienced in the East German labour market.

Keywords: Matching estimation, causal effects, programme evaluation, panel data

JEL: J 68.

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1 Introduction*

Over the last decade, Germany spent more than 7 billion EUR per year on active labour market policies (ALMP) to combat the large and persistent unemployment problem in East Germany. In this paper, we investigate the effects of the most important parts of these policies on the labour market outcomes of their participants. The analysis is based on a large and informative individual database coming from administrative data sources and employs econometric matching methods. Concentrating on programmes that start between 2000 and 2002, we find that over a horizon of 2.5 years the programmes fail to increase the employment chances of their participants in the regular labour market. However, the programmes may have other effects, like keeping their participants occupied, that may, or may not, be worthwhile having in the special situation of the East German economy.

Although German Unification happened not too long ago, there is already a considerable literature about the effects of training and subsidised non-market jobs in East Germany, with mixed evidence though. Over time, the data quality of the studies increased considerably. The earlier studies for East Germany use survey data. These data are rather limited with respect to the length of the observation period, sample size and the availability of sufficiently detailed information to account for selectivity and programme heterogeneity.[1] Most of these studies

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[1] Pannenberg (1995), Steiner and Kraus (1995), Pannenberg and Helberger (1997), Fitzenberger and Prey (1998, 2000), Hübler (1997, 1998), Staat (1997), Kraus, Puhani and Steiner (1999, 2000), Lechner (1999, 2000), Prey (1999), Hujer and Wellner (2000), Eichler and Lechner (2002), Bergemann, Fitzenberger and

find negative or insignificant short- to medium-term employment effects (e.g. Pannenberg, 1995; Hübler, 1998; Hujer and Wellner, 2000; Kraus, Puhani and Steiner, 2000), but there are also studies that obtain positive effects for some programmes (e.g. Pannenberg and Helberger, 1997; Prey, 1999, Eichler and Lechner, 2002). The lack of robustness is due to the sensitivity of the results to different parametric assumptions, small sample sizes, and the inability to measure medium or even long-run effects, as well as problems in appropriately defining programme and outcome variables.

The next group of papers use new administrative data explicitly developed for the evaluation of training programmes. As for the previous studies, these programmes started in the early years after unification. Speckesser (2004) and Fitzenberger and Speckesser (2005) analyse one special type of government-sponsored training programme. Based on propensity score matching, they find negative lock-in effects up to 12-18 months after programme start. Fitzenberger and Speckesser (2005) obtain positive employment effects of 5 to 10 percentage points about 20 months after programme start. Lechner, Miquel, and Wunsch (2005b) use matching methods to assess the effectiveness of three types of training programmes conducted 1993-1994 and follow outcomes over eight years after programme start. Besides the typical lock-in effects, they find strong positive medium- to long-run employment effects at a magnitude of 10-15 percentage points for short training courses and for women for the longer training programmes.

However, the problem with that specific data set is not only the limited sample size, the lack of detailed information on the specific type of training programme, and the lack of information on other programmes, but also the measures for the short- to medium-run labour market outcomes. The data do not allow distinguishing between unsubsidised employment in

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Speckesser (2004), Bergemann (2005). These studies use the German Socioeconomic Panel or the Labour

the regular labour market and subsidised employment, such as non-market jobs in employment programmes, which is in fact part of the active labour market policy.

The third generation of data used to evaluate active labour market policies in East Germany comes from the so-called 'integrated employment histories (IEH)' data base of the Institute for Employment Research (IAB). These data are used in this paper as well. Compared to the previous administrative data available for East Germany, the IEH covers a larger sample, contains much more detailed programme and outcome information, and improves substantially the information about the selection process. Due to the latter, all papers using this data so far are based on a selection on observables strategy to identify the causal effects of the programmes. Almost all employ some sort of semiparametric matching estimator. The general disadvantage of this database, which covers programmes and outcomes from 2000 to mid 2005 in its most recent version, is that only short to medium-term outcomes are available. This limited time horizon is the price to pay when interest is in recent programmes. For example, in our study, which is based on matching estimation as well, we consider programme participation between 2000 and 2002. Thus, we observe outcomes for all participants only up to 2.5 years.[2] However, as shown by Lechner, Miquel, and Wunsch (2005a, 2005b), after 30 months we can already get a reasonably accurate idea about the magnitude of possible long-term effects, at least for the shorter programmes. All papers analysing recent programmes have (and have to have) a similarly short or even shorter time horizon.

Market Monitor East or for Saxony-Anhalt (see the survey by Wunsch, 2005).

[2] Going beyond that time horizon would imply dropping late starts. Thus, the differences after 2.5 years compared to the earlier results would reflect differences in the composition of participants, content of the programmes as well as effects that need longer time to materialise. Since such a composite effect is difficult to interpret as a policy parameter, we refrain from presenting these numbers.

There are two groups of papers based on this database so far, depending whether they evaluate training programmes or employment programmes. Concerning the training programmes, Hujer, Thomsen, and Zeiss (2006) analyse the effects of programmes conducted in the period 2000-2002 on the transition rate into regular employment. Methodologically, this paper is an exception, because it is not based on matching estimation. Instead, the authors estimate a multivariate mixed proportional hazard rate model. Because of the short time horizon available to observe outcomes in their study, the negative lock-in effects drive their results. Based on similar data, Biewen, Fitzenberger, Osikominu, and Waller (2006) analyse the effects of three broad groups of training programmes for participants in 2000 until 2001 using matching methods. The authors conclude that about 20 months after the start of the programmes, there are no or only very small effects that are hard to pin down precisely.[3]

Using a different version of the IEH, several papers by Caliendo, Hujer, and Thomson (2004, 2005a, 2005b) analyse the effects of employment programmes by comparing participants in February 2000 with eligible nonparticipants in the same month. Based on matching methods, they conclude that after 3 years the programmes did not improve the employment chances of their participants.

Our paper contributes in several dimensions to a better understanding of the individual effects of East German labour market programmes. First, this is the first study looking jointly at the effects of a large variety of training programmes as well as two employment programmes, allowing interesting comparisons across programme types. We do not only compare the programmes to some nonparticipation state, but also compare them with each other. The latter comparison gives interesting hints about the effectiveness of the caseworkers' allocation of

[3] There is also the report for the government about the recent labour market reform in 2004 as suggested by the so-called Hartz-Kommission (see Schneider, Brenke, Kaiser, Steinwede, Jesske, Uhlendorff, 2006) which

different participants into different programmes. Second, we find interesting differences of the effects of the programmes with respect to individual heterogeneity of their participants: For example, their effects are much worse for individuals who have good pre-programme labour market prospects. Third, compared to the studies looking at post-unification training programmes, we have much larger samples, better information on the type of programmes, on individual labour market outcomes, as well as on the selection process into the programmes. Thus, we obtain considerably more comprehensive and more robust results as before. Finally, the paper contains new interesting findings that appear to be of policy relevance. Those results can be summarised as follows:

Programme participation leads to increased unemployment, more programme participation, and increased benefit receipt.

With respect to the chances in the regular labour market, some programmes actually harm participants, while other programmes did at least not increase the chances of their participants. There is so far no sign that there will be any positive long-term effects.

The selection process into the different programme types was not optimal, because a different allocation of participants among the programmes would have improved employment. Furthermore, too many people with intact labour market chances end up in programmes. Those people fared worst among all participants.

From the analysis, it appears clear that in the very depressed labour market of East Germany, the recent active labour market policy did not help in reintegrating the unemployed back into the unsubsidised part of the labour market. If one pursues the view that active labour market policies are supposed to cure some malfunctioning of the labour market, than one is led to

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contains some hints about possible effects of training in East Germany. Those hints clearly provide no robust evidence for positive effects.

conclude that with such amount of malfunctioning as seen in East Germany, this cure is not strong enough. It appears instead that other more substantial changes may be required that attack the roots of the problems, and not only its symptoms. However, these findings do not necessarily imply that the programmes had no positive effects on their participants, it just implies that those effects are probably in a different sphere (receiving earnings from work instead of benefits, having a daily routine, etc.) than earnings and employment in the regular labour market.

The remainder of the paper is organised as follows: The next section briefly reviews the economic and institutional environment of the East German labour market. Section 3 describes the data. Section 4 outlines our approach to identification and estimation of the programme effects. Section 5 contains the results from the econometric matching estimations. Section 6 discusses some of the sensitivity and heterogeneity checks conducted. The last section draws policy conclusions. Appendix A gives more information on the data used. Appendix B contains some more details on the econometrics applied, while Appendix C contains additional results not presented in the main body of the text. Finally, an appendix that is available in the internet contains more detailed background material concerning estimation, data, and results.

2 Economic conditions and labour market policy in East Germany

2.1 Economic development since German Unification

After the near-collapse of the East German economy following German Unification (by December 1990, production of goods had dropped to 46% of its 1989 level; Akerlof et al., 1991), the East German work force had declined by almost 3 million people in 1991 (BA, 2001). A substantial part of these people was directly absorbed by active labour market programmes to the effect that the official unemployment rate - which does not include participants in ALMP

– is not skyrocketing. Furthermore, many older people left the labour force encouraged by generous early retirement schemes. In spite of this, registered unemployment rose rapidly to a rate of more than 10 per cent in 1991 (BA, 1992). Since then, the East German economy has been recovering only slowly. Unemployment has risen steadily and has become very persistent with a fraction of long-term unemployed of 40% in 2005. The fraction of young people and persons with low education or health problems has also increased steadily while female unemployment is declining, because more women leave the labour force.

Table1: GDP growth and unemployment since 1993

	1993	1995	1997	1999	2001	2003	2005
GDP growth	12.6	6.3	1.9	2.8	1.1	1.0	-0.1
Unemployment rate	15	15	19	19	19	20	19
Thereof:							
Women	65	64	58	54	51	49	47
Non German	3	4	4	4	5	5	6
No professional degree	23	21	21	24	24	23	26
Age < 25	12	11	12	12	13	12	14
Age $\geq$ 55	8	16	20	21	15	10	12
Unemployed for more than 1 year	31	29	30	32	35	43	40
Health problems	10	14	16	19	21	21	24

Note: Entries are in percent.
Sources: Statistische Ämter der Länder (2006), BA (1992-2006).

2.2 Unemployment insurance in Germany 1998-2004

In Germany, unemployment insurance (UI) is compulsory for all employees with more than a minor employment including apprentices in vocational training.[4] German UI does not cover self-employed. Persons who have contributed to the UI for at least 12 months within the three years preceding an unemployment spell are eligible for unemployment benefits (UB). The minimum UB entitlement is six months. In the period we consider, the maximum claim increases stepwise with the total duration of the contributions in the seven years before becoming unemployed, and age, up to a maximum of 32 months at age 54 or above with previous

contributions of at least 64 months.[5] Actual payment of UB for eligible unemployed is conditional on active job search, regular show-up at the public employment service (PES), and participation in ALMP measures. Since 1994, the replacement rate is 67% of previous average net earnings from insured employment with dependent children, and 60% without.

Until 2005, unemployed became eligible for unemployment assistance (UA) after exhaustion of UB. In contrast to UB, UA was means tested and potentially indefinite. However, like UB, UA was proportional to previous earnings but with lower replacement rates than UB (57% / 53% with / without dependent children, respectively). Unemployed who were ineligible for UB and UA could receive social assistance, which was a fixed monthly payment unrelated to previous earnings, means tested and administered by local authorities.

2.3 East German ALMP 1998-2005

Directly after unification, short-time work, which is a reduction in work hours combined with a subsidy from the unemployment insurance system to compensate the resulting earnings loss, subsidised non-market jobs (so-called job creation schemes, JCS), and further vocational training (FVT) was used on a rather massive scale. In recent years, however, the focus shifted towards the internationally more common minor adjustments of skills in short so-called training measures (which are much cheaper than FVT). Furthermore, direct temporary wage subsidies as well as the support of self-employment increased at the expense of subsidised non-market jobs (see Table 2).

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[4] However, civil servants (Beamte), judges, professional soldiers, clergymen and some other groups of persons are exempted from contributions. For further details on the German UI and ALMP, see the comprehensive survey by Wunsch (2005).

[5] For example, a 40-year-old unemployed with at least two years of insured employment has a maximum claim of 12 months.

Table 2: The most important instruments of ALMP in East Germany (1998-2005)

	1998	1999	2000	2001	2002	2003	2004	2005
	Expenditure in million EUR							
Total expenditure on ALMP	7920	8964	8620	8360	8265	7326	5042	2454
	Share in %							
Training measures (TM)	1	1	2	2	2	3	4	2
Further vocational training (FVT)	37	33	34	36	35	27	25	16
Short-time work	1	1	1	1	1	1	2	3
Job creation schemes (JCS)	35	32	31	25	22	18	19	7
Structural adjustment measures (SAM)	18	17	14	9	8	7	7	6
Temporary wage subsidies	2	3	5	7	10	12	12	8
Support of self-employment	2	2	3	3	3	6	14	36
Other	4	10	11	17	19	26	17	21
	Participation in 1000							
Training measures (TM)[a]	NA	167	191	227	332	376	400	287
Further vocational training (FVT)[a]	236	183	214	188	183	92	61	40
Short-time work[b]	34	27	24	27	45	35	29	25
Job creation schemes (JCS)[b]	151	168	153	123	92	70	65	36
Structural adjustment measures (SAM)[b]	162	180	98	67	58	40	28	12
Temporary wage subsidies[b]	NA	65	91	99	116	107	90	29
Support of self-employment[b]	NA	32	30	31	34	72	68	105

Note: NA: Not available. [a] Entries in 1000 persons. [b] Yearly average of stock in 1000 persons.
Source: BA (1992-2006).

One important feature of German ALMP is the large heterogeneity of training courses. Course contents, the amount of human capital added and planned durations vary considerably, particularly among FVT courses. With our data (see Section 3), we are able to account for heterogeneity in training measures and FVT in a detailed way.

Table 3: Descriptions of the programmes we evaluate

Programme type (acronym)	Description	Mean planned duration (days)
Short combined measures (SCM)	Acquisition of specific knowledge and skills	56
Jobseeker assessment (JSA)	Assessment of jobseekers ability and willingness to search for job and to work, basic job search assistance	45
Short training (ST)	Minor adjustment of skills	48
Job related training (JRT)	Combined off-the-job and on-the-job training in a specific field of profession	172
General further training ≤ 9 months GT-9M)	General update, adjustment and extension of knowledge and skills; mainly off the job, planned duration ≤ 9 months	173
General further training > 9 months (GT-9M+)	General update, adjustment and extension of knowledge and skills; mainly off the job, planned duration > 9 months	347
Degree course (DC)	Vocational training that awards a formal professional degree and that corresponds to regular vocational training in the German apprenticeship system	658
Job creation scheme (JCS)	Subsidised non-market jobs which are in the interest of the public	274
Structural adjustment measure (SAM)	Subsidised non-market jobs in economically weak regions	315

Note: Calculations of the mean planned durations are based on our evaluation sample (see Section 3.3).

Table 3 summarises the programme types we evaluate in our empirical analyses. Besides seven types of training courses, we evaluate the most important forms of subsidised non-market jobs. We do not include temporary wage subsidies and support of self-employment though, because our identification strategy (see Section 4) might not be valid for these programmes. Short-time work is not observable in our data.

Short combined measures (SCM) are a series of very short training courses aiming at removing specific minor skill deficits. *Jobseeker assessment* (JSA) courses have the main objective of assessing a jobseeker's availability, willingness, and ability for active job search or specific kinds of jobs or programmes, but they also provide basic job search assistance. *Short training* (ST) courses provide minor adjustments of skills. All three types of programmes belong to the category of so-called training measures (TM) and have durations of no more than three months with mean planned durations of below two months.

Job related training (JRT) combines off-the-job training with a substantial amount of on-the-job training in a specific field of profession, where the latter often takes place in a simulated work environment rather than a regular firm. The mean planned duration is about six months. *General training* (GT) subsumes the classical, mainly off the job, further vocational training courses which provide a general update, adjustment, and extension of knowledge and skills. Planned durations range from only a few months to up to two years. *Degree courses* (DC) provide a usually two-year training which is equivalent to an apprenticeship in the German apprenticeship system. It awards an officially recognised professional degree if completed successfully. JRT, GT, and DC belong to the category of further vocational training (FVT).

Job creation schemes (JCS) and *structural adjustment measures* (SAM) are subsidised jobs, which are outside of and should not compete with the regular labour market. JCS are targeted at unemployed with particularly bad employment prospects like the elderly or the long-term

unemployed. SAM aim at smoothing the effects of large job losses in a region by absorbing the unemployed in subsidised employment. In both programmes, participants hold these jobs usually for about one year.

2.4 Interactions between programme participation and UI payments

One important feature of German labour market policy has always been that (most) programme participations extend the period in which unemployment benefits (UB) can potentially be drawn. The extension occurs either directly by explicitly counting programme participation in the same way as insured employment towards the acquisition of UB claims. Or it occurs indirectly by receiving a different form of benefit (so-called maintenance allowance, MA, during participation in FVT) of the same amount as UB (or UA) during participation without or only less than proportionately reducing the UB claim at programme start. Table 4 summarises the respective rules.

Table 4: Programme participation and accumulation of benefits

Year	Programme	Rules
Until 1997	FVT	Receipt of MA if eligible; UB claim stays constant; counts in the same way as insured employment
	JCS	Regular salary, no benefits; counts as insured employment
1998-2002	TM	Receipt of UB or UA if eligible; UB claim reduced by the programme duration
	FVT	Receipt of MA if eligible; UB claim stays constant; entitlement qualification period extended by up to 2 years
	JCS, SAM	Regular salary, no benefits; counts as insured employment
2003-2004	TM	Receipt of UB or UA if eligible; UB claim reduced by the programme duration
	FVT	Receipt of MA if eligible; UB claim reduced by half of the programme duration; entitlement qualification period extended by up to 2 years
	JCS, SAM	Regular salary, no benefits; no longer counts as insured employment
Since 2005	TM	Receipt of UB or UA if eligible; UB claim reduced by the programme duration
	FVT	Receipt of UB or UA if eligible; UB claim reduced by half of the programme duration
	JCS, SAM	Regular salary, no benefits; does not count as insured employment

Note: TM and SAM have been introduced in 1998. The regular entitlement qualification period are the three years before the beginning of an unemployment spell in which the duration of insured employment is counted for the acquisition of an UB claim. At least 12 months of insured employment within this period are needed to acquire a new UB claim and the total claim increases with the duration of insured employment in the seven years before the beginning of an unemployment spell.

Since 1998, all major reforms of German labour market policy have reduced the possibilities to renew or extent UB claims by programme participation as legislators have increasingly

become aware of the adverse effects these rules have on search intensity and the budget of the public employment agency (PES).

3 Data and definition of the evaluation sample

3.1 The data

We use a new administrative database that has been built up by the Institute for Employment Research (IAB). The database is a 2% random sample from all individuals who have been subject to German social insurance at least once since 1990. It combines information from four different administrative sources: social insurance records, programme participation data as well as the benefit payment register and the jobseeker register of the PES. Table A.1 in Appendix A summarises the main features of these data sources.

Besides being very recent, the database is very rich in terms of covariate information and observed pre-programme employment histories (at least 10 years) to control for selectivity in programme participation (see Section 4.1). Moreover, it covers participation in all major German active labour market programmes for the unemployed from 2000 to mid 2005, and the information about programmes is very detailed so that it is possible to account for programme heterogeneity in a uniquely detailed way.

Nevertheless, the database also has several drawbacks that may be important for the interpretation of our results. Firstly, information on direct programme costs is not available in the data. It is therefore not possible to consider the actual net effects of programmes. Secondly, prior to 2000 there is no explicit information on participation in ALMP except for benefit payment during participation in training. In particular, it is not possible to distinguish subsidised from non-subsidised employment. Thirdly, the common observation period after programme start is relatively short (only 2.5 years) since we are interested in relatively recent

programmes conducted 2000-2002. Because of the rather long durations of some programmes (see Table 1), Lechner, Miquel, and Wunsch (2005a, b) show that the ability to measure long-run effects is crucial for the evaluation of German ALMP. However, their results also imply that after 30 months we can already get a reasonable idea about the magnitude of possible long-term effects, at least for the shorter programmes.[6]

3.2 Definition of our evaluation sample and programme participation

Our population of interest is defined by those unemployed who receive unemployment benefits (UB) or unemployment assistance (UA) and who are eligible for programme participation. According to German legislation, this is also the main target group of German ALMP. Our sample consists of the inflow into unemployment from insured employment or out of labour force between January 2000 and the first half of December 2002. If there are multiple entries into unemployment of a person in this period, we consider the first one as the sample inflow date.

When choosing the appropriate subpopulation from our inflow sample into unemployment, we aim at having a homogenous group of people that covers the prime age part of the East German[7] population who is eligible for participation in the programmes under consideration. Therefore, we require that all individuals were employed[8] at least once before programme participation and that they received unemployment benefits (UB) or assistance (UA) in the month before the programme start (as well as in the month of potential programme start for nonparticipants).[9] To avoid most influences coming from retirement, early retirement, and

[6] The studies of Gerfin and Lechner (2002); Frölich, Lechner, and Steiger (2003); Lechner and Smith (2005) and Sianesi (2004) faced similar problems.

[7] We exclude Berlin.

[8] 'Employed' means that we observe the person at least once in insured employment in the data.

[9] In fact, receipt of UB or UA directly before entering a programme is not sufficient to ensure eligibility. Individuals must also have a formal professional degree or at least three years of work experience. Thus by

primary education, we also impose an age restriction (25-49 years). Concentrating on the main body of the active labour force, we exclude unemployed who were trainees, home workers, apprentices, or without previous employment. Furthermore, we exclude unemployed with an intensity of the last employment before programme participation below half of the usual full-time working hours.

Note that drawing this subpopulation requires the use of variables measured relatively to the start date of the programme, which is only available for participants. Moreover, several variables potentially influencing both selection into programmes and outcomes should be measured relatively to the start of the programme. In this paper, we follow one of the approaches suggested by Lechner (1999, 2002b) to simulate start dates for nonparticipants. We regress the log start date of participants on a set of time invariant personal and regional characteristics and use the estimated coefficients plus a draw in the residual distribution to predict start dates for nonparticipants.

We define *participants* as those unemployed who participate at least once in a programme in the three years from the inflow into our sample. Accordingly, *nonparticipants* are all persons who do not enter a programme in this period. However, since we observe outcomes only up to mid 2005, we only evaluate the first participation of a person in a programme that occurs after the date of the inflow into the sample and before 2003.

3.3 Selected descriptive statistics

Table 5 presents descriptive statistics for selected variables. The numbers indicate that entry into the programmes is highly selective (for a full list of variables and statistics, see the internet appendix).

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also requiring individuals to be employed at least once before the programme, the remaining group of participants and nonparticipants is most likely to be eligible.

Table 5: Means and shares (in %) of selected variables

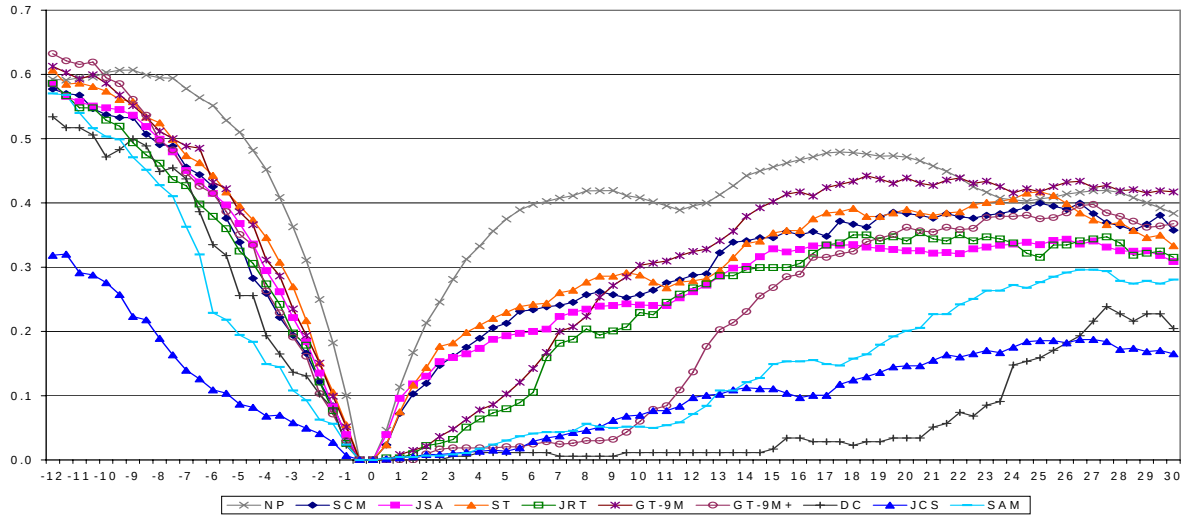
Treatment	NP	SCM	JSA	ST	JRT	GT-9M	GT-9M+	DC	JCS	SAM
Observations	4024	429	1066	549	313	605	533	176	587	463
					Personal characteristics					
Age (years)	38	38	37	37	37	38	38	34	40	38
Woman	38	45	40	44	36	29	43	40	34	28
No professional degree	11	10	10	7	8	7	6	14	10	9
Completed apprenticeship	85	81	88	86	89	88	81	82	87	89
University / polytechnic college degree	4	8	2	7	3	4	13	5	2	2
Health problems	14	11	11	9	10	9	9	11	19	7
					Characteristics of desired job					
Unskilled	30	28	27	22	26	21	18	38	31	24
Skilled	66	64	71	71	72	74	67	59	66	73
High-skilled	4	8	3	7	2	5	15	4	2	2
No work experience required	8	6	8	7	6	5	5	11	7	4
					Earnings of last job					
Monthly earnings (EUR)	1386	1400	1364	1447	1698	1445	1594	1382	1323	1343
	Remaining unemployment benefit claim at the beginning of the current unemployment spell									
No claim	50	57	45	50	38	27	26	40	65	34
Claim (days)	101	70	106	88	140	157	162	105	59	116
					Employment history over the 10 years before programme start					
Duration of current unemployment spell (months)	5	7	7	7	7	6	7	8	10	7
Fraction employed	66	66	65	69	66	70	70	64	58	68
Fraction unemployed	18	18	17	15	18	15	13	15	25	16
Fraction out of labour force	11	10	11	10	10	9	10	15	9	9
					Regional information					
Local unemployment rate ≤ 15%	8	9	8	9	6	10	8	10	4	6
Local unemployment rate > 25%	11	7	10	8	13	12	8	11	14	13

Note: If not stated otherwise, entries are in percent. All variables except the duration of the current unemployment spell are measured at or relative to the unemployment spell in which (simulated) programme start takes place. The duration of the current unemployment spell is measured at (simulated) programme start.

Women seem to be concentrated in SCM, ST, and GT-9M+ while GT-9M, JCS, and SAM exhibit a male bias. DC seems to be a device to provide younger and untrained unemployed with a first professional degree. JCS attracts a larger share of slightly older unemployed, unemployed with health problems, low earnings, and long unemployment durations. It often takes place in the regions with the highest unemployment rates. The latter is also true for SAM and JRT. Participants in the latter seem to have, however, above average previous earnings. Nonparticipants differ from participants because of their lower current unemploy-

ment duration and their rather high fractions of untrained unemployed and unemployed with health problems.

Figure 1: Rates of unsubsidised employment before and after programme start (unmatched sample)



Note: Unsubsidised employment. Month zero is the (simulated) programme start. Negative values on the abscissa refer to months before programme start, positive values to the months after programme start.

In Figure 1, we show how nonparticipants and programme participants differ in terms of (unsubsidised) employment rates before and after programme start, and *before* correcting for any selectivity. By construction of our sample, the employment rates are zero at and in the period directly before programme start. Nonparticipants have substantially higher employment rates in the 10 months before their simulated programme start than all the different groups of participants. Participants in JCS exhibit particularly low employment rates before programme start while all other participants face rather similar rates though the rates of participants in DC and SAM seem to fall somewhat more rapidly six months before programme start. After the (simulated) programme start, none of the groups reaches its pre-programme levels. However, the employment rate of nonparticipants recovers quickly. For participants in the shortest programmes (SCM, JSA, and ST) there is also a steep ascent in the beginning but it becomes rather flat very early after programme start. For participants in both types of GT the ascent of the employment rate is somewhat delayed due to their longer durations but the development

looks rather positive after completion of the programmes. The rates of participants in DC, JCS, and SAM recover only very slowly.

To get a better understanding of how selection into different programmes works with respect to employment prospects, we predict the employment chances the different groups of participants would have had without a programme conditional on a rich set of covariates. This prediction is based on a probit estimation of the employment chances of nonparticipants at the end of the observation window. For this purpose, we consider only employment that generates at least 90% of the earnings of the previous job. As explanatory variables, we use all variables that are important in the selection models for the different programme participations versus nonparticipation. This includes personal characteristics, variables that summarise individual pre-programme employment histories and regional characteristics.

In Table 6, we present various statistics for the predicted employment probabilities from this estimation. It shows that by various measures JCS received by far the most difficult cases in terms of reemployment chances (as already suggested by Figure 1), as opposed to the similar programme SAM whose participants appear to be very similar to the average, or even a bit better. The differences for the remaining groups are not that striking and there is a considerable heterogeneity within all programmes. Finally, the last column shows that the predicted nonparticipation employment chances are, as expected, negatively correlated with the predicted participation probabilities. However, given the official policies, these correlations are surprisingly small.

Table 6: Descriptive statistics for the predicted probability to be employed in a job with at least 90% of previous earnings in half-month 60 after programme start

Participation / Subsample	Acronym	Mean	Median	33%-Quantile	67%-Quantile	Correlation with participation probability**
Nonparticipation	NP	.27	.19	.10	.34	
Short combined measures	SCM	.27	.16	.07	.33	-.10*
Jobseeker assessment	JSA	.26	.20	.10	.31	-.04*
Short training	ST	.27	.19	.10	.31	-.02*
Job related training	JRT	.29	.21	.12	.35	-.02
General training ≤ 9 months	GT-9M	.32	.27	.15	.41	-.09*
General training > 9 months	GT-9M+	.30	.26	.14	.38	-.09*
Degree course	DC	.25	.18	.10	.27	-.02*
Job creation scheme	JCS	.17	.09	.03	.15	-.22*
Structural adjustment measure	SAM	.29	.24	.16	.34	-.05*
Total		.27	.19	.10	.33	

Note: Predicted probabilities from a probit estimation among nonparticipants. Dependent variable: Employed in unsubsidised employment with at least 90% of the earnings of the last job before programme start, measured in half-month 60 after programme start. * Correlation is significant on the 5% level. ** Predicted probability to participate in the respective programme or not to participate at all. Correlation computed in the population.

3.4 Measurement of the labour market outcomes

According to German legislation, the main objective of German ALMP is to reduce unemployment by improving the chances of the unemployed to find regular (unsubsidised) employment. However, since in East Germany there are particularly bad labour market conditions, other objectives like preventing or reducing human capital depreciation, keeping the unemployed attached to the labour market or providing social contacts and organised daily routines by "keeping them busy" in subsidised employment or training programmes without the direct prospect of finding a regular job have become non-negligible weight. Since in a situation with more than 20% of people not employed, providing a decent income for those people and avoiding social unrests may be other implicit goals of that policy.

We try to capture the different aspects of the potential effectiveness of the different programmes by considering a variety of outcome variables. The outcome *unsubsidised employment* measures the programmes' success in helping their participants to find regular employment. We also assess the quality of employment in terms of stability of the earnings compared

to previous jobs as well as potential gains in productivity measured by actual earnings differences. In contrast, *registered unemployment*, which here includes programme participation, measures whether individual unemployment is indeed reduced. The outcome *programme participation* assesses whether the programme participation we evaluate changes the probability of future programme participation in the same or a different programme.

We measure whether participants are better off in terms of *total earnings*, i.e. the sum of earnings from subsidised and unsubsidised employment and any benefits from the PES. In contrast, to assess some of the programme costs, *received benefits* measures the benefits and subsidies paid by the PES to the unemployed. This outcome variable includes all benefits (UB, UA, MA) received during participation in training courses and 60% of the wages from subsidised employment. The latter is a conservative proxy for subsidies paid by the PES, since that share is not directly observable in the data. In many cases, the subsidised fraction of the wage is certainly much higher.

We also assess whether the programmes succeed in keeping their participants busy through any form of employment or participation in any kind of programme. Finally, to enable the comparison with previous findings from earlier studies, we consider the outcome total employment that includes both subsidised and unsubsidised employment. In Section 5, we present the main findings from the different outcome variables and the different comparisons of the programmes. Table C.1 in Appendix C contains effects accumulated over the 2.5 years in which we observe the various outcome variables. Further results are available in the internet appendix.

All effects are measured half-monthly based on time relative to the start of the programme (with simulated start dates for nonparticipants): *Half-month 1* is the half-month after the pro-

gramme started. Focusing on the beginning instead of the end takes into account the potential endogeneity of actual programme duration.

4 Identification and estimation

4.1 Conditional independence

We are interested in the average effects of the programme on the programme participants compared to participation in another specific programme or no participation at all. To identify these parameters we rely on the conditional independence assumption to solve the selection problem that arises from the fact that persons in the different treatments differ systematically in a way that might be related to the outcome variables of interest (see Section 3.3). The assumption states that if we can observe all factors that jointly influence outcomes in the comparison state and the participation decision, then - conditional on these factors - participation and the outcomes, which the participants would have obtained in the comparison state, are independent, and the effects of interest are identified (Rubin, 1974; Imbens, 2000; Lechner, 2001, 2002a, b).

Selection into programmes is determined by three main factors: eligibility, selection by caseworkers and self-selection by potential participants. Eligibility is ensured by the choice of our evaluation sample (see Section 3.2). Given eligibility, based on an assessment of the employment prospects and the specific deficits or needs of the unemployed the caseworker decides - usually in consultation with the potential participant – about programme participation. According to German legislation, caseworkers have to take into account the chances of the unemployed for completing a specific programme successfully, and the situation in the local labour market. The latter is particularly important in East Germany. Therefore, we merged rich regional information to our data that allows us to control for local labour market condi-

tions in a detailed way. This data contains information on the industrial, employment, population, and wealth composition of the region as well as migration streams, tax revenues and local unemployment rates. Individual variables in our data capturing information about employment prospects and chances for successful completion of a programme include age, educational attainment, family and health status, characteristics of the desired job as well as employment histories for at least 10 years before the programme. The latter include information on employment status, employers, earnings, position in previous job, specific occupation, and industry.

From the point of view of the unemployed, his decision whether or not to participate in a programme is guided by considerations very similar to those of the caseworker, but there are also additional reasons for joining or not joining a programme. If, for example, the unemployed sees no chance to find a job with or without a programme, he may prefer not to join a programme that reduces his leisure time. This again requires controlling for all factors that determine individual employment prospects and labour market conditions. Moreover, legislation provides rather strong incentives to participate. On the one hand, unemployed who refuse to join a programme, risk suspension of their unemployment benefits. On the other hand, most programmes count towards acquisition of new unemployment benefit claims (see Table 2). Therefore, we include a variable that indicates the UB claim at the beginning of an unemployment spell.

The internet appendix, Table IA.1, contains a complete list of all variables that are available in the data. In contrast to administrative data previously available for Germany, we observe whether a jobseeker has health problems or a disability affecting employability. We also observe a set of characteristics of the job the unemployed is looking for, the number of placement propositions by the PES, as well as information on benefit sanctions and compliance to

benefit conditions (e.g. attendance at interview with PES or cooperation with PES staff). Thus, though we are still not able to observe soft characteristics directly like motivation and ability of the unemployed, we have a set of previously unavailable important proxy variables and we are able to capture their indirect effects on pre-programme employment history that is starting effectively observed shortly after unification in 1990.

4.2 Estimation

All possible parametric, semi- and nonparametric estimators of treatments effects with observational data are built on the principle that for every comparison of two programmes, for participants in the programme of interest, we need comparison observations from the other programme with the same distribution of relevant characteristics. Characteristics are relevant if they jointly influence selection and outcomes (see Section 4.1 for these variables). Here, we use adjusted propensity score matching estimators for multiple treatments as our baseline estimator to produce such comparisons. A clear advantage of these estimators is that they are essentially nonparametric and that they allow arbitrary individual effect heterogeneity (see Heckman, LaLonde, and Smith, 1999, for matching with a binary treatment, and Imbens, 2000, and Lechner, 2001, for multiple treatments).

To obtain estimates of the conditional choice probabilities (the so-called propensity scores), which we use in our selection correction mechanism to form our comparison groups, we estimate probit models for all comparisons (all programme types against each other as well as nonparticipation). The analysis revealed that gender, age, qualification, and family status are important individual characteristics that determine participation. Furthermore, observed employment and unemployment histories are significantly correlated with participation choice. Moreover, the characteristics of the desired job an unemployed is looking for differ systematically among programmes. Regional information, such as the industrial, employment, and

wealth composition of the region as well as tax revenues, which entered the probits in a highly disaggregated way to capture the specifics of supply and demand in the local labour market, play important roles in the selection process. Finally, remaining unemployment benefit claims indeed seem to provide rather strong incentives to enter a programme.

We use a matching procedure that incorporates the improvements suggested by Lechner, Miquel, and Wunsch (2005a). These improvements aim at two issues: (i) To allow for higher precision when many 'good' comparison observations are available, they incorporate the idea of calliper or radius matching (e.g. Dehejia and Wahba, 2002) into the standard algorithm used for example by Gerfin and Lechner (2002). (ii) Furthermore, matching quality is increased by exploiting the fact that appropriate weighted regressions that use the sampling weights from matching have the so-called double robustness property. This property implies that the estimator remains consistent if either the matching step is based on a correctly specified selection model, or the regression model is correctly specified (e.g. Rubin, 1979; Joffe, Ten Have, Feldman, and Kimmel, 2004). Moreover, this procedure should reduce small sample bias as well as asymptotic bias of matching estimators (see Abadie and Imbens, 2006) and thus increase robustness of the estimator. The actual matching protocol is shown in Table B.1. See Lechner, Miquel, and Wunsch (2005a) for more information on this estimator.

5 The effects of programme participation

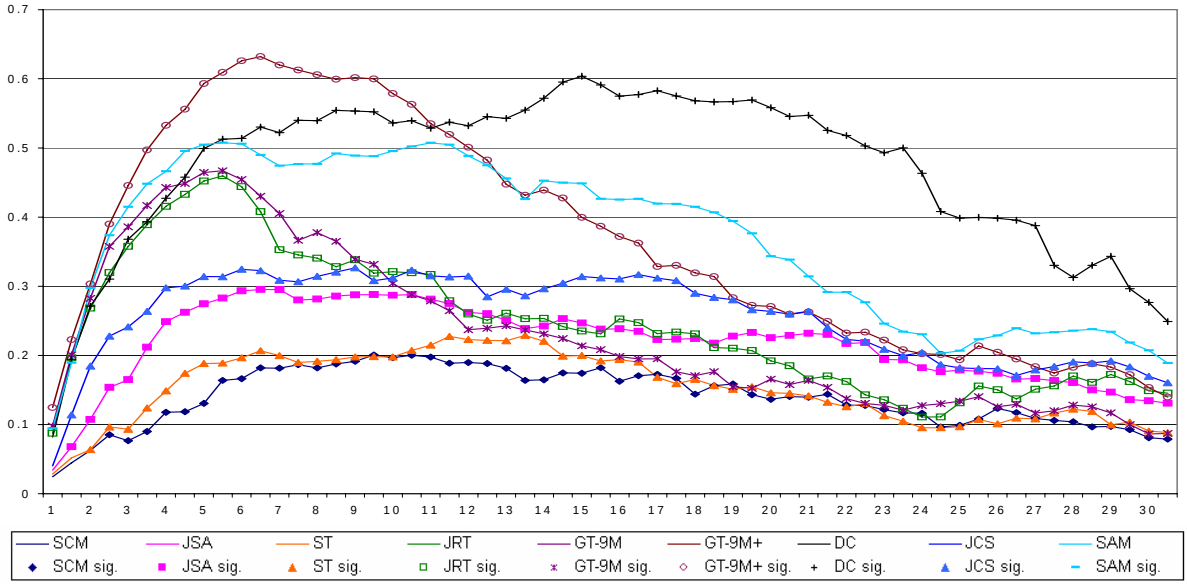
Below we present various figures displaying the average programme effects of the programme participants of the different programmes compared to nonparticipation for various outcome variables. Each line in the respective figure represents a different programme and relates to the effects for the specific population of participants in that programme. Dots appear on a particular line if the effect is pointwise significant on the 5%-level. Outcomes are either measured in percentage points when they relate to changes in labour market status, or in dif-

ferences of EUR when they relate to some earnings or income variable. The results are given for every half-month after the programme start, but the labeling on the corresponding axes refers to the respective month after the start of the programme. In the figures presented below, we only focus on the comparisons with nonparticipation. Extensive inter-programme comparisons, however, are available in the internet appendix of this paper, as well as in one of the following tables..

5.1 Programmes increase unemployment of their participants

Figure 2 shows the first of our key findings, namely that programme participation generally increases individual unemployment compared to nonparticipation. From the figure, we see that this effect differs substantially between the programmes, but there is not a single programme leading to a reduction in unemployment.

Figure 2: Effects of programme participation compared to nonparticipation: registered unemployment



Note: Abscissa: Months after programme start. Ordinate: Effect in %-points. Each line represents the respective population of participants, which may differ for each programme. Dots indicate that the effect is significant on the 5% level (sig.).

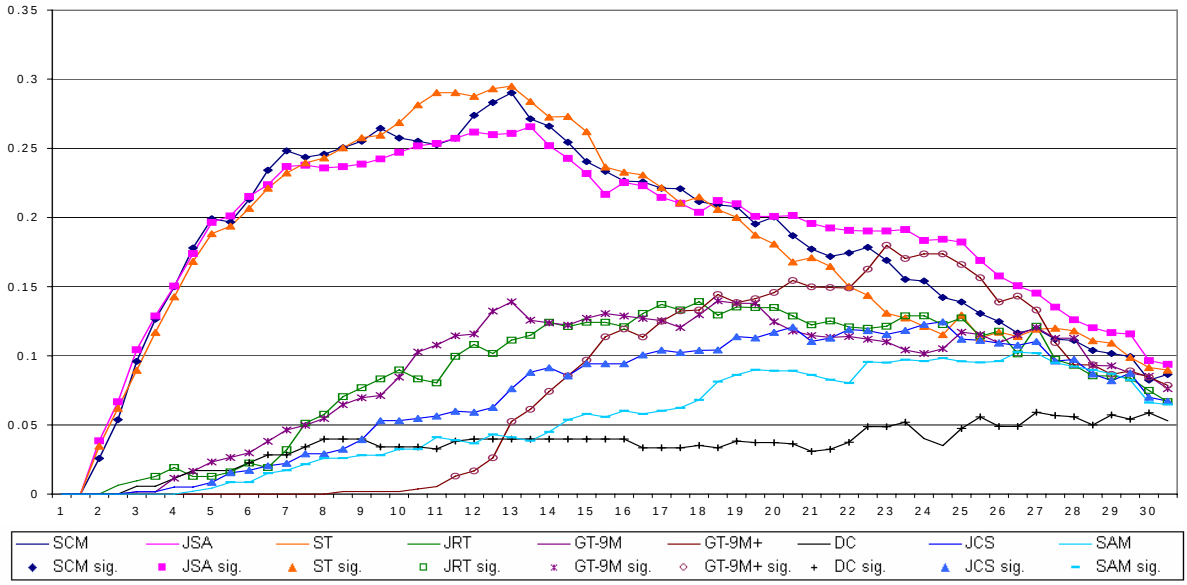
Generally, the negative effects are worst in the beginning and decline somewhat over time. They are also worse for the longer programmes: Over the 30 months considered, participants

in DC accumulate 14 (!) months of additional unemployment, with SAM 11 months, with JCS 8 months and with GT-9+ they accumulate 7 months (see Table C.1 in Appendix C for detailed results). The increase in the unemployment duration may well be due to the fact that all programmes increase the period in which benefits can be received by the unemployed.

5.2 Programmes keep participants busy and increase benefit receipt

Figure 3 shows that the programmes do not only increase the unemployment duration, but they also increase the likelihood of attending another programme in the future. This seems particularly true for the three types of the short training measures. In total over the 2.5 years after programme starts, these programmes accumulate each about 5-6 months of additional programme participation, whereas the other programmes add about 2-3 months of additional programme participation.

Figure 3: Effects of programme participation compared to nonparticipation: further programme participation



Note: See note below Figure 2. For programme participants we only consider further participations after the actual programme evaluated.

Table 7 shows in what kind of programmes unemployed participate. Nonparticipants also exhibit some programme participation after the 3-year window for which we require them not to

participate, mainly in the category other programmes, the largest fraction of which are temporary wage subsidies for regular jobs and support of self-employment. This category is also frequented by most of the participants who exhibit future participations.[10] Participation in the short training measures is often followed by GT and for JSA also by DC. Participants in GT, on the other hand, often participate in a JCS after the completion of GT.

Table 7: Further programme participation (%)

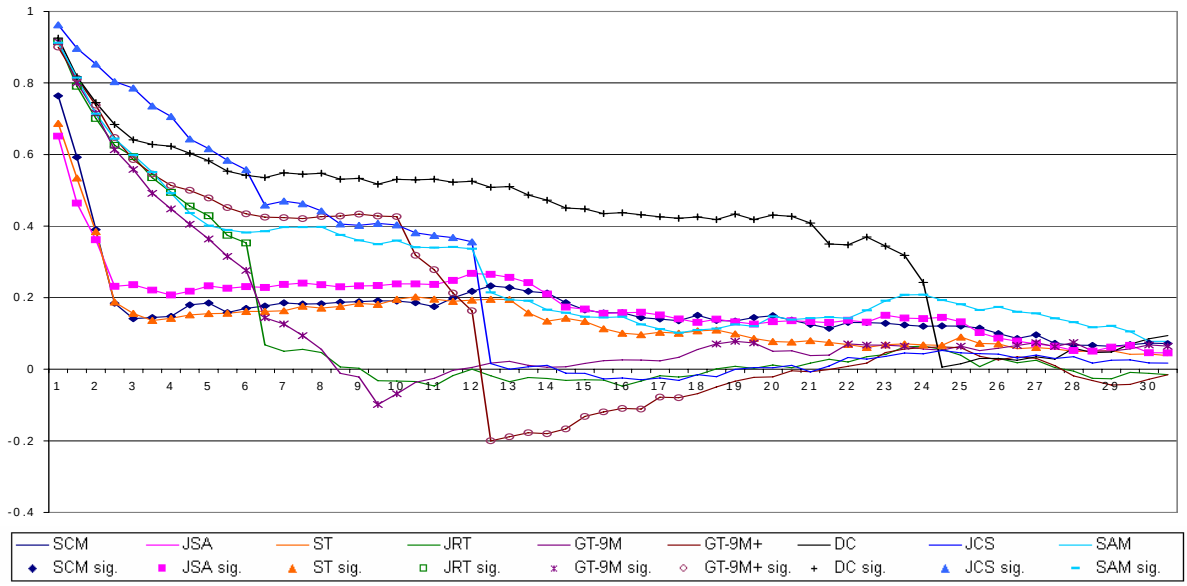
Treatment status	Acronym	SCM	JSA	ST	JRT	GT	DC	JCS	SAM	Other	At least one
Nonparticipation	NP	1	3	2	0.1	0.8	0.2	3	0.4	7	0.16
Short combined measures	SCM	10	8	5	2	18	6	7	2	16	0.62
Jobseeker assessment	JSA	2	14	4	2	10	11	7	3	17	0.59
Short training	ST	3	8	9	2	11	5	8	5	20	0.59
Job related training	JRT	5	12	6	4	5	2	9	4	13	0.51
General training	GT	3	9	7	1	6	1	8	3	20	0.51
Degree course	DC	4	10	6	1	6	3	3	1	13	0.41
Job creation scheme	JCS	4	7	3	1	4	2	13	2	20	0.49
Structural adjustment measure	SAM	4	6	4	1	3	2	7	4	13	0.38

Note: The largest fraction of *Other* are temporary wage subsidies followed by support of self-employment.

Our next finding in Figure 4 shows the effect of programme participation on any form of employment, including the time in any programme. It shows that one of the effects of programmes in East Germany is keeping the unemployed busy. For all programmes, Figure 4 shows that for this definition of employment large drops occur around the time when most participants complete their programme.

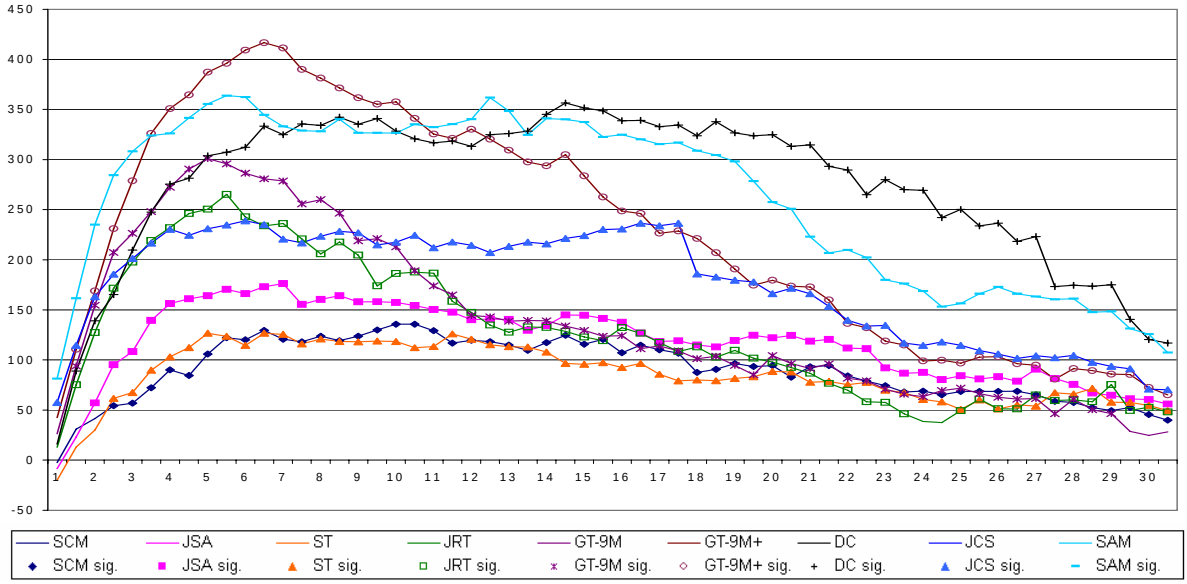
[10] In many cases, regular programmes were followed by periods of employment accompanied by a 6 or 12 month wage subsidy. To avoid having to pay back that subsidy, firms have to keep the initially subsidised employers for at least another period of unsubsidised employment of the same length as the subsidised employment period. Therefore, for some comparisons we see large drops in programme participation (for the definition of the outcome variables and the state of nonparticipation, all wage subsidy programmes are coded as programme participation, even if they are not explicitly evaluated in this paper) about 6 months after the end of a 6-month wage subsidy. See the internet appendix for all details.

Figure 4: Effects of programme participation compared to nonparticipation: subsidised and unsubsidised employment and programme participation



Note: See note below Figure 2.

Figure 5: Effects of programme participation compared to nonparticipation: benefits (EUR)



Note: See note below Figure 2.

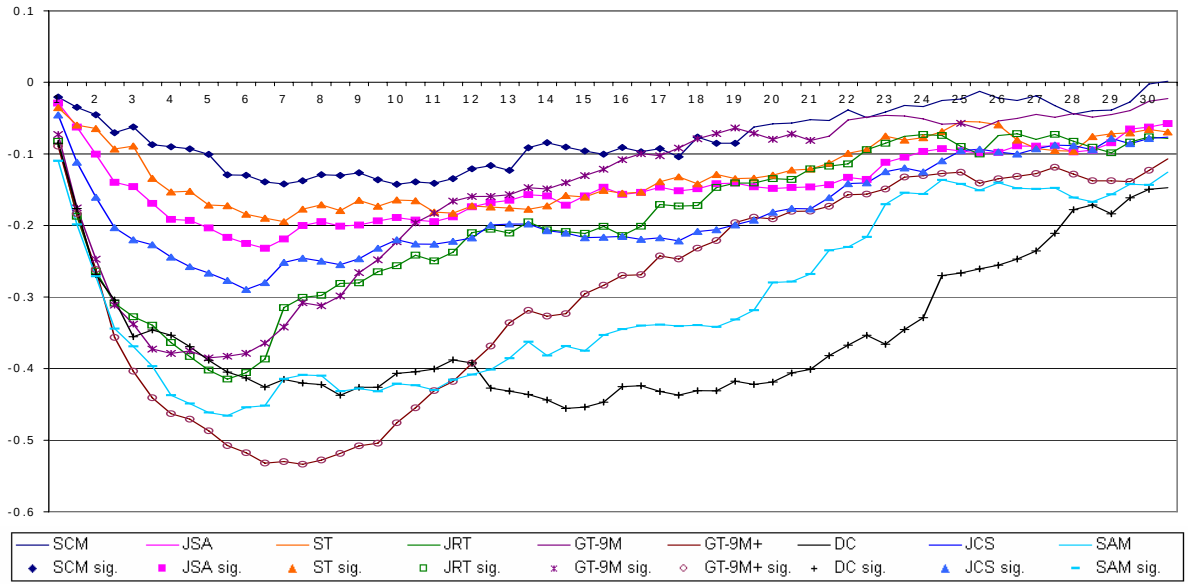
Figure 5 shows that the programmes do not only keep their participants busy, but the programmes (directly and indirectly) reward their participants by increasing the amount of unemployment benefits paid to them (incl. all benefits and 60% of wages received while participating in subsidised employment). Summing up these payments over the 2.5 year horizon, it

appears that participants in DC and SAM get an extra amount of about 8000 EUR of benefits, participants in GT-9M+ about 7000 EUR, in JCS about 5000 EUR, in JRT and GT-9M about 4000 EUR, in JSA about 3500 EUR and in SCM and ST about 2500 EUR. These numbers are substantial and hint at the large cost of the programmes in terms of benefits and wage subsidies.

5.3 Programmes do not increase the employment chances of their participants

It should clearly be one of the primary goals of East German training and employment programmes to improve the chances of the participants to find an unsubsidised job. Figure 6 shows that, however, after 2.5 years such effects are absent.

Figure 6: Effects of programme participation compared to nonparticipation: unsubsidised employment



Note: See note below Figure 2.

The only programmes that have no, or almost no, negative effect at the end of the observation period are the short combined measures (SCM) and short general training (GT-9M) programmes. All other programmes have significant negative effects. However, 2.5 years might be too short an observation period for a programme that has a typical duration of 2 years, like

DC, and a corresponding large (huge!) lock-in effect. This programme may or may not show future positive effects. Even for this programme, it is worrying that the negative effect after 2.5 years is quite large with about -15%. Certainly, for the short training programmes and probably also the employment programmes, the negative effects after 2.5 years are an indication that negative long-run effects should be expected.

5.4 Several groups of participants would have been better off had they participated in a different programme

We already saw that some groups of programme participants would have had better labour market chances had they not participated in any programmes. In this section, we show that even ignoring the option of nonparticipation, some programme groups would have fared better had they participated in a different programme.

Table 7 presents this comparison for all programmes and their participants (given in lines) compared to all alternatives (given in the columns) based on the outcome variable measuring unsubsidised employment. Whereas the upper part of the table contains the point-in-time estimate for the end of the observation period, the lower panel presents the number of months accumulated over those 2.5 years. Whenever an effect is negative, it means that on average the programme group would have fared better in the alternative programme. The shaded fields on the main diagonal of this table show the level of the outcome variable for the actual participants in the respective programme.

Ignoring the state of nonparticipation and taking only the case where both outcome measures agree, we see (at least) that participants in JSA, GT-9M+, DC, JCS, and SAM would have improved their employment chances had they participated in the shorter programmes in GT-9M (or SCM). This indicates that there is room for improving the process of allocating the unemployed to the various programmes.

Table 7: Effects of programme participation for participants in one programme had they participated in another programme: unsubsidised employment

Programmes	Comparison state									
	SCM	JSA	ST	JRT	GT-9M	GT-9M+	DC	JCS	SAM	NP
SCM	0.36	0.05	*0.08*	0.10	0.01	0.08	-0.02	*0.13*	**0.14**	-0.01
JSA	*-0.09*	0.31	-0.04	0.02	**-0.08**	-0.03	0.03	0.02	*0.07*	-0.06*
ST	-0.07	0.03	0.33	-0.11	-0.06	0.06	*0.14*	0.10	**0.13**	-0.06
JRT	-0.14	-0.02	-0.07	0.32	**-0.10**	-0.04	-0.01	0.10	0.08	-0.09
GT-9M	-0.04	*0.06*	0.00	*0.10*	0.42	0.07	**0.22***	0.12	**0.10**	-0.01
GT-9M+	-0.09	0.03	-0.01	0.07	*-0.08*	0.37	**0.19**	0.10	0.10	-0.10
DC	-0.11	-0.06	**-0.16***	-0.05	**-0.15***	-0.09	0.20	-0.02	-0.02	-0.12
JCS	-0.04	-0.01	-0.03	-0.04	**-0.12***	**-0.13**	0.01	0.17	-0.01	-0.06
SAM	-0.02	-0.03	-0.02	-0.04	-0.09	-0.03	0.03	0.03	0.28	-0.11
	Cumulated months over 2.5 years									
SCM	9.2	**2.1***	1.1	*2.6*	0.8	**3.8***	**5.9***	**4.8***	**6.3***	**-2.2***
JSA	-2.4	8.2	-2.0	1.1	-0.5	**2.3***	**5.2***	*2.2*	**4.3***	**-4.3***
ST	-0.4	*1.3*	9.4	-0.5	0.9	**4.0***	**7.8***	**4.1***	**6.0***	**-3.1***
JRT	**-5.2**	**-1.8**	**-4.0***	7.5	*-1.9*	1.8	**5.2***	1.7	**4.4***	**-5.8***
GT-9M	-4.0	0.7	-1.9	1.4	9.4	**3.2***	**7.2***	*2.7*	**4.8***	**-4.6***
GT-9M+	**-7.0***	**-1.8**	**-4.3***	-0.9	**-3.4***	6.5	**5.1***	1.6	**2.9***	**-8.5***
DC	**-9.3***	**-5.0***	**-9.3***	**-4.8***	**-6.3***	**-3.8***	1.8	**-2.3***	**-1.9***	**-10.4***
JCS	**-2.9**	**-2.5***	**-2.6**	**-2.0**	**-2.3***	**-2.0**	1.8	3.1	0.2	**-5.0***
SAM	**-7.3***	**-3.3***	**-5.6***	**-3.2***	**-3.1***	**-1.8***	**1.9***	**-0.8**	4.3	**-8.6***

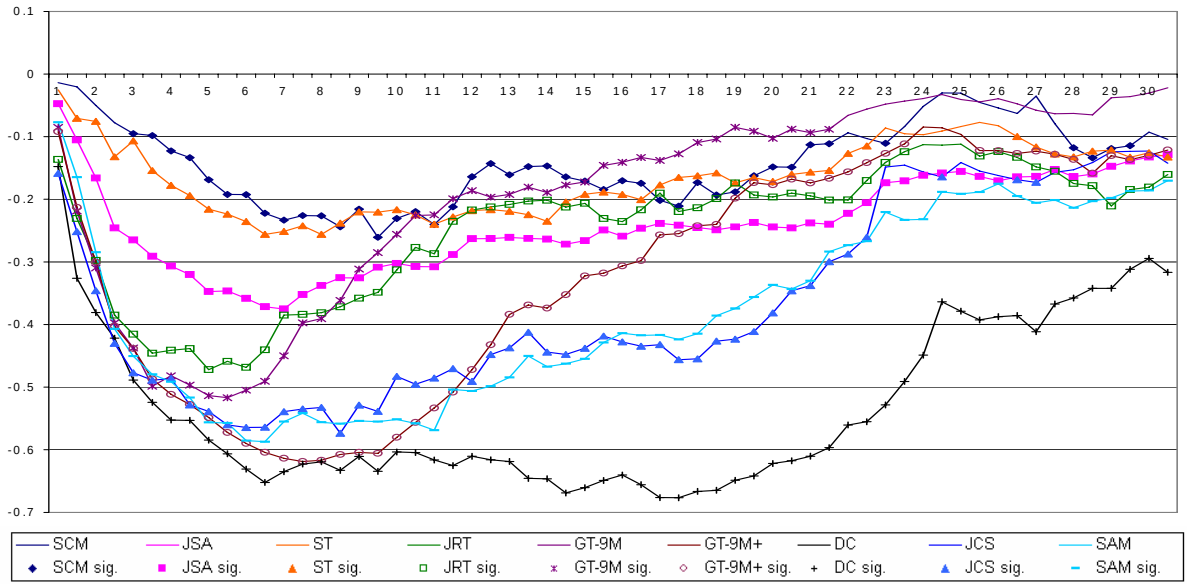
Note: Numbers in *italics* indicate significance on the 10% level, **bold** numbers on the 5% level, and * on the 1% level. Dark shaded entries on the diagonal are the levels of the respective potential outcome in the respective group of participants. Off-diagonal elements are the effects of the programme given in the line for its participants compared the state that those participants would have participated in the programme given as headings of a column.

5.5 Unemployed with reasonable chances on the labour market got hurt most

Next, we analyse the effects of the programmes on unsubsidised employment for the groups with good and bad no-programme labour market chances separately. This separation is performed according to the no-programme employment index discussed in Section 3.3.

The results for the group with better chances are presented in Figure 7. They are striking in the sense that all programmes with the exception of GT-9M (and perhaps SCM) hurt this group. SAM, JCS, and DC have large negative effects of about -30%, whereas the shorter programmes have negative effects between -10% and -20%.

Figure 7: Effects of programme participation compared to nonparticipation: unsubsidised employment; unemployed with non-programme employment chances above the median

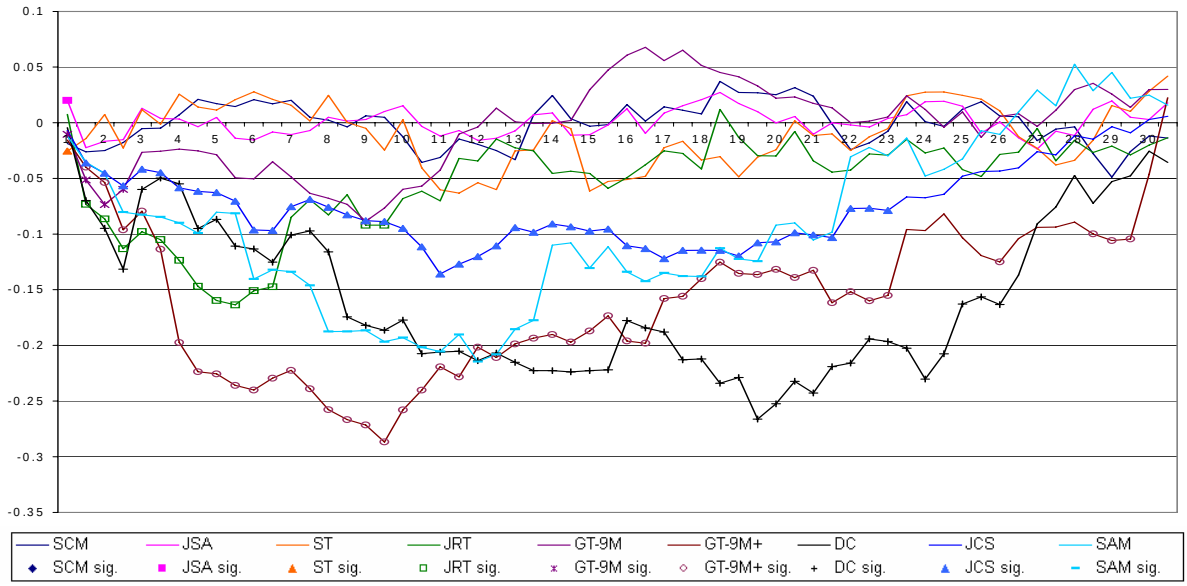


Note: See note below Figure 2. The employment index is equal to the predicted probabilities from a probit in the pool of nonparticipants. Dependent variable: employed in unsubsidised employment with at least 90% of the earnings of the last job before programme start, measured in half-month 60 after programme start.

For the group which has worse labour market chances even without the programmes (Table 8), at least none of the programmes seem to reduce employment after 30 months significantly, however, a significant positive effect cannot be detected either.

A straightforward reason for this finding may be due to differential lock-in effects. The better the pre-programme employment chances, the quicker an unemployed finds a job. Therefore, the reduction in employment rates due to a lack of job search and reduced job offers while participation in a programme is larger for 'better' unemployed, leading to a larger lock-in effect as compared to 'worse' unemployed who would need longer anyway to find a job. Apparently, the lock-in effects got so large that 'good' programme participants could recover.

Figure 8: Effects of programme participation compared to nonparticipation: unsubsidised employment; unemployed with non-programme employment chances below the 33% quantile



Note: See note below Figure 2. The employment index is equal to the predicted probabilities from a probit in the pool of nonparticipants. Dependent variable: employed in unsubsidised employment with at least 90% of the earnings of the last job before programme start, measured in half-month 60 after programme start.

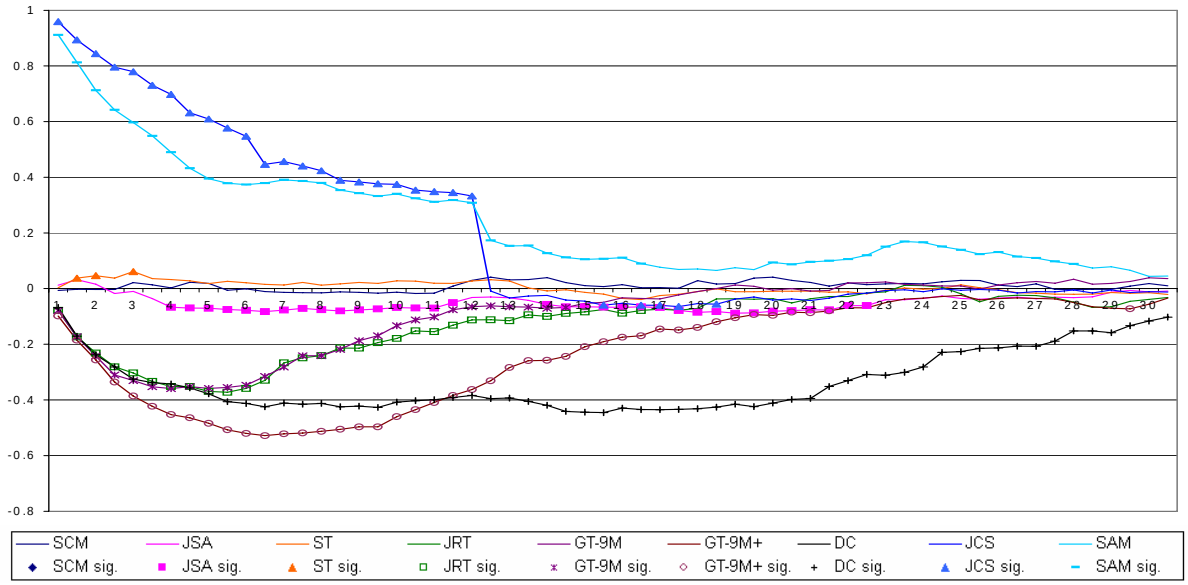
5.6 Why were the previous results more positive?

In a previous study by Lechner, Miquel, and Wunsch (2005b) that was based on a similar methodology, we found generally more positive effects of the training programmes that were in effect 10 years earlier. For the three training programmes that we looked at (there was no information on employment programmes and subsidies in the old data), we found positive effects for retraining (similar to DC) after about 35 months. This is beyond our horizon available in this paper, but for the shorter training programmes we obtained significant positive effects compared to nonparticipation after 25 months for training courses longer than 6 months, and after about 12 months for training courses 6 months and shorter. What has changed? One thing that is different between the two studies is that for the first six years the old data did not allow to distinguish subsidised and non-subsidised employment.

Figure 9 presents the results of our current analysis based on an employment variable similar to the one used previously. We see that the negative effects of programmes disappear, with

the exception of DC, which still shows negative effects of about -15%. However, no positive effects occur either, leading us to the conclusion that the definition of the outcome variable is not the reason for the discrepancies in the findings of the two papers.

Figure 9: Effects of programme participation compared to nonparticipation: total (subsidised and unsubsidised) employment



Note: See note below Figure 2.

Since there is no data available on programmes between 1997 and 2000, it is very hard to analyse the reasons for the changes. It could be that the programme quality, or the quality of the selection process into the programmes, or the quality of the suitable potential participants declined, or that the labour market changed in a direction that made it harder to reward programme participation. This issue remains open for future research.

6 Sensitivity checks

We conducted several sensitivity analyses, the details of which are given in the internet appendix.

We did not find any substantial heterogeneity of the programme effects for the socio-economic groups we looked at, other than the general feature mentioned above, namely that unemployed with intact pre-programme labour market chances fair worse than unemployed with bad pre-programme labour market chances.

With respect to the technical properties of the estimation, we varied the criteria to define the common support as well as the time window used to define participation as well as nonparticipation, but no significant differences appeared.

7 Conclusions

In this paper, we analyse the most important components of the East German active labour market policy between 2000 and 2002. Our empirical investigation is based on a well-suited, large, and informative individual database of participants and nonparticipants that originated from administrative records. These data are analysed with econometric matching methods. We considered various labour market outcomes over a period of 30 months after the respective programmes started. Our analysis leads us to the following policy conclusions:

If the success of the programmes is measured by the primary goal of the official active labour market policy (ALMP), namely, ALMP should bring its participants back into jobs in the first labour market, all programmes failed. They do *not improve* the employment chances or earnings. In particular, for the group of individuals with better employment chances in the labour market, several programmes *reduce* those chances by a considerable amount. This finding is however not surprising. By using training and employment programmes, active labour market policies can at best reduce unemployment due to mismatch in the labour market. Furthermore, it may prevent a deterioration of the general human capital of the workforce due to individual interruptions of the employment spells and the lack of learning on the job while in unemployment. ALMP can certainly not solve the deep structural problems in the

labour market experienced in East Germany over the last decade. In other words, it tries to alleviate some of symptoms of the sickness of the East German labour market, but cannot cure the disease.

If ALMP has to fail to deliver better individual labour market outcomes given the specific circumstances of the East German economy, could it still be worthwhile running ALMP programmes? Indeed, one may argue that ALMP is still required in East Germany at least for two reasons: The first reason is that participation in those programmes keeps people busy and provides them with some income from work or work-related tasks. In other words, it may be and is used to combat social unrest in an environment that saw (official) unemployment rates around 20% for a long time, and non-employment rates that are considerably higher. The second reason for having ALMP could be to keep people ready for work, i.e. use short training and employment programmes to keep their working skills and human capital from deteriorating, so that they actually will find jobs when (if) the structural problems of the East German economy will be overcome and the economy will ultimately pick up. Our analysis shows that the programmes are effective in the first dimension. The effectiveness in the second dimension however remains to be seen.

Taking those arguments seriously, an active labour market policy for East Germany should give up the goal to increase the individual probability of unemployed to find regular employment, which cannot be achieved anyway. Instead, it should concentrate on the two smaller goals explained above, which are worth to reach as well. However, such a policy would look differently than the one we analysed. In particular, it would drastically reduce the expensive long-term courses that make only sense if the unemployed were educated with skills that are in considerable short supply, which does not appear to be the case on a large scale in East Germany. Unemployed should participate in employment programmes and take

up jobs related to hiring subsidies, even if those jobs will only be of a temporary nature. Furthermore, sending unemployed from time to time to shorter training programmes to practice and update their skills should also be considered as worthwhile. However, there remains the overarching issue about the costs to reach the limited goals of such a policy. Although costs would be probably somewhat smaller than for today's policy, it is not clear at all how much the taxpayer will be willing to pay for such a reorganised active labour market policy in East German.

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Appendices A, B, and C as well as the internet appendices can be found in the online version of this paper.

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- The Case of East Germany -

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Escaping the Unemployment Trap
- The Case of East Germany -

by

Christian Merkl and Dennis J. Snower

January 2007

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Escaping the Unemployment Trap
- The Case of East Germany -

Abstract

This paper addresses the question of why prolonged regional unemployment differentials tend to persist even after their proximate causes have been reversed (e.g., after wages in the high-unemployment regions have fallen relative to those in the low-unemployment regions). We suggest that the longer people are unemployed, the greater is the likelihood of falling into a low-productivity "trap," through the attrition of skills and work habits. We develop and calibrate a model along these lines for East Germany and examine the effectiveness of three employment policies in this context: (i) a weakening of workers' position in wage negotiations due to a drop in the replacement rate or firing costs, leading to a fall in wages, (ii) hiring subsidies, and (iii) training subsidies. We show that the employment effects of these policies depend crucially on whether low-productivity traps are present.

Keywords: labor markets; labor market traps; calibration; East Germany

JEL: E24, J30, J31, J64

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1 Introduction

The persistence of large European regional unemployment differentials - particularly within the large European economies, France, Germany, Italy and Spain - remains a challenge to economists, despite a prodigious literature on the subject (e.g. Decressin and Fatás, 1995, Elhorst, 2005, Faini et al., 1997, Gray, 2004, Sinn and Westermann, 2001, Taylor and Bradley, 1997). The mystery is not how these unemployment differentials arose, for usually regions of relatively high unemployment are generally ones in which labor costs have been relatively high in relation to productivity. Rather, the mystery is why unemployment differentials far outlive their original causes. Specifically, once the unemployment differentials have persisted for a long time, then they do not go away, even after labor costs fall relatively to productivity. Why?

East Germany is a good case example. After German reunification in 1991, East German real wages rose dramatically relative to productivity and unemployment jumped upwards in response. With the social and monetary union in October 1990, East German labor costs jumped from 7% (using the informal exchange rate) to about one half of the West German level (see e.g., Franz and Steiner, 2000, Sinn, 2002). Since then, however, labor costs have fallen steadily in relation to productivity, but the employment rate has remained stubbornly low, hovering near 20 percent for the past decade (see figure 1[1]). Traditional labor market analysis has trouble accounting for this experience.

This paper suggests a simple explanation[2]: Once people remain unemployed for a long time, they tend to fall into a "trap" representing a contraction of their employment opportunities. Snower and Merkl (2006) describe several such traps, but do not model them. Consider a few examples.

Immediately after German reunification, East German wage bargaining was conducted primarily by *West German* unions and employers, and these had strong incentives to push East German wages up, in order to reduce migration of East German workers to West Germany and of West German firms to the East. Given the low short-run elasticity of labor demand, this "bargaining by proxy" was not only in the interests of West German unions, but also West German firms who feared the entry of new firms sparked by the new migration flows. The upward wage pressure was reinforced through generous unemployment benefits and associated welfare entitlements. The resulting East German wage hike led to a sharp fall in East German employment, and this effect was prolonged through the introduction of generous job security provisions and costly hiring regulations, which raised the persistence of employment (i.e. made current employment depend more heavily on past employment). The persistently low employment was mirrored in long-term unemployment.[3]

This is where possibility of traps arises. The long-term unemployed are prone to attrition of skills and work habits and they are of course unable to get on-the-job training. As their productivity falls, they find more difficult to find jobs, even if labor costs fall relative to the average productivity of the employed workforce.

Naturally, if these "efficiency labor costs," i.e. labor costs deflated by average productivity, fell sufficiently to more than compensate for the drop in the productivity of the long-term unemployed, then their employment opportunities would improve; but the data appear to suggest that these costs did not fall enough.

Furthermore, the massive East German investment subsidies that were granted in the aftermath of reunification - often paid to prevent uncompetitive firms to lay off their employees - resulted in the creation of capital that was relatively unproductive and prone to underutiliza-

[1] Sources: Bundesagentur für Arbeit (2006a, b) and Statistische Ämter des Bundes und der Ländern (2006), own calculations.

[2] For an alternative explanation see Uhlig (2006).

[3] The share of long-term unemployed (with a duration of more than one year) has increased from one quarter in 1992 to roughly one half today (Sachverständigenrat, 2004).

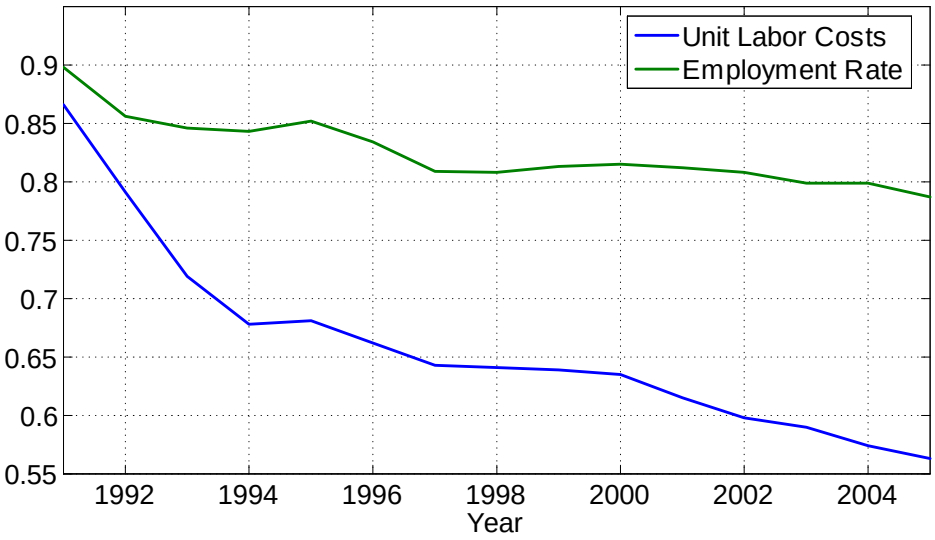

Figure 1: East German labor cost normalized by productivity and the employment rate for dependently employed workers.

tion (see, for example, Sinn, 1995). The labor cooperating with this capital became similarly unproductive and underutilized, even if efficiency labor costs subsequently fall.

What these traps have in common is that they are both associated with low productivity[4]: the long-term unemployed are prone to become less productive and this traps them in unemployment. The drop in productivity may arise either because workers lose skills or because they lose access to "good jobs" (i.e. highly productive, well-paying ones).

This paper models such a trap, and examines its implications for labor market activity and employment policy. We build an analytical model of the low-productivity trap and calibrate it for the East German labor market. In this context, we inquire which policies are effective in creating employment.

The trap highlights a major, often ignored, cost of long-term unemployment. A specific rise in efficiency labor costs sends employees into short-term unemployment; but should this state persist and thus turn into long-term unemployment, then an equal and opposite fall in efficiency labor costs may be insufficient to bring these workers back into employment.

Our notion of a labor market "trap" is related to the literature on segmented labor markets, for example, models that divide the labor market into a high-wage "primary sector" and a "secondary sector" that is market clearing.[5]

This paper contributes to this literature by explaining sources of mobility between the two sectors and examining the implications for employment and unemployment dynamics. As noted, our model describes a labor market where workers in the primary sector who become unemployed risk losing their skills or their access to high-productivity jobs (for instance, because they become stigmatized and demotivated through their unemployment spell), and thereby they risk sinking into the "trapped" sector. The longer they are unemployed, the greater this risk becomes. On the other hand, workers who are employed in the trapped sector may gain skills

[4]See Fuchs-Schündeln and Izem (2007) and Ragnitz (2007) for a thorough analysis of the low labor productivity in East Germany. See Burda (2006) for a neo-classical model of economic integration with adjustment costs, which explains the "capital deepening" and the "labor thinning" in the East.

[5]See, for example, Bulow and Summers (1986), McDonald and Solow (1985), Weitzman (1989), Dickens and Lang (1988) for the early foundations of this literature and Kleven and Sorensen (2004) and Lommerud et al. (2004) for more recent contributions. For the empirical literature see, for example, Dickens and Lang (1985), Saint-Paul (1996) for a survey and Ghilarducci and Lee (2005) for a recent contribution.

or access to high-productivity jobs (e.g. by using their jobs to gain information and contact to other employment opportunities), and thereby they may rise into the primary sector. The longer they remain employed, the greater is the likelihood of rising. In short, unemployment is the road to bad jobs and long-term unemployment, whereas employment is the road to good jobs and shorter unemployment spells.

As shown below, these dynamic relations have important implications not only for the persistence of employment and unemployment, but also for the effectiveness of labor market policies. Specifically, we show that

- the existence of low-productivity traps implies that reductions in wages in the trapped sector (induced, say, by cuts in unemployment benefits or firing costs), on their own, are relatively ineffective in raising the corresponding employment rate (both in relation to the primary sector and an economy without low-productivity traps).

- hiring subsidies for the trapped unemployed have a relatively strong positive influence on employment, i.e. for a given subsidy size (both absolute and relative to the wage) they are more cost-effective[6] than hiring subsidies for primary unemployed. There are two driving forces: The presence of traps reduces the deadweight effects of hiring subsidies and hiring subsidies enable more trapped workers to move to the primary sector via on the job training.

- training subsidies and programs that raise the productivity of workers in the trapped sector, thereby improving their chances of entering the primary sector, may also have a relatively strong employment long-run effect, but this effect takes a long time to manifest itself.

The paper is organized as follows. Section 2 presents our model. In Section 3 this model is calibrated for the East German labor market. Section 4 considers the policy implications. Finally, Section 5 concludes.

2 The Model

Our labor market has a "primary" sector and a "trapped" sector. The average productivity per worker in the trapped sector is assumed to be lower in the trapped (a_T) than in the primary sector (a_P). Moreover, firms face a random cost ε_t, iid across workers and time, with a constant cumulative distribution $\Gamma(\varepsilon_t)$. This cost may be interpreted as an operating cost or as a negative productivity shock.

Decisions in the labor market are made in the following sequence: First, workers move between sectors. Specifically, each unemployed worker in the primary sector has an exogenously given probability ν of losing productivity and thereby entering the trapped sector (due either to skill attrition or loss of access to good jobs); and each employed worker in the trapped sector has an exogenously given probability ϖ of gaining productivity and thereby ascending to the primary sector.[7] Second, the wage is determined through bargaining. Third, the value of the random cost ε_t is revealed. Finally, firms make their hiring and firing decisions.

Let the hiring rates of workers in the primary and trapped sectors be η_P and η_T, respectively, and let their firing rates from these sectors be ϕ_P and ϕ_T, respectively. (These hiring and firing

[6] We call a policy more "cost effective" than another policy when it generates more employment, for a given net government expenditure outlay.

[7] Thus the cumulative probability of that an unemployed primary worker falls into the low-productivity trap rises with the duration of unemployment, and the cumulative probability of an employed trapped worker to escape from the trap rises with employment duration.

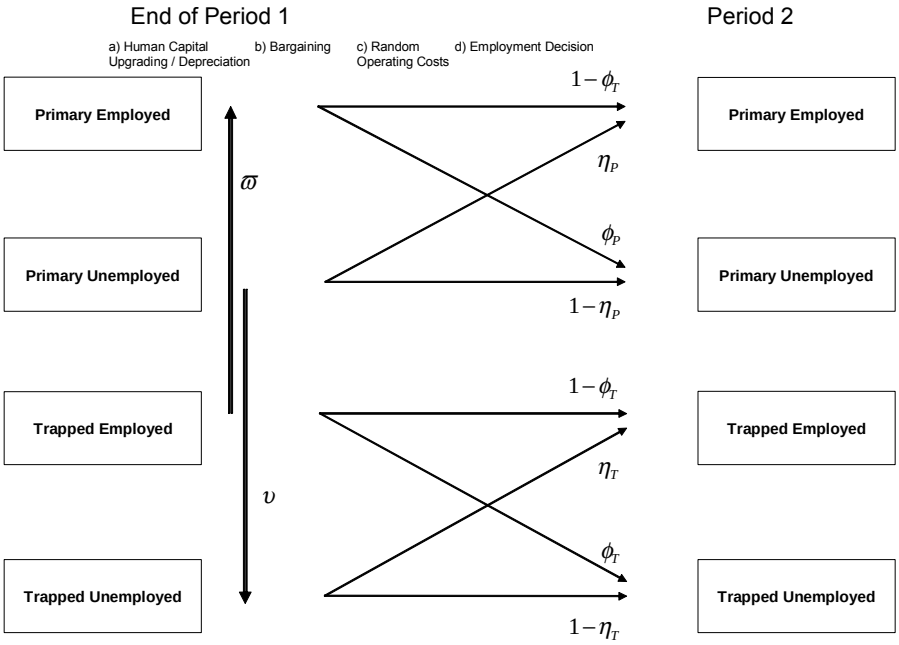

Figure 2: Transition Probabilities

rates will be derived choice-theoretically below.) The transitions between the various economic states are pictured in figure 2. Each employed primary and trapped worker remains employed with probability $(1-\phi_P)$ and $(1-\phi_T)$, respectively; she becomes unemployed with probability ϕ_P and ϕ_T, respectively. Each unemployed primary and trapped worker remains unemployed with probability $(1-\eta_P)$ and $(1-\eta_T)$, respectively; she becomes employed with probability η_P and η_T, respectively.

2.1 Wage Determination

We assume that the wage is the outcome of a Nash bargain between the median insider and her firm in the respective sector.[8] The median insider faces no risk of dismissal at the negotiated wage.[9]

There are constant returns to labor.[10] Under bargaining agreement, the insider receives the

[8]The critical reader may object that insider power has been seriously eroded in East Germany due to the fall in union membership since reunification. The first response to this objection is that we should not confuse our insider bargaining with union bargaining, since our Nash bargaining problem could be interpreted as the individual median insider bargaining with her firm. Second, much of the erosion of East German insider power since reunification has resulted from the replacement of bargaining by proxy (in which West German unions and firms had dominant influence on negotiations about East German wages) by self-sufficient bargaining (in which East German workers and firms have taken control of East German wage determination). In our model, we assume that East German wage determination is entirely self-sufficient in this sense. And finally, although union membership has dropped in East Germany, union wage agreements still have very broad coverage. For example, in 2003 firms that were covered by a firm level or sectoral wage agreement employed 54 percent of all workers in East Germany. A large share of the other firms followed existing wage agreements voluntarily, covering 52 percent of the remaining employees (Schnabel, 2005).

[9]This assumption is made merely for analytical convenience; various other assumptions would lead to similar results. The wage could e.g. be the outcome of a bargain between the firm and the marginal worker, or between the firm and a union representing all employees. In this last case, the insiders' objective in the bargain will depend on their retention rate.

[10]In what follows, only those variables have time subscripts that, for given parameter values, actually vary through time in our model. j is the index for the sector. It can either be P (primary sector) or T (trapped

wage $w_{T,t}$ and the firm receives the expected profit $(a_T - w_{T,t})$ in each period t. The expected present value of returns to a trapped insider under bargaining agreement $\left(V^I_{T,t}\right)$ is

$$V^I_{T,t} = w_{T,t} + \delta \begin{pmatrix} (1-\varpi)\left(1-\phi_{T,t+1}\right) V^I_{T,t+1} + (1-\varpi)\,\phi_{T,t+1}\,(1-\varpi)\,V^U_{T,t+1} \\ +\varpi\left(1-\phi_{P,t+1}\right) V^I_{P,t+1} + \varpi\phi_{P,t+1} V^U_{P,t+1} \end{pmatrix} \tag{1}$$

where δ is the discount factor and $V^U_{T,t+1}$ $(V^U_{P,t+1})$ is the expected present value of returns of an unemployed trapped (primary) worker and $V^I_{T,t+1}$ $(V^I_{P,t+1})$ is the expected present value of returns of an employed trapped (primary) worker, respectively. Note that with probability ϖ a trapped worker is upgraded to the primary sector and thus has a higher future present value. The expected present value of returns to the firm under bargaining agreement is

$$\widetilde{\Pi}'_{T,t} = (a_T - w_{T,t}) + \delta \begin{pmatrix} (1-\varpi)\left(1-\phi_{T,t+1}\right) \widetilde{\Pi}^I_{T,t+1} - (1-\varpi)\,\phi_{T,t+1} f_{T,t+1} \\ +\varpi\left(1-\phi_{P,t+1}\right) \widetilde{\Pi}^I_{P,t+1} - \varpi\phi_{P,t+1} f_{P,t+1} \end{pmatrix} \tag{2}$$

where $\widetilde{\Pi}^I_{T,t+1}$ $(\widetilde{\Pi}^I_{P,t+1})$ is the future profit in the trapped (primary) sector, weighted with the probability that the worker stays in the respective sector.

Under disagreement, the insider's fallback income is $b_{T,t}$, assumed equal to the unemployment benefit. The firm's fallback profit is $-f_{T,t}$, which is the firing cost per employee (in the trapped sector). In words, during disagreement the insider imposes the maximal cost on the firm (e.g. through strike, work-to-rule, sabotage) short of inducing dismissal. Assuming that disagreement in the current period does not affect future returns, the present values of insider's returns under disagreement is

$$V'^I_{T,t} = b_{T,t} + \delta \begin{pmatrix} (1-\varpi)\left(1-\phi_{T,t+1}\right) V^I_{T,t+1} + (1-\varpi)\,\phi_{T,t+1}\,(1-\varpi)\,V^U_{T,t+1} \\ +\varpi\left(1-\phi_{P,t+1}\right) V^I_{P,t+1} + \varpi\phi_{P,t+1} V^U_{P,t+1} \end{pmatrix} \tag{3}$$

and the present value of the firm's agreement under disagreement is

$$\widetilde{\Pi}'_{T,t} = -f_{T,t} + \delta \begin{pmatrix} (1-\varpi)\left(1-\phi_{T,t+1}\right) \widetilde{\Pi}^I_{T,t+1} - (1-\varpi)\,\phi_{T,t+1} f_{T,t+1} \\ +\varpi\left(1-\phi_{P,t+1}\right) \widetilde{\Pi}^I_{P,t+1} - \varpi\phi_{P,t+1} f_{P,t+1} \end{pmatrix} \tag{4}$$

Thus the insider's bargaining surplus is

$$V^I_{T,t} - V'^I_{T,t} = w_{T,t} - b_{T,t} \tag{5}$$

and the firm's bargaining surplus is

$$\widetilde{\Pi}_{T,t} - \widetilde{\Pi}^I_{T,t} = a_T - w_{T,t} + f_{T,t} \tag{6}$$

The negotiated wage maximizes the Nash product (Λ)

$$\Lambda = \left(w_{T,t} - b_{T,t}\right)^{\gamma} \left(a^I_T - w_{T,t} + f_{T,t}\right)^{1-\gamma}, \tag{7}$$

where γ represents the bargaining strength of the insider relative to the firm. Thus the negotiated wage is

$$w_{T,t} = (1-\gamma)\, b_{T,t} + \gamma\,(a_T + f_{T,t})\,. \tag{8}$$

The bargaining problem is analogous in the primary sector (see Appendix), so that the negotiated primary wage is

$$w_{P,t} = (1-\gamma)\, b_{P,t} + \gamma\,(a_P + f_{P,t})\,. \tag{9}$$

sector).

2.2 Employment Decision

Having determined the wage, we now proceed to derive the hiring and firing rates for the primary and trapped sector.

2.2.1 Primary Sector

Given the realized value of the random cost variable ε_t, which is iid across individuals and time and whose mean is normalized to zero, an insider generates the following present value of expected profit:[11]

$$\Pi_t = -\varepsilon_t + \sum_{t=0}^{\infty} \delta^t \left(1-\phi_P\right)^t \left(a_P - w_P\right) - \delta\phi_P f_P \sum_{t=0}^{\infty} \delta^t \left(1-\phi_P\right)^t. \tag{10}$$

i.e. with probability $(1-\phi_P)$ the insider is retained and generates profit $(a_P - w_P)$, whereas with probability ϕ_P is fired and generates the firing cost f_P (constant per employee).

The insider is fired when her generated profit is less than the firing cost: $\Pi_t < -f_P$, so that $\varepsilon_t > \left(a_P - w_P + (1-\delta) f_P\right) / \left(1-\delta\left(1-\phi_P\right)\right)$. Recalling that $\Gamma\left(\varepsilon_t\right)$ is the cumulative density of the random cost ε_t, the firing rate is given by the following implicit function:[12]

$$\phi_P = 1 - \Gamma\left(\frac{a_P - w_P + (1-\delta) f_P}{1-\delta\left(1-\phi_P\right)}\right) \tag{11}$$

The firm faces a hiring cost of h, constant per worker. An entrant is hired when his generated profit exceeds this hiring cost: $\Pi > h_P$. Thus the hiring rate is

$$\eta_P = \Gamma\left(\frac{a_P - w_P - \delta\phi_P f_P}{1-\delta\left(1-\phi_P\right)} - h_P\right) \tag{12}$$

2.2.2 The Trapped Sector

As noted, each worker in the trapped sector is assumed to have an average productivity a_T that is lower than the one of his counterpart in the primary sector. Furthermore, trapped workers have a probability ϖ of moving into the primary sector. Thus, the present value of the profit generated by an entrant in the trapped sector is[13]

$$\begin{aligned}\Pi_t \;=\; & -\varepsilon_t + \frac{a_T - w_T - \delta\left(1-\varpi\right)\phi_T f_T}{1-\delta\left(1-\phi_T\right)\left(1-\varpi\right)} - \phi_P\delta\varpi\frac{f_P}{\left(1-\delta\left(1-\varpi\right)\left(1-\phi_T\right)\right)} \\ & + \left(1-\phi_P\right)\delta\varpi\left(\frac{a_P - w_P - \delta\phi_P f_P}{\left(1-\delta\left(1-\phi_P\right)\right)\left(1-\delta\left(1-\varpi\right)\left(1-\phi_T\right)\right)}\right)\end{aligned} \tag{13}$$

Along the same lines as before, a worker is fired if her expected profits are smaller than minus the firing costs $(\pi_t < -f_T)$:

$$\phi_T = 1 - \Gamma\left(\begin{array}{c}\frac{a_T - w_T - \delta(1-\varpi)\phi_T f_T}{1-\delta(1-\phi_T)(1-\varpi)} + f_T - \phi_P\delta\varpi\frac{f_P}{(1-\delta(1-\varpi)(1-\phi_T))} \\ + \left(1-\phi_P\right)\delta\varpi\left(\frac{a_P - w_P - \delta\phi_P f_P}{(1-\delta(1-\phi_P))(1-\delta(1-\varpi)(1-\phi_T))}\right)\end{array}\right) \tag{14}$$

And she is hired if the expected profits are bigger than the hiring costs in the trapped sector $(\pi_t > h_T)$.

[11] In what follows, only those variables have time subscripts that, for given parameter values, actually vary through time in our model.

[12] We assume that $(\partial\Gamma/\partial\phi) > -1$, so that a rise in $(a-w)$ or f both reduce the firing rate.

[13] See the Appendix for a detailed derivation.

$$\eta_T = \Gamma \left(\begin{array}{c} \frac{a_T - w_T - \delta(1-\varpi)\phi_T f_T}{1-\delta(1-\phi_T)(1-\varpi)} - h_T - \phi_P \delta \varpi \frac{f_P}{(1-\delta(1-\varpi)(1-\phi_T))} \\ + (1-\phi_P)\,\delta\varpi \left(\frac{a_P - w_P - \delta\phi_P f_P}{(1-\delta(1-\phi_P))(1-\delta(1-\varpi)(1-\phi_T))} \right) \end{array} \right) \tag{15}$$

2.3 Employment Dynamics

We allow for the possibility that the employed workers in the trapped sector may raise their productivity - through learning-by-doing, improved work motivation, better work habits and so forth - and then move into the primary sector. Specifically, we also allow for the possibility that unemployed workers in the primary sector may lose productivity - through attrition of human capital, reduced work motivation, lost work habits, etc. - and then fall into the trapped sector. In particular, we assume that, in each period, a constant proportion ϖ of the employed workers in the trapped sector ascend to the primary sector, and a constant proportion υ of the unemployed primary workers descend into the trapped sector.

Thus, we obtain the following employment equation for the primary sector:[14]

$$N_{P,t} = (1-\phi_P)\,N_{P,t-1} + (1-\phi_P)\,\varpi N_{T,t-1} + \eta_P\,(1-\upsilon)\,U_{P,t-1} \tag{16}$$

The number of employed in the primary sector ($N_{P,t}$) consists of workers who are retained from the previous period[15] plus the newly hired workers ($\eta_P\,(1-\upsilon)\,U_{P,t-1}$).

For the trapped sector the employment dynamics equation is:

$$N_{T,t} = (1-\phi_T)\,(1-\varpi)\,N_{T,t-1} + \eta_T\,(U_{T,t-1} + \upsilon U_{P,t-1}) \tag{17}$$

The number of employed workers in the trapped sector is equal to those who are retained and have not received a human capital upgrade ($(1-\phi_T)\,(1-\varpi)\,N_{T,t-1}$) plus the newly hired workers ($\eta_T\,(U_{T,t-1} + \upsilon U_{P,t-1})$).[16]

After some re-formulations (see Appendix), we obtain an employment dynamics equation (expressed in employment rates) for the primary sector

$$\begin{aligned} n_{P,t} &= \frac{1}{g_{t,P}}\left[(1-\phi_P)\,n_{P,t-1} + (\eta_P\,(1-\upsilon))\,(1-n_{P,t-1})\right] \\ &\quad + (1-\phi_P)\,\varpi\frac{L_{T,t-1}}{L_{P,t}} n_{T,t-1} \end{aligned} \tag{18}$$

and for the trapped sector

$$n_{T,t} = \frac{1}{g_{t,T}}\left[(1-\phi_T)\,(1-\varpi)\,n_{T,t-1} + \eta_T\,(1-n_{T,t-1})\right] + \eta_T \upsilon\,(1-n_{P,t-1})\,\frac{L_{P,t-1}}{L_{T,t}} \tag{19}$$

where L_P and L_T are the labor forces of the primary and secondary sector. $g_{t,P} = L_{P,t}/L_{P,t-1}$ and $g_{t,T} = L_{T,t}/L_{T,t-1}$ are the labor force growth in the primary and trapped sector.

The labor force in each sector is equal to the previous period's labor force plus the net movement from the other sector:

$$L_{P,t} = L_{P,t-1} - \upsilon u_{P,t-1} L_{P,t-1} + \varpi n_{T,t-1} L_{T,t-1} \tag{20}$$

and

[14] Note that capital letters (N, U) refer to levels, while small letters (n, u) are (un-)employment rates.

[15] $(1-\phi_P)\,N_{P,t-1}$ are the primary employees carried forward from the previous period and $(1-\phi_P)\,\varpi N_{T,t-1}$ are the previously trapped workers who received a human capital upgrade.

[16] Note that the pool of potential recruits is enlarged by those who moved from the primary to the trapped sector ($\upsilon U_{t-1,P}$).

$$L_{T,t} = L_{T,t-1} + \upsilon u_{P,t-1} L_{P,t-1} - \varpi n_{T,t-1} L_{T,t-1}. \tag{21}$$

Setting the sectoral growth rate to zero and omitting time subscripts, we obtain the following steady state value for the employment in the primary sector

$$n_P = \frac{\eta_P (1-\upsilon) + (1-\phi_P)\varpi \frac{\eta_T \frac{L_T}{L_P} + \eta_T \upsilon}{(1-[(1-\phi_T)(1-\varpi)]+\eta_T)}}{\phi_P + (\eta_P (1-\upsilon)) + (1-\phi_P)\varpi \frac{\eta_T \upsilon}{(1-[(1-\phi_T)(1-\varpi)]+\eta_T)}} \tag{22}$$

and in the trapped sector

$$n_{T,t} = \frac{\eta_T + \eta_T \upsilon (1-n_P) \frac{L_P}{L_T}}{(1-[(1-\phi_T)(1-\varpi)]+\eta_T)} \tag{23}$$

Logically, if we set $\upsilon = \varpi = 0$, we have two entirely separated sectors in this economy and the above formula delivers the well-known formula:

$$n_P = \frac{\eta_P}{\phi_P + \eta_P} \text{ and } n_T = \frac{\eta_T}{\phi_T + \eta_T} \tag{24}$$

3 Calibration of the Model

In 2004, 17.2 percent of the East German full time employed workers were below the low wage income threshold, which is defined a two thirds of the East German median income, i.e. they earned below 7.36 € per hour (Rhein and Stamm, 2006). We consider these workers as a good proxy for the trapped sector. From Hunt (2004) we know that about 60 to 80 percent of unemployed in East Germany do not "survive" their first year of unemployment, i.e. they leave unemployment within one year, which we interpret as hiring. During the second year of unemployment the non-survival rate drops to much smaller numbers, roughly ranging in the magnitude of 20 to 50 percent (very much dependent on gender and observation period), with even smaller non-survival rates thereafter. It can be assumed that trapped workers represent a large share of the long-term unemployed since they have lower hiring rates and higher firing rates than primary workers. However, they do not do so exclusively, since primary workers in our model can stay unemployed for several periods without becoming employed and trapped (although the probability is decreasing over time). For simplicity, we set the steady state (indicated by the subscript $_0$) hiring rate for trapped workers ($\eta_{T,0}$) to 30 percent and the one for primary workers to 80 percent ($\eta_{P,0}$), roughly corresponding to Hunt's (2004) non-survival rates for long-term and short-term unemployed. In accordance with a transition table for the European Union (one year transition probability from "low pay" to "no pay", see European Commission, 2004), we set the steady state firing rate for trapped workers equal to $\phi_{T,0} = 0.18$. To obtain an aggregate employment rate of 80 percent[17], we set the steady state firing rate in the primary sector ($\phi_{P,0}$) to 12 percent.

Furthermore, we have to choose an exogenous probability of an employed trapped worker to move to the trapped sector (ϖ). According to Rhein et al. (2005) the probability for German low wage income earners to move beyond the low income threshold after 5 years is 32.5 percent.[18] The European Commission (2004) calculates a probability of 50 percent for a low-pay worker to move to a higher pay within seven years.[19] In line with these two pieces of evidence, we set $\varpi = 0.08$. By setting the labor share of primary workers to 76 percent,

[17] This corresponds to the employment rate of dependently employed in East Germany (see Bundesagentur, 2006a, b).

[18] Corresponding to an average yearly probability of 7.6 percent.

[19] Corresponding to an average yearly probability of 9.4 percent.

about 17 percent of all employed workers belong to the trapped sector; thus corresponding to the numbers by Rhein and Stamm (2006). To obtain a stable initial equilibrium, we set the probability of a primary worker to move to the trapped sector (υ) to 11.2 percent.[20] In our initial equilibrium the unemployment rate in the primary sector is 12 percent, whereas it amounts to 35 percent in the trapped sector.

We set the replacement rates in the primary and trapped sector to 65 and 80 percent, respectively.[21] Aggregate real productivity (a, gross value added per worker) in 2005 was about €38,000 and real wages (w, measured as real labor costs) were about €22,000 in East Germany.[22] (All estimates are divided by the German GDP deflator, base year 1991.[23]). We set the productivity for trapped workers to 50 percent of the economy's average, while setting the one of primary workers to 110 percent of the average productivity.

Furthermore, we assume that in the long-run the productivity and all real costs (the wage, the hiring and firing costs and the operating cost ε) grow at the same rate of two percent ($\alpha = 1.02$). All future values are discounted (δ) at rate 3%.[24]

In the literature firing costs (f_t) and hiring costs (h_t) which amount to 60 percent and 10 percent of labor costs, respectively, are proposed (Chen and Funke, 2003). It is well known that the employment duration is one of the most important determinants of firing costs[25]. Thus, we set them to 40 percent for trapped workers, whose employment duration is shorter due to higher firing rates, and to 70 percent for primary workers. We assume that all workers have the same bargaining bargaining power is set equally for both sectors ($\mu = 0.195$) in order to match the aggregate labor costs in East Germany.

We simulate our model in a linearized form, choosing first derivatives of the cumulative function that replicate the employment path from 1991 to 2004 as closely as possible in the homogeneous model. (For the derivation of the linearized equations see Appendix.)

4 Policy Exercises

We now consider the effects of various labor policies in the context of our calibrated model of the East German labor market. We first examine the employment effects of policies targeted at the trapped sector, and then investigate untargeted policies. In both cases, we explore the influence of (i) a reduction of the ratio of the firing costs to the wage ("firing cost ratio") together with a fall in the replacement ratio[26], (ii) hiring subsidies, (iii) training subsidies that raise the probability of moving from the trapped to the primary sector. For the training subsidies the policy can of course only be targeted at trapped employees.

[20] This is necessary to guarantee that the condition $vU_{NT} = \varpi N_T$ holds, i.e. in the old steady state the number of people moving from the trapped to the non-trapped sector equals those moving into the other direction.

[21] The net replacement ratios (unweighted average across six family types) of workers with 67, 100, and 150 percent of average productivity are 78.25, 68.25, and 64.67 percent, respectively (OECD, 2006).

[22] Source: Statistische Ämter des Bundes und der Länder (2006).

[23] This is done to make numbers comparable to Snower and Merkl (2006).

[24] This is the average real interest rate over last 15 years, calculated as the yearly money market interest rate minus the inflation rate (using the GDP deflator). Source: International Financial Statistics, International Monetary Fund.

[25] See e.g. Grund (2006).

[26] In Snower and Merkl (2006) we have done several ex-post policy exercises with a model that did not contain traps. Especially during the last years of the observation period (1991-2004), our prediction was more optimistic than the real outcome, suggesting the existence of labor market traps. The first policy exercise is the same as in Snower and Merkl (2006), but the innovation of this paper over Snower and Merkl (2006) is that it models the effects of labor market traps. It turns out that they have far-reaching implications for the effectiveness of employment policies, as shown below.

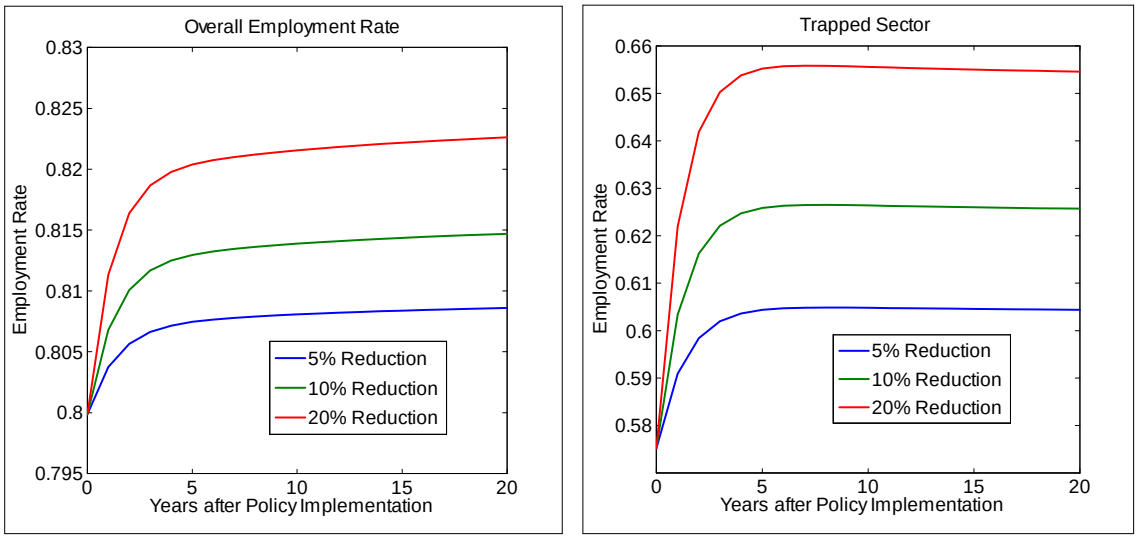

Figure 3: Effects of a Firing Cost Ratio (FCR) and Replacement Ratio (RR) Reduction in the Trapped Sector

4.1 Policies Targeted at the Trapped Sector

4.1.1 Lower Replacement Rate and Firing Costs

Figure 3 shows the effects of a 5, 10 and 20 percent reduction of both the firing cost ratio (the ratio of firing costs to the wage) and the replacement ratio (the ratio of unemployment benefits to the wage) in the trapped sector, which both take place in period 0:

Steady state effects: A lower replacement ratio and a lower firing cost ratio in the trapped sector affect the wage bargaining process. They change the fall-back position of both bargaining parties. As a consequence, insiders bid for lower wages. This improves firms' incentives to hire and retain more of the less productive workers and thus to increase their long-run employment rate in the trapped sector. A 20 percent reduction of the replacement ratio and firing cost ratio[27] makes wages fall to about two thirds of their initial steady state value. But this considerable reduction lifts the trapped sector's employment rate only from 58 percent to 65 percent. The reason can be found in the microfounded hiring and firing equations. Since trapped workers face a higher steady state firing rate, the expected future profits of an employed worker in the trapped sector is smaller than in the primary sector. For given operating costs this leads to smaller hiring and hiring sensitivities with respect to wage changes.

There are two reasons why the effects on the overall employment rate are quite moderate: (i) The trapped sector contains only a small share of all workers (24 percent). (ii) Only some of the newly hired workers obtain a human capital upgrade which leads to a higher employment rate, while most of the newly hired trapped workers face a high risk of being fired (compared to primary sector workers). In the long-run a 20 percent reduction of the replacement ratio and firing cost ratio in the trapped sector only reduces the share of trapped workers from 24 to 22 percent.

As a consequence, a 20 percent reduction of the replacement ratio and firing cost ratio (inducing a wage reduction to two thirds of the initial value) in the trapped sector increases the overall long-run employment rate only by 2 percentage points. *This very insensitive reaction may explain why the recent reduction of the wages in East Germany (compared to the*

[27] Note that in the trapped sector wages react more sensitively to cuts in the replacement rate and firings costs than in the primary sector.

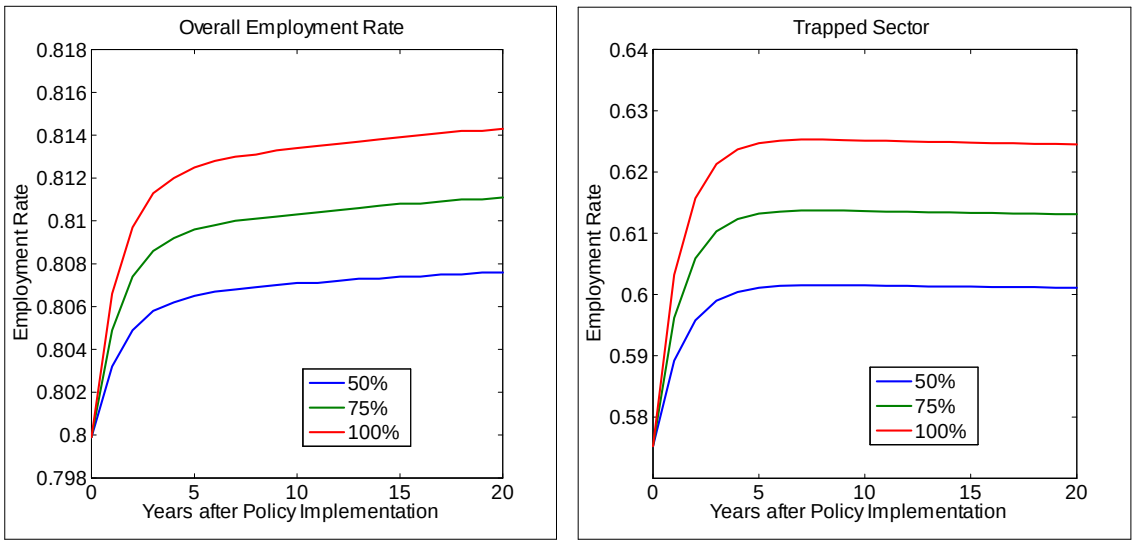

Figure 4: Effects of a Hiring Subsidy in the Trapped Sector

productivity) did not have much of an effect on the employment rate (see figure 1).[28]

Adjustment dynamics: The increased hiring rate and reduced firing rates do not only lift the employment rate in the trapped sector. With more employed people and an exogenously given probability to move from the trapped to the primary sector, the sectoral upward movement increases. It takes a long time until this development shows its full effects: For a 20 percent reduction of the replacement ratio and the firing cost ratio, 90 percent of the convergence to the new steady state are realized only after 10 years.

If the replacement ratio of the most unemployment-prone group is reduced (the trapped unemployed), the described policy comes at the price of increased income inequality (between high income and low income earners). While this policy may help some trapped workers who would not have found a job otherwise and who get a chance to move to the primary sector, it hurts the insiders in the trapped sector who obtain a lower wage and the trapped workers who remain unemployed and receive lower unemployment benefits (due to lower unemployment benefits).[29]

4.1.2 Hiring Subsidies

Figure 4 shows the employment effects of a hiring subsidy which is targeted at the trapped sector with different magnitudes (50, 75 and 100 percent of the respective wage).

Steady state effects: A hiring subsidy for trapped workers increases the firms' incentive to hire more workers with lower productivity. Other than in a homogenous economy, hiring subsidies deliver a double dividend. Besides the immediate hiring effects, there is a longer lasting "transition effect," caused by the inter-sectoral movement. The increased employment rate strengthens the upward mobility to the primary sector. A hiring subsidy of 100 percent would for example reduce the share of trapped workers (of the overall workforce) from 24 to 22.5 percent.

Adjustment dynamics: The after effects of the increased movement to the primary sector take some time to work themselves out: for a 100 percent hiring subsidies, 90 percent of the

[28] Note that the reduction of the employment rate at the beginning and middle of the nineties can easily be explained by the initial wage shock. However, it is more difficult to explain the development during the last ten years.

[29] See Brown, Merkl and Snower (2006) for a more detailed analysis of the inequality effects of different policies.

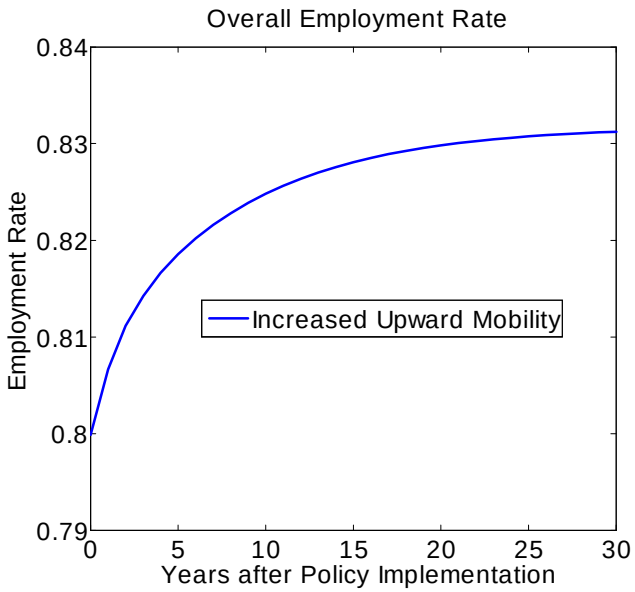

Figure 5: Effects of Training Subsidies

distance to the new steady state is reached after 12 years.

If hiring subsidies are targeted at trapped workers only (as done in the simulation), they are much more cost-effective[30] than an untargeted strategy: (i) the deadweight is much lower since the initial steady state hiring rates in the trapped sector are below those in the primary sector, (ii) the replacement ratio of trapped workers is above those of primary workers and thus the savings (in terms of the respective wage) generated by the job creation are much bigger, (iii) the aforementioned "transition effect" strengthens the overall outcome.

Hiring subsidies need to be financed. According to our simulation, long-run net expenditures caused by a 100 percent hiring subsidy[31] for all trapped workers are about the same as the long-run net savings generated by a 7 percent reduction of the firing cost ratio and replacement ratio.[32]

Hiring subsidies increase employment, without worsening the living standard of the poorest workers, namely, the unemployed trapped workers (since they continue to receive the same benefits as before). As a consequence, it may be easier from a political economy point of view to implement hiring subsidies than reducing the replacement ratio, which makes the unemployed workers worse off.

4.1.3 Training Measures

Training subsidies or other measures that improve job-related training (e.g. on the job training, qualification courses, training measures, etc.), could improve trapped workers' productivity and consequently their access to primary good. In our model, better training measures can be captured in terms of an increase in the exogenously given probability of moving from the trapped to the primary sector (ϖ). Figure 5 shows what happens if the probability of moving from the trapped to the primary sector increases from 8 to 16 percent. The latter number roughly corresponds to a rate found in many other European Union countries, such as Belgium, Denmark, France, Italy the Netherlands or Spain (European Commission, 2004).

Steady state effects: The training measures above raise the economy's overall steady state

[30] Defined as employment effect for a given additional government expenditure.

[31] Of the labor costs in the trapped sector.

[32] This calculation is based on an average tax rate of 20 percent and the aforementioned net replacement rates.

employment rate by moving more people to the primary sector which is associated with higher employment rates. Naturally, the steady state employment rate of the trapped sector does not increase, as only the inter-sectoral mobility is affected but not the sectoral hiring and firing rates. Thus, better training measures change the share of workers in the respective sectors. The aforementioned policy would increase the share of primary workers from 74 to 86.5 percent.

Adjustment dynamics: It takes a very long time until such a policy shows its full effects. In our model 90 percent of the distance to the new steady state would be reached 17 years after the implementation of the policy.

Furthermore, in reality it will be a challenge to design training measures in a way that they can effectively improve workers' upward mobility (for empirical work for East Germany see, for example, Lechner, Miquel and Wunsch, 2005, and Lechner and Wunsch, 2007).

4.2 Untargeted Policies

4.2.1 Reduction of Unemployment Benefits and Firing Cost Ratio

If the unemployment benefits and firing cost ratio are reduced for all workers (not just for those in the trapped sector), the employment effects will be modified as follows:

(i) The primary sector's hiring rate increases and the firing rate decreases, as firms' obtain an incentive to hire/retain more of the less productive workers.

(ii) While a higher employment rate in the primary sector is reached quickly, there are long-lasting aftereffects through the intersectoral movement of labor. A lower unemployment rate in the primary sector means that fewer people drop into the trapped sector and thus the trapped sector shrinks compared to the primary sector. While a 20 percent cut in unemployment benefits and firing cost ratio for in the trapped sector only would increase the primary sector's share labor share from 76 to 78 percent, extending the policy to the entire economy would increase the primary sector's labor share from 78 to 88 percent.

(iii) If the firing rate in the primary sector goes down, there is a positive spillover effect on the hiring and firing rates in the trapped sector (see equations (14) and (15)). Since trapped workers have a constant probability of getting a human capital upgrade in the future, higher retention rates in the primary sector increase these workers' profitability, giving an incentive to firms to retain/hire more of the less productive workers.

4.2.2 Hiring Subsidies

In this section we compare untargeted hiring subsidies (provided to all workers) to those targeted at the trapped sector (as described in the previous section). Providing a 100 percent hiring subsidy[33] to all workers (instead of trapped workers only) would roughly double the employment effects which are shown in the previous section. However, such an exercise would come at a substantial cost to the government. Specifically, the net costs[34] of such an untargeted strategy would be about 9 times higher than those for a 100 percent hiring subsidy targeted at trapped unemployed. The main reason is the very substantial deadweight effect because the hiring rates in the primary sector are much bigger than in the trapped sector.

[33] Measured in terms of the respective wage.

[34] Defined as the costs for the hiring subsidy minus the increased revenue from higher employment (via higher tax revenues with an assumed tax rate of 20 percent and lower costs for unemployment benefits) in the new steady state.

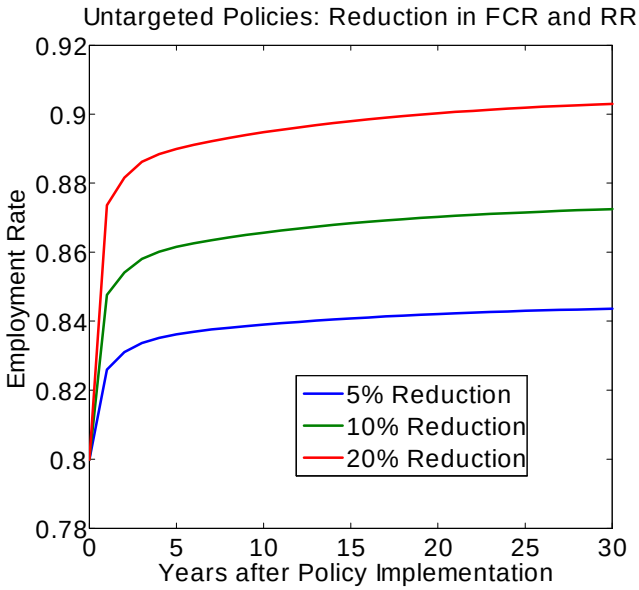

Figure 6: Effects of an Untargeted Reduction of the FCR and the RR

4.3 Summary of Calibration Results

4.3.1 Kick-Starting East Germany

Our calibration exercise shows that even very significant wage reductions in the trapped sector (induced by reductions in the respective replacement ratio and the firing cost ratio) would not be sufficient to bring East Germany to employment levels comparable to West Germany.[35] If the replacement ratio and firing cost ratio are reduced in the primary sector as well, this does not only make primary workers more profitable for firms, but also improves the average profitability of the trapped workers (each of them receives a human capital upgrade with a certain probability). Consequently, the employment rate in the trapped sector will rise. Furthermore, the lower unemployment rate in the primary sector will reduce the workers who move to the trapped sector, thus increasing the economy's ratio of primary to trapped workers. Our calibration shows that these spillover effects are very important. Reductions of the replacement ratio and firing cost ratio for all workers can improve the employment rate in the trapped sector and in the economy as a whole much more than a policy that is focused on trapped workers.

While an untargeted strategy is more effective for the reduction of the replacement ratio and firing cost ratio, the opposite is true for hiring subsidies. If they are targeted at the trapped sector, they turn out to be more cost effective than untargeted hiring subsidies, for the following reasons. In the presence of traps, hiring subsidies yield a double dividend of increased hiring and transition to the primary sector. Furthermore, the associated deadweight in the trapped sector is much smaller than in the primary sector. As shown in our calibration, the net budgetary outlay for an targeted subsidy is one ninth as high as the one for an untargeted hiring subsidy, while it delivers one half of the overall the employment effects.

Training measures improve the prospects of trapped workers and thus lift the economy's employment rate in the long-run. But it takes a long time until they show their full effects.

As shown above, a moderate cut in the replacement ratio and a reduction of the firing cost ratio can be combined with a substantial hiring subsidy in a self-financing policy package. Together with improved training measures these labor market policies would help the East to become somewhat more independent of the "caring hand that cripples" (Snower and Merkl,

[35] This result differs very much from Snower and Merkl (2006) who show in a labor market model without traps that very moderate reforms at the beginning of the nineties would have had substantial positive effects.

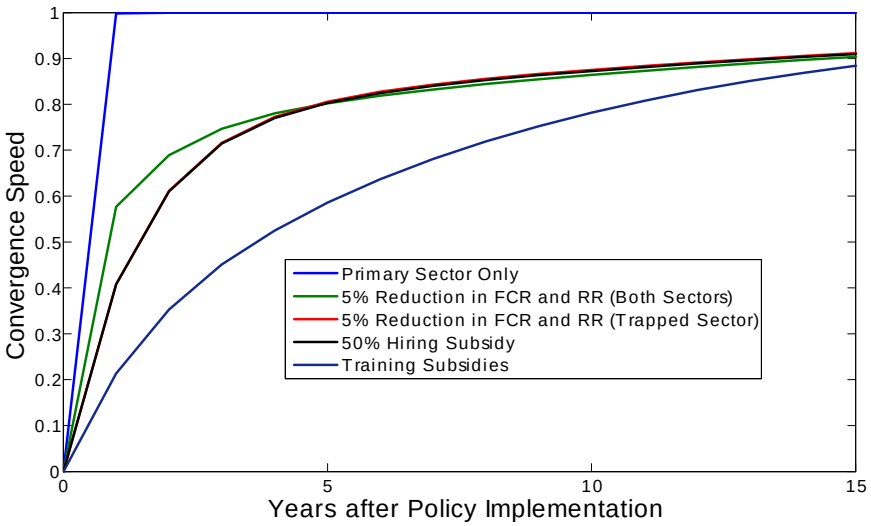

Figure 7: Convergence Speed of Different Policies

2006).

4.3.2 General Lessons for Regional Unemployment Problems

The behavior of the dual labor market, with a primary and a trapped sector differs in two substantial respects from a homogenous labor market:

(i) As shown above, even very substantial reductions in the replacement ratio and the firing cost ratio are not sufficient to reduce the unemployment ratio in the trapped sector to rates which can usually be observed in continental European countries, say around 10 percent.

(ii) The effects of different labor market policies are much more persistent under a dual labor market than under a homogenous labor market. We illustrate this phenomenon in figure 7. It takes at least a decade for policies like the reduction of the replacement ratio and firing cost ratio or hiring subsidies to show 90 percent of their after effects. Training subsidies need even more time to show 90 percent of their full after effects. For a comparison: In an economy which only consists of the primary sector, almost the whole effects of labor market reforms would already be visible after one year ("Primary Sector Only").

5 Concluding Thoughts

The paper explains a puzzling aspect of regional employment and unemployment differentials, namely, that they are very persistent despite changes in wages relative to productivity. Therefore, we develop a dual labor market model with a primary and trapped sector. We show numerically that the trapped sector of the economy, which faces an enormous unemployment rate, reacts very sluggishly to reductions of the wage. We propose additional measures to leave the trap, namely hiring subsidies and better training schemes.

East Germany is simply an extreme example of this phenomenon, which also exists in Spain and Italy and elsewhere. This phenomenon makes the inequality across regions especially persistent and policy makers have been at a loss about how to treat this problem. Our paper provides new insights on which policies are useful and effective under these circumstances and on potential trade-offs which policy makers face.

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The Technical Appendix can be found in the online version of this paper. See http://www.ifw-kiel.de/pub/kap/2007/kap1309.htm

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1310

Explaining the East German Productivity Gap –The Role of Human Capital

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January 2007

http://www.ifw-kiel.de/pub/kap/2007/kap1310.htm

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Kiel Working Paper No. 1310

Explaining the East German Productivity Gap

- The Role of Human Capital -

by

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January 2007

Dr. Joachim Ragnitz (IWH) *

Explaining the East German Productivity Gap – The Role of Human Capital[1]

Abstract

The paper concentrates on the question whether the low level of productivity in East Germany can be explained by deficits in the stock of human capital. It is shown that figures on "formal" qualifications yield a too optimistic view on human capital endowments; in fact, the effective stock on human capital in East Germany is lower than in West Germany when differences in job activities are taken into account. One reason is the dominance of non human capital-intensive industries as a consequence of locational decisions in the past. Another reason is a low human capital intensity within the different branches which is a consequence of specialization within affiliated firms. In the next years human capital endowment of the East German economy will further deteriorate as a result of selective migration and unfavorable educational attendance of the younger cohorts. This impedes a fast convergence in productivity between East and West Germany.

Keywords: Productivity, East Germany, Human Capital

JEL: J24, O47

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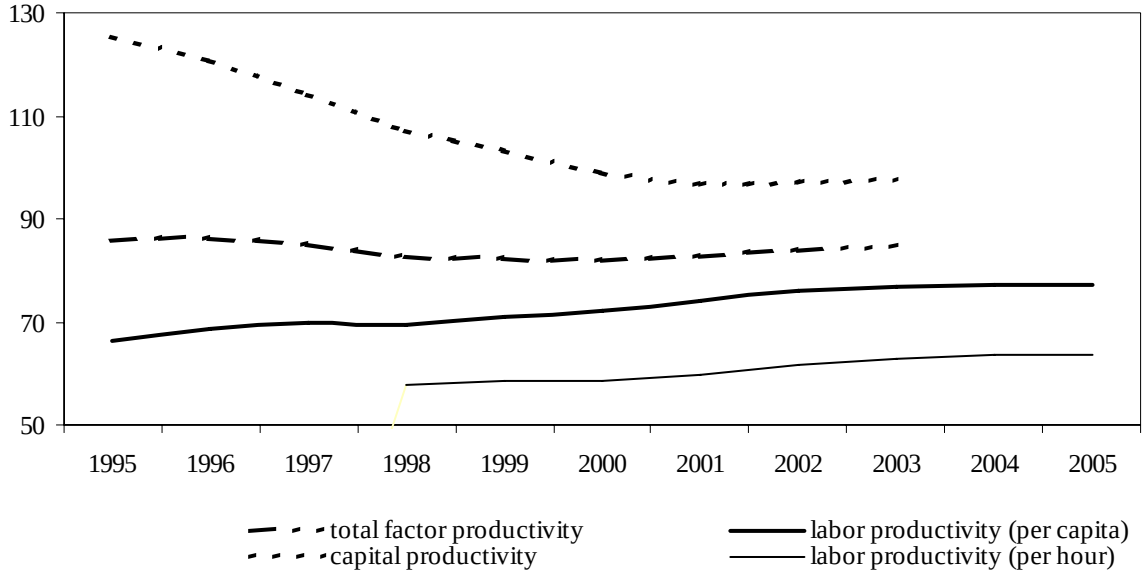
Introduction

One major problem of the East German economy is low productivity. This is true at least in comparison to West Germany, which is generally seen as a yardstick for economic performance in the former GDR. Although one might think of the former communist countries in Eastern Europe to be a more appropriate reference (indeed, compared with these, productivity in East Germany is fairly high), it is widely accepted that equal institutional conditions as in West Germany would favor a fast convergence process towards the West (Burda/Funke 1993). Further, also in political terms („equalization of living conditions“) West Germany is generally taken as reference. Contrary to that, productivity convergence has been rather slow for some time. Only in the beginning of the transformation process (that is: 1991 to 1995) strong productivity increases were observed, being a consequence of retrieving modernization in existing firms, the establishment of new plants and the improvement of capacity utilization in existing firms. Since 1997, however, convergence speed is far lower as neoclassical convergence theories propose (Barro/Sala I Martin 1991, Uhlig 2006).

Generally, productivity is measured as labor productivity. Calculated as GDP per employee, labor productivity is actually at 77% of the West German level; calculated as GDP per working hour, however, it is only 64%, especially due to a lower extent of part-time work in East Germany. But, from an economic view, other productivity measures are also relevant, and only in part these show a similar picture. Capital productivity, for example, was much higher in East Germany than in West Germany during the 1990ies, and even today it is still at about 97% of West German levels. One reason for this is, that, for some time at least, a lack of capital was compensated by a higher input of labor. However, as the underlying data for capital stock also include public infrastructure where West Germany is better equipped, it seems to be more appropriate to look at the private sector only. Indeed, in industry (defined as manufacturing and construction sector), capital productivity, is only 70% of the West German level which is in accordance with the hypotheses of a continuing productivity gap. Total factor productivity (determined as the residual of a growth accounting procedure) lies at 83% for the whole economy (thus including the public capital stock) and at 67% in industry alone.

Figure 1: Productivity development in East Germany



Source: Federal Statistical Office Germany 2006; own calculations.

Explanations for the productivity gap – A review of the literature

The productivity of a national economy or a region are is a complex measure that is determined by a variety of different factors. Additionally, in empirically oriented studies there is the problem that many of these variables cannot be measured directly, and, even more, many of them are highly correlated which makes it difficult to identify the "true" reasons for a low productivity level. Existing work for the explanation of the productivity gap of the East German economy therefore suffers from the fact that the underlying productivity-relevant factors cannot be separated clearly. This has resulted in a variety of different attempts to explain productivity, and so far no generally accepted explanation can be given.

This paper is to add one more possible explanation that was neglected in the past, that is the role of human capital. So, it is behind the scope of the analysis to find an all-comprehensive explanation for the East German productivity gap. For this reason, after a brief survey of the literature, different indicators of human capital are suggested and compared in the light of the existing data; it is shown, that the East German productivity gap can partly be explained by a lack in human capital if this is appropriate measured.

In the primarily empirically oriented literature on the explanation of the productivity gap of the East German economy the following factors are been worked out as substantial causes:

- industry structure: One of the characteristics of the East German economy is a high share of industries that typically reach only a low productivity level. Strikingly above all stands the predominance of the construction sector and the high share of household services, both

compared to West Germany. By calculation, from this sectoral composition of the economy in the aggregate a low productivity level results though productivity in the different sectors is not really low compared to the West. However, this effect must not to be over-estimated, as at least in the manufacturing sector only about 4 percentage points of the productivity gap can be explained by differences in (sectoral) structure.

More interesting are the reasons for the specific industry structure in the New Laender; normally transformation-specific effects and the structural effects of high transfer payments are mentioned. Additionally, initial productivity lags were more pronounced in sectors that normally inhibit a high productivity as the isolation of the GDR prevented the firms in these industries from applying the newest technologies. And some authors (Klodt 1999, Snower 2006) even conclude that the due to strong subsidization in East Germany partially unprofitable productions could survive, leading to the high share of those typically low-productive sectors.

- size structure: A similar arguments holds for the size structure of the East German economy as more firms than in the West have only a small number of employees. Typically, these smaller firms reach only a low productivity level, for example because size advantages in production cannot be exploited or financing bottlenecks prevent from a more innovation-oriented market strategies. At least in the manufacturing sector the size structure seems to explain the productivity gap relative to the West nearly completely. However, firm size is not an independent factor of explanation, as it commonly reflects other productivity-relevant factors, e.g. size-specific capital intensity or the stock of knowledge capital.
- functional structure: With the re-building of the East German economy many West German and foreign firms invested in the New Laender to make use of specific locational advantages (e.g. low labor costs, high subsidization or a low level of bureaucracy). Typically, only pure manufacturing plants were built up, while those segments of the value added chain that were of strategic relevance and commonly exhibit a high productivity remained at the existing locations (e.g. administration, research and development). As far as this is reflected in the statistically measured value added, productivity in East Germany is lower (though productivity in functionally comparable firms would be not far apart).

  However, empirical studies show that subsidiaries of foreign enterprises have a higher productive than the average East German firm. Therefore, the functional structure argument is not really convincing with respect to explaining the low level of productivity but only in explaining the size of the productivity gap.
- capital intensity: Generally, capital intensity is considered the most important variable to explain labor productivity. Indeed, on an overall economic level the capital stock per employee is only 80% of the West German value, which seems to explain the lower level of productivity nearly completely. The major reason for this are lower labor costs in East Germany, which favors labor to capital. However, aggregate figures do not tell the whole story

as they do count also the public capital stock which is rather small in the East; it is a better way to look at the sectoral capital intensities which are not really lower than in West Germany. In manufacturing and construction, capital intensity reaches a level that is about 4% higher than in West Germany, as the effect of low labor costs is over-compensated by the subsidization of capital. Therefore, the lower productivity in this sector (78.8% of West German values) cannot be explained by a smaller capital intensity

- innovation activities: Firm productivity depends on the success of launching new products on the relevant market; therefore innovative enterprises are considered to be more productive. East German firms in the aggregate show lower innovation activities than West German firms, partly because of a lack of R&D-intensive larger firms in East Germany, partly due to branch-specific effects (concentration on markets with low R&D-intensity), partly due to the above-mentioned “extended workbench”-argument. This structural effects can result in a lower R&D-level on the macroeconomic level though on the level of individual comparable firms differences in innovative activities might be far lower. Indeed, a general innovation lag in East Germany cannot be detected if branch and size differences between East and West Germany are taken into account.

  Surprisingly, however, the productivity gap between East Germany and West Germany is bigger for innovative firms than for non-innovative firms (Czarnitzki 2003). One reason for this could be that innovative activities need much time to bring about consecutive market success.

- infrastructure: Complementary infrastructural facilities – in East Germany still poorly developed – are considered to be a productivity-increasing factor. However, this argument is not really convincing in explaining the productivity gap of East Germany as there are sufficient locations in East Germany with good infrastructural conditions. Further, the impact of infrastructure in developed economies with a high infrastructure stock must not be overestimated.

- networks and creation of spatial clusters: Different from Western Germany, East German firms seem to be weakly integrated in efficient firm networks – thus productivity increasing spillovers cannot be used sufficiently. However, the empirical literature in this field is ambiguous, as some studies indicate that there is a high tendency to cooperation in Eastern Germany. Additionally it is still unclear, if the integration in networks really results in higher productivity (Günther 2004, 2005).

- Price differences: Productivity comparisons usually refer to nominal productivity (adjustments in prices normally refer to comparisons in time, not in space). As far as East German firms realize lower sales prices than West German firms in consequence of cost advantages (labor costs), insufficient market power or explicit low-price-strategies, their turnover is lower. If this isn’t compensated for by price advantages for inputs, the result will be lower productivity. Estimations for the late 1990’s indicate that the price advantage (respectively the price-related

disadvantage for the turnover) of East German firms compared to West German producers accounted for around 10%.

As it is seen, the literature yields a number of different arguments to explain the productivity gap. However, so far the literature does not answer the question whether the productivity gap of East Germany can be explained by differences in the endowment with human capital. The following analysis will add some new ideas to the discussion, though it must be realized that still some more research work has to be done.

Insufficient endowment with human capital as a source of the productivity gap?

Theoretic considerations suggest that human capital is a important factor for growth, as it allows for more innovation activities and a better understanding of newly created knowledge from elsewhere in the world. Therefore, deficits in the endowment with human capital can impede long run convergence processes. This view is at least partly supported by empirical studies with aggregate and with individual firm data.

Empirical productivity analysis' for East Germany in principle support the argument of a positive impact of human capital endowments on productivity. Regression models using the IAB-establishment panel for the manufacturing sector show that a large share of high-qualified employees influences productivity levels in a positive way (Table 1; similar results by Bellmann et al. (2006)). However, the explanatory power of the estimation is rather low which might be due to the omission of relevant variables.

Table 1: Regression on labor productivity for the manufacturing sector in East Germany

	standardized coefficient	t-value
(constant)	4470.907	1.296
Western ownership	893.603	10.386
Foreign ownership	1842.653	12.809
Share_skilled labor	1240.770	11.359
Share_university	2535.525	17.016
Share_management	-1648.733	-7.192
Share_qualified_staff	1444.846	8.884
Size of enterprise U20	4153.577	2.697
Size of enterprise U50	4166.545	4.276
Size of enterprise U100	4238.950	4.599
Size of enterprise U500	4265.416	6.989
Individual enterprises	1476.366	1.787
Subsidiary	1762.586	3.038
Dummys (industrial sectors)		

a dependent variable: productivity 2004. R^2=0,10
Source: Own calculation; IAB-establishment panel.

Indeed, these results should be interpreted carefully as the measurement of the factor human capital brings about several problems. Typically, the endowment of a region with human capital is measured by the level of formation (respectively: years of educational attainment) of the employed persons. According to this approach, human capital deficits cannot be detected in East Germany – a

consequence of the comparative high educational level of the former GDR, which continues to have an effect up to today (see Table 2).

Table 2: Structure of human capital (employable population)

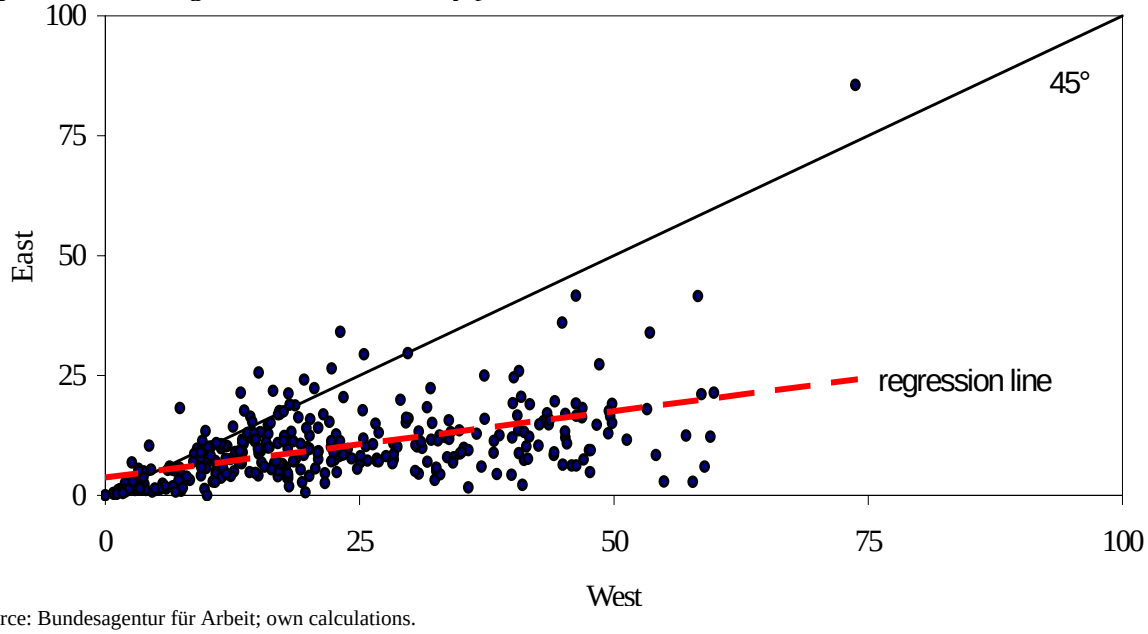
indicator	Percentage of highly trained employees				Percentage of low qualified employees			
age group	25-35		25-65		25-35		25-65	
federal state year:	1991 [a]	2002 [a]	1991	2002	1991 [a]	2002 [a]	1991	2002
Brandenburg	29.6	23.3	32.3	30.6	3.4	5.2	8.2	5.1
Mecklenb.-Western Pom.	27.6	25.8	31.6	28.4	3.4	7.1	9.1	8.2
Saxony	29.6	29.6	30.8	30.1	2.7	3.6	6.5	4.0
Saxony-Anhalt	29.0	21.8	29.4	26.1	4.1	5.1	9.4	6.3
Thuringia	30.3	28.7	30.5	30.0	1.8	4.9	7.0	6.9
East Germany	29.4	29.9	31.0	30.2	4.5	6.5	8.6	6.9
East Germany [b]	29.3	26.4	30.8	29.2	3.0	4.8	7.8	5.7
West Germany [b]	20.9	27.8	19.1	22.7	12.4	13.5	21.2	17.0
Germany	22.9	28.2	21.8	24.3	10.6	12.2	18.3	14.8

[a] Estimated values for expected human capital indicators.
[b] without Berlin.
Source: Own calculation; Microcensus 2002.

In 2002, the share of high qualified (graduates, engineers, master craftsmen) in the population aged 15 to 65 (=potential labor force) in East Germany (30%) was still 7.5 percentage-points higher than in West Germany while the share of less qualified persons was only 5.7%, that is 10 percentage points lower than in West Germany. So, from the viewpoint of labor supply, East Germany is well equipped with (technical) high qualified human capital. However, due to the transformation process in East Germany it is questionable whether this indicator is really good in measuring the human capital endowment in East Germany. Technical graduations that were achieved in the former GDR cannot always be compared with analogous West German education achievements; this is even more true with respect to qualifications that were needed to support the political system. Additionally, many qualifications acquired in the GDR might be devaluated through the change of the political and economic system, temporary unemployment or lowbrow employment, leading to an overestimation of the real stock in human capital (a problem that is hard to solve empirically).

With regard to productivity, however, it is not the potential of qualified labor that is relevant but the qualifications stock in the number of effectively employed persons. But even in the group of employed persons the share of university graduates is still 1.5 percentage points higher than in West Germany; for skilled labor, the respective figure is even 8 percentage points. Consequently, the share of less qualified in the total number of employees in East Germany is 7.7 percentage points lower than in the western part (cf. figure 2 and 3). Insofar the structure of labor supply and effectively realized labor demand seems to be similar.

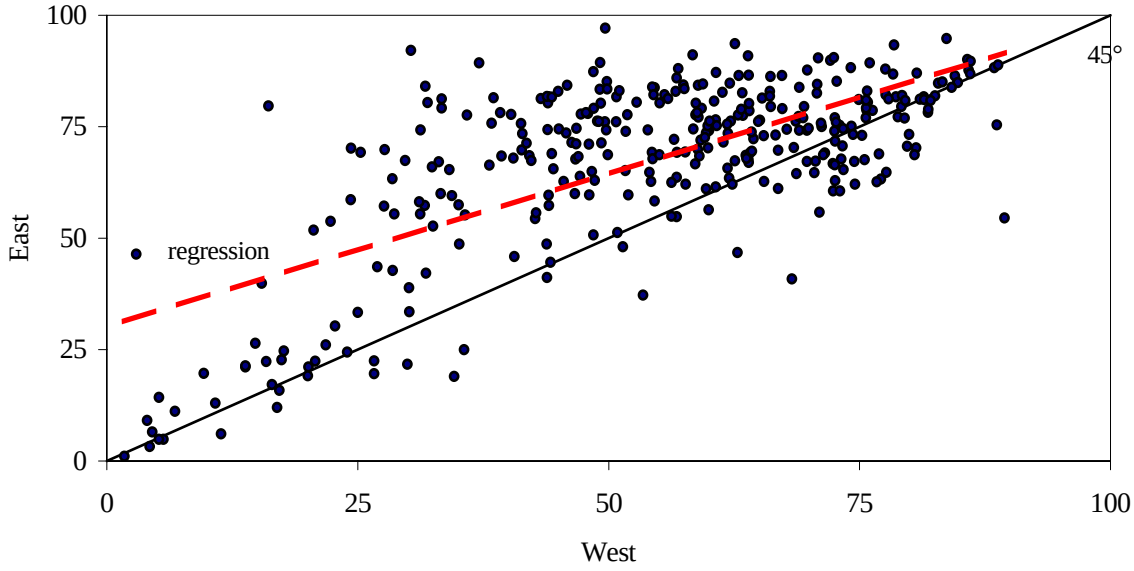
Figure 2: Percentage of unskilled labor by professions, 2004



Source: Bundesagentur für Arbeit; own calculations.

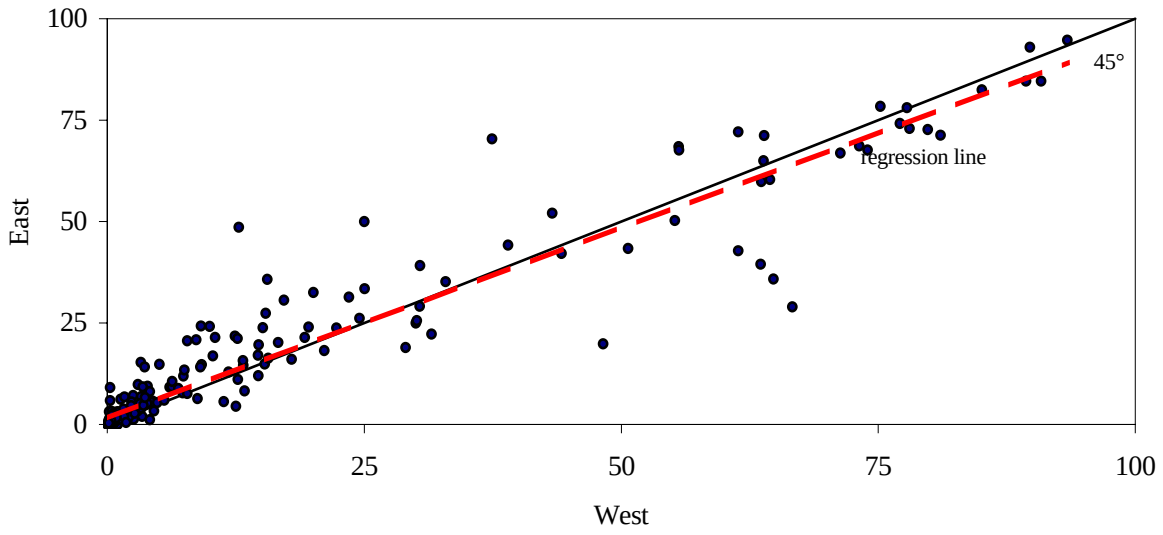
But the question is if the labor force is really employed accordant to their educational achievements. If West Germany is taken as a yardstick, it can be shown that a considerable share of the East German human capital is not employed according to its formal level of education, which therefore reduces the reachable productivity level. This means that jobs for less qualified labor are more often given to better qualified labor in East Germany. This generally effects „average" skilled employees with a finished professional training. Compared to West Germany, 15% of all employees with a finished professional training are employed under their formal level of qualification in East Germany.

Figure 3: Percentage of medium skilled labor by professions, 2004



Source: Bundesagentur für Arbeit; own calculations.

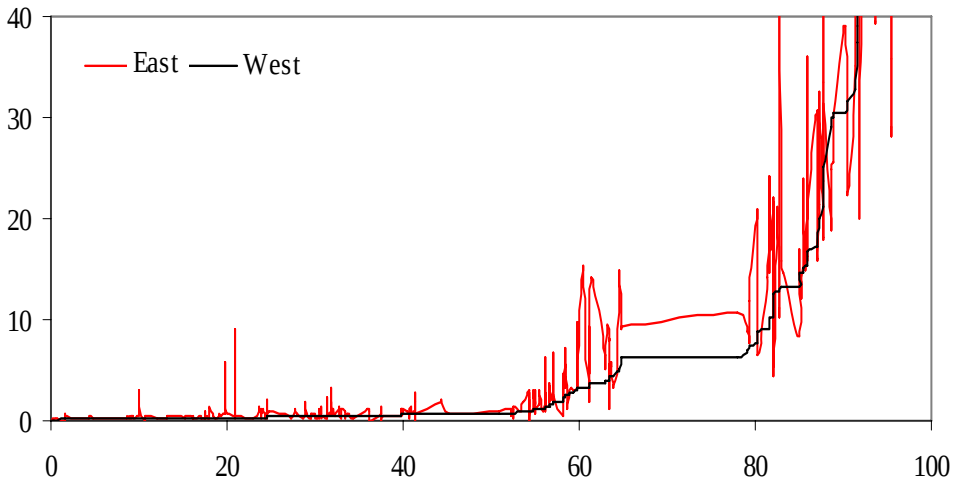
Figure 4: Percentage of high skilled labor by professions, 2004



Source: Bundesagentur für Arbeit; own calculations.

Looking at university graduates in East Germany, the same phenomena – although in a minor form - can be discovered. All in all it can be shown, that in the western part the share of university graduates is higher; but the differences are generally very low (cf. figure 4). Looking more precisely on the data shows that professions carried out by high-qualified persons in West Germany are normally reserved for university graduates in East Germany, too. However, in the East a considerable number of university graduates is working in fields usually carried out by less-qualified persons in West Germany. This becomes more significant when the scale of the figure is adjusted (cf. figure 5). Overall this affects – measured with comparison to West German conditions – around 17% of all university graduates.

Figure 5: share of employees with a university degree by professions (sorted by high qualified labor shares in West Germany), 2004
- weighted with number of employees (East) -



Source: Bundesagentur für Arbeit; own calculations.

Alternative Indicators of Human Capital

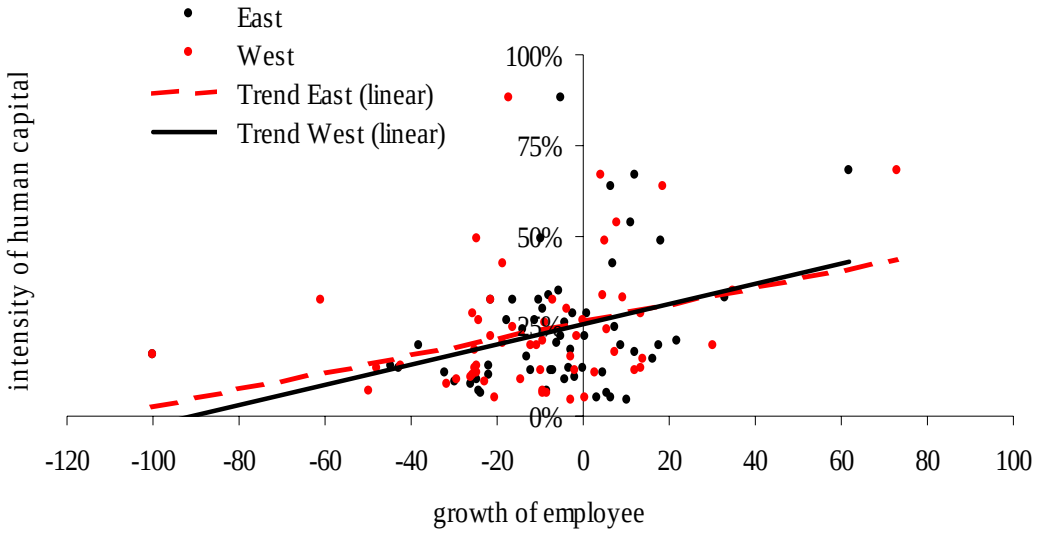
As already mentioned, the text built on a comparison of technical educational achievements so far, which is of only limited use for a description of the situation in East Germany. A better concept is it to determine the stock of human capital with the help of the present kind of employment. In the following some – more descriptive – findings shall be illustrated; regression analysis' aren't yet possible as a result of missing data, as a combination of human capital data with firm-data on productivity is needed (for example the LIAB of the Institute of labor research, Nuremberg).[2]

The following analysis is based on data that include information about the educational achievement and the effective profession of all employees in East and West Germany (disaggregated by branch). Combining this data with classifications on human capital intensity of the different professions (HRST-classification), it is possible to achieve results about the effective human capital intensity in both parts of the country independent of formal qualification. Looking at the endowment of East and West Germany with the so determined human capital endowment in production, it can be shown that – in contrast to the results received by data on formal qualifications – in East Germany a human capital gap really exists. Looking further only at the professions typically carried out by high qualified persons (university degree or master craftsmen), 25.1% of all working places in East Germany are estimated to be high qualified, compared to 27.8% in West Germany. Since 1998 – with an increasing human capital intensity in both parts of the country – the differences between East and West Germany are slowly decreasing. When disaggregating by branches it can be shown that the increase of the share of high qualified persons in both parts of the country is accomplished mostly by a strong growth of the human capital intensive branches; this effect is even stronger in East Germany (cf figure 6). Human

[2] A more detailed study using these data will be presented soon.

capital intensity would have decreased in Eastern Germany, if there hadn't be a structural change in favor of human capital intensive branches of the economy. This is not only a consequence of the decline of employment in the construction sector. Altogether there is a weak but positive correlation between human capital intensity and growth of employment during the period 1998-2004 which is merely identical in East and West Germany. Insofar this reflects the trend to a more human capital intensive production structure, which is typical for a high income country.

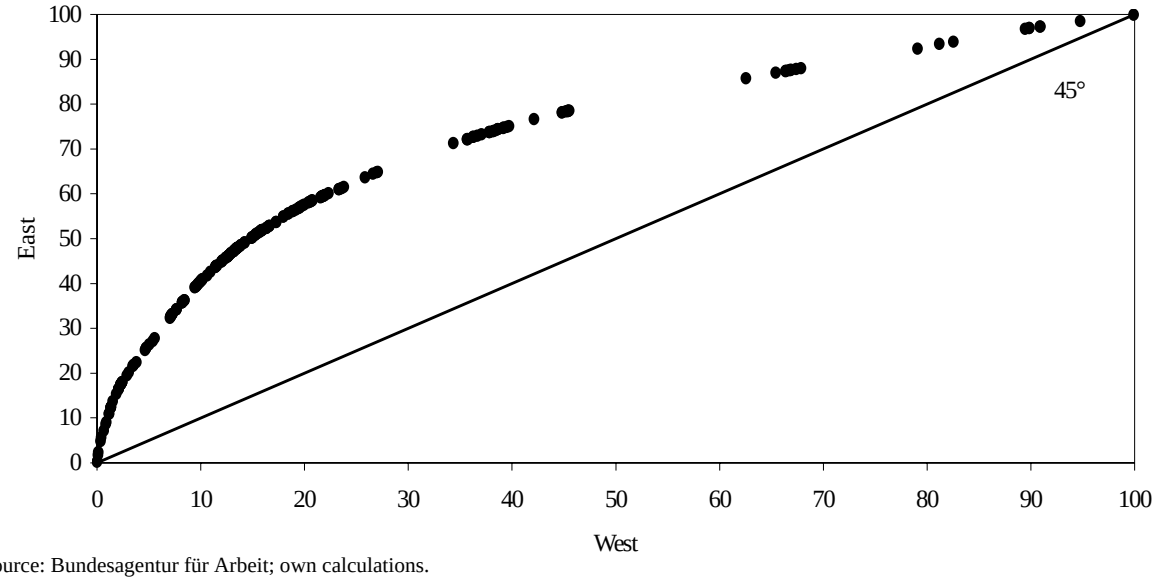
Figure 6: Employment Growth by human capital intensity (1998-2004)



Source: Bundesagentur für Arbeit, own calculations.

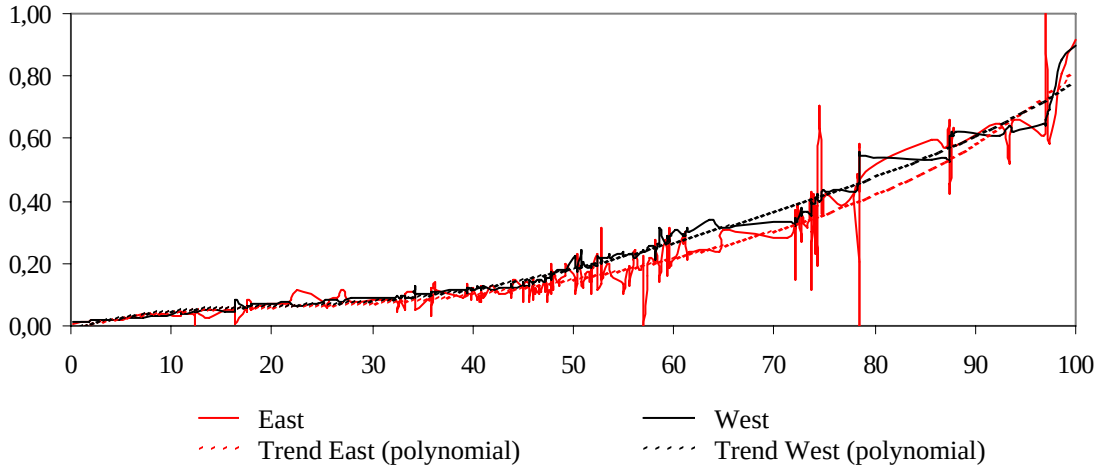
The reasons for the still lower human capital intensity of production in East Germany can on the one hand side be seen in the specific branch-structure (higher weight of industries with typically lower share of high qualified employees, cf. figure 7), on the other hand side in a lower share of high qualified employees in most industries (cf. figure 8). Indeed, both arguments are equally important for the situation: With the same structure as in West Germany, aggregated human capital intensity would be 94.5% of the western value (instead of 90.4%). The illustration below points this out: branches with weak human capital are overrepresented in the eastern part. Conversely this implies that 5.5% of the overall gap in aggregated high qualified intensity is a result of a lower share of high qualified labor within the branches.

Figure 7: Share of industries in East Germany 2004
- cumulated shares, sorted by HRST -



Source: Bundesagentur für Arbeit; own calculations.

Figure 8: High qualification professions by industries 2004
- weighted by number of employees (East) –



Source: Own calculation.

This becomes even more apparent when disaggregating by industries: There are less job opportunities for high qualified persons in nearly all branches in the eastern part. Though, in general, qualification needs seem to be similar (rank correlation 0.896) - branches employing high qualified labor are typically acting in the same way in East Germany - the share of employees with high qualifications on average is lower than in West Germany (c.f. trend line in figure 8). This is at least typical for branches with a „mean" number of high-qualified employees.

It is not easy to find an convincing explanation for these results. Most plausible are the following arguments:

- The economic structure significantly reflects the „after-transition-history", especially the higher share of the construction sector (9.0% vs. 2.6%) with a typically lower share of high

qualified employees (7.2% in comparison to 27% in the total) and inversely the lower presence of high qualification services and industries. Overall it can be observed that West Germany is showing a weak but clearly positive correlation between branch-specific human capital intensity and the share of this branches in the total (R^2= 0.16); in East Germany, however, this context is less developed (R^2=0.10).

- The lower human capital intensity in East Germany might also reflect an market-driven adjustment-process. In expectation of a shortage (quantitative or qualitative) of skilled labor qualification-intensive industries did not settle down in the East so often. Here it can be argued that agglomeration advantages of different locations in combination with spillover-effects are becoming more and more important for human capital orientated branches. Correspondingly human capital intensive branches are showing a higher spatial concentration. As these advantages were more significant in the western part at time of unification, the new Laender weren't attractive enough, leading to the special industry structure we can observe now.

- That human capital intensity within East German branches is low can either be the result of an intra-sectoral specialization (which cannot be identified by using aggregated statistics) or a disproportionately high presence of downstream productions in East Germany (the extended workbench-argument). One indication for the latter is that within the manufacturing sector – where foreign investors were most important – human capital intensity is only at 76% of the West German value, compared to 90% in the economy as a whole. A more pronounced analysis in the so called „Fortschrittsberichterstattung Ost" („East German progress reports") of major research institutes showed that East German industrial firms are indeed characterized by a higher share of workers (c.f. to employees) compared to those in the West (cf. table 3); furthermore semi-skilled labor and lower skilled employees have a higher share. It fits in this picture that the productivity level of the industry is clearly below the western value.

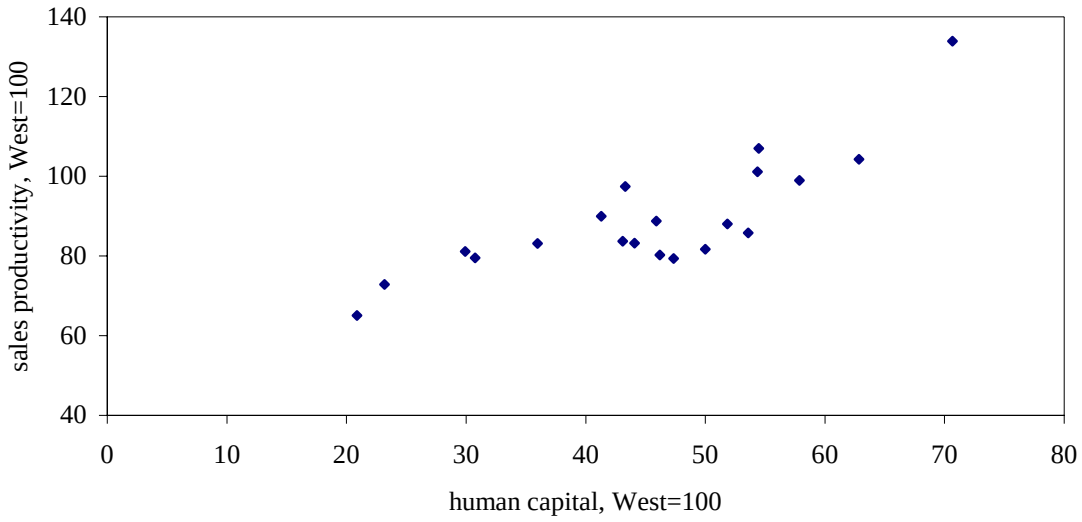
Table 3: Functional Structure of Employment in the East German Industry, 2001

	workers	therefrom: high-skilled	therefrom: semi-skilled	employees	therefrom: high-skilled	therefrom: low skilled
East	70.6	44.7	43.5	29.4	31.0	22.0
West	62.0	49.4	33.6	38.0	39.0	16.0

Source: DIW/IAB/IfW/IWH/ZEW (2002).

Finally, a significant (positive) correlation can be found between the relative (compared to West Germany) human capital intensity indicator calculated above and relative (sales-) productivity, when branch-level data are used (no firm data are available at the moment) (cf. figure 9). Industries that employ a significant higher share of qualified labor, have a higher productivity compared to their West German counterparts. This is in line with theoretical considerations and leads to the conclusion that the possibilities of further productivity advances relative to the West are restricted.

Figure 9: Sales productivity and human capital intensity by industries, 2004



Source: Statistisches Bundesamt; own calculations.

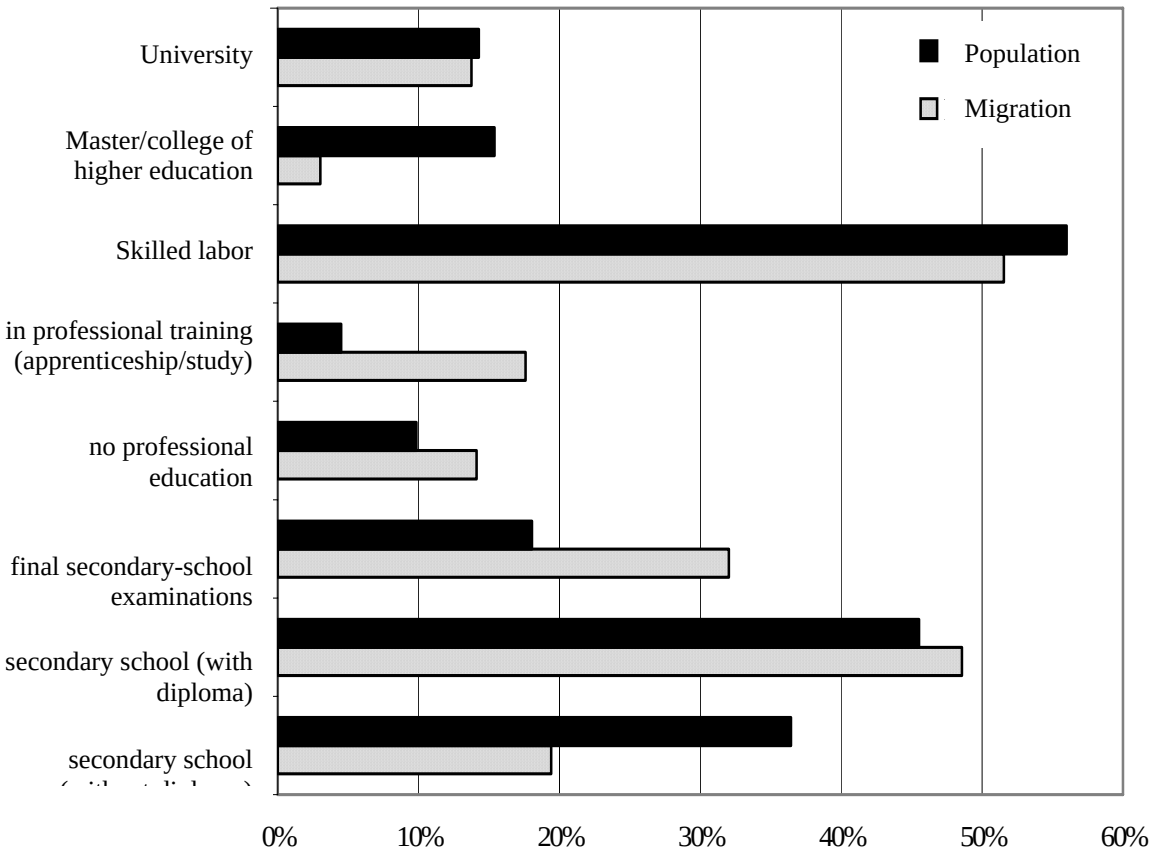
Deterioration of human capital endowment – Consequences for the convergence prospects

So far, the analysis led to the result that though there is a high potential of skilled labor in East Germany, this is not well exploited by existing firms because of a lack of human capital intensive branches and lower human capital human capital intensity within industries. This view is supported by the fact that lots of employees work below their level of qualification. With the help of the above mentioned correlation between productivity and human capital endowment, these facts can help to explain the productivity gap between East and West Germany, though, of course, many other factors are also important.

However, there are signals that the relative good endowment with high qualified human capital in East Germany is eroding. This is on the one hand a result of (net-)migration from East to West Germany, on the other hand a consequence of the insufficient educational attendance of younger people.

Schneider (2005) shows, that migrations flows between East and West Germany are highly selective: Migration from East to West Germany is mostly done by young good qualified persons. Around 45% of the migrants emanate from the group of 18-30 years old persons; most of them for reason of professional training or starting their professional career (cf. figure 10). This can be identified by looking at the group „in professional training", which is disproportionately high represented in the migration group compared to overall population. Less qualified people are disproportionately low represented within this group.

Figure 10: Structure of migrants in education (in relation to population)



Source: Schneider (2005).

Further, migration into the New Laender is insufficient in quantitative size to compensate for the migration-induced human capital loss (cf. table 4). This – and not the differences in the structure of migrations flows – is the main source of the deterioration of the human capital base caused by migration from East Germany.

Table 4: Age structure in emigration and immigration of East Germany
- 1999-2003, annual average, absolutely and in percent -

Age	**Emigration**		**Immigration**	
	in thousand	**in percent**	**in thousand**	**in percent**
< 18	29,0	15,7	18,6	16,1
18 - 25	54,6	29,5	24,6	21,4
25 - 30	29,6	16,0	17,6	15,3
30 - 50	55,2	29,8	36,6	31,8
50 - 64	11,0	5,9	10,2	8,9
> 64	5,6	3,0	7,6	6,6
Aggregate	*185,0*	*100,0*	*115,2*	*100,0*

Source: Ferderal Statistical Office Germany 2004, FS 1/1.2; Schneider (2005).

Table 5: Balance of migration in relation to the respective age- and education-group in East German
- 1999-2003, annual average -

Education **Age:**	**18-25**	**25-30**	**30-50**	**50-64**	**> 64**
no professional education	-2,5%	-2,9%	-1,8%	-0,1%	0,0%
in professional training (apprenticeship/study)	-1,7%	-7,4%	-	-	-
Skilled labor	-3,3%	-1,0%	-0,3%	0,0%	0,1%
Master/college of higher education	-	3,0%	0,5%	0,2%	0,3%
University	-	-2,5%	-0,3%	0,0%	0,2%

Source: Schneider (2005)

Table 6: Percentage of Migration in relation to the respective age- and education-group in East German
- 1999-2003, annual average -

Education **Age:**	**18-25**	**25-30**	**30-50**	**50-64**	**> 64**
no professional education	4,1%	5,9%	4,0%	0,6%	0,1%
in professional training (apprenticeship/study)	3,2%	20,1%	-	-	-
Skilled labor	6,0%	2,6%	0,9%	0,3%	0,2%
Master/college of higher education	-	1,4%	0,3%	0,1%	0,1%
University	-	7,2%	1,3%	0,4%	0,4%

Source: Schneider (2006).

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The second cause for the deterioration of the human capital base is the (actual) educational attendance of the East German youth. A comparatively high number of pupils leave the school system without any graduation certificate. Additionally, many young people don't find a regular vocational training position as a result of too small a number of training firms or even as a result of missing basic educational preconditions, leading to a refusal by the firms. And, finally, the quotas of people entering the tertiary education system is lower than in West Germany.

As a result of these developments, the share of high qualified person in overall East German population in the age-specific cohort of the 25-35 years old persons has decreased between 1991 and 2002 by 3 percentage points, while the size of this cohort was increasing by 7% in the western part (cf. table 2). However, the share of less qualified persons in this cohort has increased in both parts of the country, but in East Germany more than in West Germany. Nevertheless, the level of the less qualified younger people is still lower in East Germany, mainly due to structural differences (lower share of immigrants). A present study, undertaken by IWH and ifo Dresden, used this background to project the development of labor supply and demand by qualifications. It showed that, if keeping the educational attendance of the East German population constant, the human capital endowment will increasingly deteriorate. As labor demand decreases with the ongoing population decline and a depressed increase of incomes, unemployment in the group of less qualified labor will not decrease much, while with respect to high qualified labor, demand surpluses will occur. This also implies that a fast convergence in productivity levels cannot be expected in the near future, if it is not possible to reverse the development of the human capital supply (and: human capital demand).

Conclusions

This article concentrated on the question to which extent the low level of productivity in East Germany can be explained by deficits in human capital endowments. It could be demonstrated that East Germany, in view of effective fields of employment, has a low human capital intensity, and that existing human capital is often employed below its true level of qualification. One reason is the dominance of non human capital-intensive industries as a consequence of locational decisions in the past. Another reason is a low human capital intensity within the different branches which is a consequence of specialization within affiliated firms.

In the next years human capital endowment of the East German economy will further deteriorate as a result of selective migration and unfavorable educational attendance of the younger cohorts. This impedes a fast convergence in productivity between East and West Germany. For economic policy the means that professional and advanced training measures have to be paid more attention. Further policy could attempt to avoid this human capital gap with help of a selective investment promotion strategies, leading to (selective) migration into the New Laender. But all in all it is still hard to recognize how convergence in living conditions can be realized in a foreseeable future.

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Regional Labor Markets, Network Externalities and Migration: The Case of German Reunification

by

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January 2007

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Regional Labor Markets, Network Externalities and Migration: The Case of German Reunification

Abstract

Fifteen years after German reunification, the facts about slow regional convergence have born out the prediction of Barro (1991), except that migration out of East Germany has not slowed down. I document that in particular the 18-29 year old are leaving East Germany, and that the emigration has accelerated in recent years. To understand these patterns, I provide an extension of the standard labor search model by allowing for migration and network externalities. In that theory, two equilibria can result: one with a high networking rate, high average labor productivity, low unemployment and no emigration ("West Germany") and one with a low networking rate, low average labor productivity, high unemployment and a constant rate of emigration ("East Germany"). The model does not imply any obviously sound policies to move from the weakly networked equilibrium to the highly networked equilibrium.

Keywords: German reunification, labor market search, network externalities, migration, regional economics

JEL: J21, J24, J61, J64, J11, E24

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1 German reunification: 15 years later.

Germany was divided into three parts: West Germany, East Germany and Berlin. These three parts have been united together on October 3rd, 1990. 15 years later, it is time to take stock of what has happened since. Fiscal transfers into East Germany have been massive. According to Busch (2002) for 1991 to 1999, own calculations for 2003, and a linear interpolation for 2000 to 2002, a total net transfer of 940 billion Euros has been paid from West to East Germany for the time span from 1991 to 2003. Figure 2 shows that the transfers have been more than one third of East German GDP on average: indeed, the absolute amount of the transfers has been steadily rising or barely falling for most of these years. While approximately 20% of the (gross) transfers have been used to pay for subsidies to firms as well as to building infrastructure, approximately 50% have taken the form of direct transfers for socio-political reasons. Due to the East-West transfers, the per-resident fiscal budget of the East German Bundesländer is approximately 15% higher than in the West. These transfers have been financed mostly with an increase in debt. Additionally, a "solidarity tax" has raised a total of nearly 90 billion Euros from 1991 to 2000.

Despite (or, possibly, because) of these transfers, convergence of conditions in East Germany to those in the West have been slow. Indeed, Canova and Ravn (2000) have shown, that reunification is tantamount to a mass migration of low-skilled agents holding no capital into a foreign country. Using an extension of standard neoclassical growth theory, they show how this should have let to an investment boom in the absence of a welfare state, but a prolonged recession in its presence. Thus, the anemic growth in Germany and many of the reunification problems may possibly find their cause rather than their remedy in these massive transfers to the East. This also echoes the warning of Sinn and Sinn (1993), reiterated in Sinn (2002), against raising the wages in East Germany too quickly to West German levels.

The slow rate of convergence between regions is another matter, however. Germany is not unusual in this respect. For disparate regions in a country, the slow convergence process has been documented e.g. by Barro and Sala-i-Martin in a series of papers, summarized in their book (1995). Based on this research, Barro (1991) warned against too much optimism regarding the speed at which East Germany will catch up with West Germany in a Wall Street Journal op-ed piece. He stated then that "*there are substantial variations in estimates of East German productivity in 1990; a reasonable range is from*

one-third to one-half the West German figure. An extrapolation of the U.S. experience to the eastern regions of unified Germany implies that per-capita growth in the East would be initially 1 1/2 to 2 percentage points per year higher than in the West. This growth advantage ... means that it will take about 15 years to eliminate one-half of the gap ... If so, the East would eventually catch up to the West, but in a couple of generations rather than a couple of years or a couple of decades." Barro's forecast turns out to be close to the current facts. 10 to 15 years after reunification, average labor productivity in East Germany (without Berlin) for 2001 to 2003 is at approximately two thirds the average labor productivity of West Germany (without Berlin), and therefore pretty much exactly where Barro predicted it would be. Likewise, the productivity growth rate differential between East Germany (without Berlin) and West Germany (without Berlin) for 1999 to 2003 is 1.6%, in line with Barro's prediction.

The prediction in the Wall Street Journal appears to be a slight misprint, however. Given a convergence rate of 2% annually, one finds that $\exp(-.02n) = .75$ is solved by $n = 14.4$ and $\exp(-.02n) = .5$ is solved by $n = 34.7$. I.e., in 15 years, only a quarter of the productivity gap should have been eliminated, and it would take 35 years to eliminate half of it. This indeed is the (corrected) statement in Barro (1996), p.14, with an update of the analysis in Barro (2002). Compared to that calculation, productivity convergence appears to be faster, at first blush. Figure 1 provides greater detail, using the numbers from Burda (2006). Productivity convergence appears to have been fast from 1991 to 1993, so the prediction based on the 1991 numbers is far from the facts. Applying the prediction on the basis of the numbers for 1993, however, works surprisingly well. Whether the fast productivity growth in 1993 is due to mismeasurement prior to that date, whether this is due to low-productivity enterprises having simply been shut down, or whether there really has been a rather dramatic catchup in productivity in 1991 to 1993 might be an interesting subject of further research. My guess is that the former two explanations are far more likely than the latter. I conclude from this, tentatively, that the productivity convergence prediction by Barro was right, subject to a productivity jump between 1991 and 1993, probably due to some data revision or firm-closing.

His other prediction - the slowdown of migration - did not (yet) pan out, though, see figure 3. Barro stated that "*the flow of migrants will ... decline over time for two reasons: first, the East's per-capita income will rise, if slowly, relative to the West's; and second, cumulated migration will cause the West's population density to rise relative to the East's, thereby making the West relatively less attractive. The combination of these*

two forces implies that the annual number of net migrants will fall to a range of 140,000-230,000 by the year 2001; the projected cumulative number of migrants for the period 1991-2001 is 1.7 to 2.8 million.". Migration from East to West Germany was never quite as high: the total was approximately 0.7 million from 1991-2001, and the average migration rate for 2001-2003 of approximately 70 thousand is close to the average of the preceeding ten years. One interpretation is that East Germans were initially "bribed" with the huge transfers to stay where they are, and that we now witness residual pent-up migration, as these transfers are scheduled to be gradually phased out. Another possibility is that migration from East to West Germany will continue to persist, turning East Germany into a deserted wasteland, except for a few industrial core regions. Since these migratory pattern differ from those predicted by Barro, I shall investigate them more closely in section 2. I find that migration is particularly strong for the age group of 18 to 29 year olds, and it is particularly strong from the country side and small cities, and much stronger than the corresponding pattern for West Germany. It appears that East Germany is slowly but surely gentrifying and dying.

In light of the analyses of Barro and Sala-i-Martin, one may be tempted to explain this pattern within the context of standard endogenous growth theories, in line with the usual explanation of slow regional convergence.

But something is amiss. The disparity between East and West Germany is not the result of many years of a gradual drifting-apart - as it is the case for the disparate regions in West Germany, the United States or Japan, which Barro and Sala-i-Martin have analyzed. Rather, here are two parts of the same country, one of which has been held back artifically during the postwar years[1].

The regions are homogenous in many ways - the same climate, the same legal system, the same language and a similar level of general education. Technologies and blueprints can easily be transferred, capital can easily be moved. The slow rate of convergence of East to West Germany strikes me as more surprising than usual. In sum, what is needed is a theory consistent with the following stylized facts:

1. There is persistent migration from East to West Germany, in particular by the age group 18 to 29.

[1]This is similar to the distinction between risk-averse agents self-selecting into civil service job in West Germany and former East Germans being given a civil service job in East Germany, a distinction exploited by Fuchs-Schündeln and Schündeln (2005) to calculate the impact of risk aversion on occupational choice.

2. Unemployment in East Germany is higher than in West Germany.

3. Wages are lower in East Germany.

4. Average labor productivity is lower in East Germany.

5. The welfare system provides for comparable benefits in East and West Germany to short- and long-term unemployed workers.

6. There have been and continue to be sizeable fiscal transfers from West to East Germany.

7. East and West Germany operate subject to the same federal law. Regional differences in the legal system and regulations are minor.

8. Regional differences in the educational system are minor.

9. Real estate is cheaper in East Germany.

It certainly is the case that the job-specific skills and training of the workers in the East were not suitable to the new capitalist world of the West. However, the current generation of 18 to 29 year olds, which are leaving East Germany in large numbers, were small children or at most teenagers by the time German reunification happened: their education and job-specific training should be on par with that of their age-compatriots in the West. It is conceivable, that the only way for them to receive apprenticeship training is to move to westwards - but then again, why do firms not move eastwards, exploiting the cost advantage of lower real estate prices, lower wages and compensation?

What I seek is a theory of two otherwise identical regions, but where one region has higher unemployment and lower average productivity than the other, and where there is continuous, unceasing migration from the low-productivity to the high-productivity region. A standard labor search model would predict that the initially higher unemployment in the East should attract relatively more vacancy creation than in the West. Extending such a model to a two-region world with migration between them would add another valve for releasing the pressure of inequality and would eventually simply result in an equalization of the conditions in both regions. Furthermore, a reasonable parameterization would imply that this convergence happens quickly. Something more is required to make the differences persist.

Two devices come to mind. The first is costly signalling, see e.g. Spence (1973). High-quality young workers may wish to signal their high quality by the costly move to the West, whereas the low-quality young workers remain behind. I find it a bit hard to believe, however, that the informational asymmetries between firms and prospective employers could be so massive.

The second device is some kind of complementarity. One possibility is a regional sorting according to the quality of its inhabitants, as in Kremer (1993). A second possibility is a network externality between producing firms. While firms can produce in isolation, selling their products on some anonymous market, they can often be more productive by specialization as part of a larger network of firms. A hotel can outsource many of its services like cleaning or repairs, provided such services are available from specialized firms close by. A machine or car manufacturer may outsource the production of specialized parts.

In section 3 , I provide such a model, extending the standard labor search model to allow for emigration as well as network externalities of production. The model has two equilibria. The "highly networked" equilibrium is the equilibrium, in which unemployment is low and average labor productivity is high, characterizing the destination region ("West Germany", "vibrant city", "industrial core") for migrants. The "weakly networked equilibrium" by contrast is characterized by high unemployment and persistent emigration. The possibility to emigrate weakens job creation further, as the option value of emigration acts like an added unemployment benefit. One may want to think of this equilibrium as characterizing "East Germany". Emigration in this model never stops, eventually turning a dying region into a wasteland.

2 Facts on Inner-German migration.

The general pattern of migration from East to West Germany since 1991 is shown in figure 3. The data counts East Berlin as part of East Germany before 2000, and all of Berlin from 2000 onwards. What is remarkable about this picture is that migration from East to West Germany has not come to rest after the initial post-unification wave. Rather, and since 1997, net emigration from East Germany has increased again. Slowly, but gradually, East Germany is shrinking in population, compared to the West.

Further investigations of East-West-German migration and commuting is presented in Hunt (2006) and Izem and Fuchs-Schündeln (2006). Here, in order to examine the

	All	East	West
Total Population:			
Number of "Kreise"	439	113	326
popul. in % of total	100	20	80
Large Cities:			
Number of "Kreise"	70	12	58
popul. in % of region	28	35	27
... without Berlin, Hamburg:			
Number of "Kreise"	68	11	57
popul. in % of region	22	15	24
Small Cities:			
Number of "Kreise"	46	15	31
popul. in % of region	3	6	3
Countryside:			
Number of "Kreise"	323	86	237
popul. in % of region	68	59	71

Table 1: *Distribution of the population in Germany.*

issue of inner-German migration further, I have examined regional data available from the "'Statistische Ämter des Bundes und der Länder", available per
https://www.regionalstatistik.de/genesis/online/logon.
Germany is divided into 439 "Kreise" or regions, including the city states Berlin and Hamburg. For each Kreis, each year from 1995 to 2003 and several age groups, data is available on emigration and immigration, i.e., reallocations crossing the border of the Kreis. Furthermore, for 2003, detailed population data is available. The data lists the names for each Kreis. Whenever it contained the word "Stadt", the German word for city, I have categorized the Kreis as a city, otherwise as countryside. Obviously, the "countryside" should properly be regarded also as serving as an extended suburb. Given modern possibilities for commuting, the distinction is blurred, certainly in a densely populated country such as Germany. Following the usual convention, I have categorized cities with a total population in 2003 of more than 100.000 as a large city and below that as a small city. The distribution across the various categories can be seen in table 1.

Figure 4 shows the distribution of the city sizes in East and West, plotting the log of the fraction of cities above a certain size versus the log of that size. As is well-known as Zipf's law, one often obtains a fairly straight line, see e.g. Krugman (1996) or Gabaix and Ioannides (2004): the same is true here.

Next, I calculate the migration rates of subpopulations within each of these categories and for various age groups, expressed in percent of the 2003 population. Figure 7 shows a key pattern: the future work force of East Germany, i.e., the population aged 18 to 29 years, is leaving East Germany in large numbers. While there is considerable "churning", i.e., while gross flows are considerably larger than net flows, there is little doubt that gradually and persistently, East Germany is shrinking in the relevant working-age population. This is also corroborated by figure 5: essentially, only people above age 50 stay in East Germany, all others gradually leave. Note also, that the migration pattern of people below 17 is nearly identical to the migration pattern of the group aged 30-49, since the former are the children of the latter. I therefore do not plot this age group in the other figures.

In figure 5, migrants crossing the German border are included. This makes a substantial difference, as a visual comparison to 3 already shows. While the latter shows persistent emigration from East to West Germany, 5 seems to indicate that there was net positive immigration until about 1997. Thus, figure 6 shows only the numbers for inner-German migration. The numbers now look bleaker, as it excludes a fairly large number of immigrants to East Germany from foreign countries. Since both types of numbers shed different light on the phenomenon, I included both throughout. For example, figure 8 is the companion figure to figure 7.

The fact that East Germans are leaving East Germany is particularly true for the country side. Figure 9 compares the migration patterns for various regions and age groups in East and West Germany. Figure 10 concentrates on inner-German migrants, i.e., excludes migration crossing the German border. While the country side provides a stable or even growing environment in West Germany, there is an exodus of young people in rural East Germany. Cities are generally attractive to young people, but more so in the West, while people above 30 and their young children (not shown) leave East German city at a faster rate than in the West. Figure 11 and figure 12 (for only inner-German migration) focusses on the migration pattern of people at age 18 to 29, showing both the rates (in percent of the 2003 population) as well as the cummulative effect. The cummulative effect needs to be taken with the caveat, that people age,

i.e., the group of 18-29 year olds is replenished by young children, as they age, etc.. Nonetheless, the implied changes in the population of East Germany, in particular, rural East Germany, and the generational composition of this population is shifting dramatically and continues to do so, 15 years after reunification.

3 A model of labor search, migration and network externalities: Details.

3.1 The model

To shed light on these phenomena, I consider an extension of the standard labor search model. Surely, market distortions and policy interference in East Germany have been big, see Snower and Merkl (2006) and adjustment costs are large, see Burda (2006). But should we be confident that East Germany would recover quickly, if all these policy distortions were to be removed? The model in this section provides a simple framework to show that this may not be so. It shows that one region (East Germany) can have higher unemployment, lower productivity and persistent outward migration compared to another region (West Germany) and without any convergence taking place, despite the absence of policy distortions or costs to moving factors of production (while the latter is the main cause of the slowdown of convergence in Burda, 2006). Workers also do not suddenly become more skilled by moving from East to West. Rather, I argue, that agglomeration effects play a key role, see also Fujita, Krugman and Venables (1999), Krugman (1996) and Cooper (1999).

A standard labor search model would predict that the initially higher unemployment in the East should attract relatively more vacancy creation than in the West. Migration would provide for an additional valve. Something more is needed. I therefore extend the standard labor search model to allow for migration as well as network externalities of production. I closely follow the notation and exposition of Rogerson, Shimer and Wright (2005), section 4. I will only study steady-state equilibria with constant shares of each type of worker in the population of the region, and therefore leave away time subscripts, unless necessary. I need to be careful in formulating the assumptions in order for a steady state to exist. The model is described as a partial equilibrium in the sense that the destination region for migration is not modelled explicitly, but it will be obvious at the end how this could be done.

For the network externalities, consider a match of a worker and a firm. In isolation, production is assumed to be y_m (m for "match"). I assume that it is beneficial for this pair to join a network of enterprises and specialize on some specific task. Thus, as part of a network, the production by this pair is now assumed to be $y_n > y_m$ (n for "network"). Joining a network is probabilistic. I assume that this probability depends on the ratio of non-networked firm-worker-pairs m_t to networked firm-worker pairs n_t: this turns out to make the model fairly tractable. Thus, let $\nu = \nu(m_t/n_t)$ be the instantaneous probability for a non-networked firm-worker match to become part of some network of firms. Division of labor is beneficial to all: so, the larger the networks, the better. There is no rivalry in joining a network. Furthermore, the more networks are already present, the larger shall be the chance of an unmatched firm to join one. I therefore assume that $\nu(\cdot)$ is decreasing. For simplicity, I assume that $\nu = \nu_h > 0$ for $m_t/n_t \leq \psi$ and $0 \leq \nu = \nu_l < \nu_h$ for $m_t/n_t > \psi$ and some value $\psi > 0$, satisfying

$$\nu_l \psi < \lambda < \nu_h \psi \tag{1}$$

where λ is the exogenous job separation rate for (networked) firm-worker matches. I shall write ν, keeping in mind, that this can take one of the two values. I will calculate the equilibrium for a "guess" for ν and then determine ν with the equilibrium ratio of m_t to n_t.

For the migration part, I assume that agents have the option of moving from the region under consideration to some other outside region. Agents experience a disutility $\kappa > 0$ from moving, expressed in wage-equivalent units. I assume that with some instantaneous probability ϕ, a new disutility level κ' is drawn iid from some distribution $F(\kappa)$. Let U be the value to an unemployed worker in the region under consideration ("East Germany") and let $\bar{U}$ be the value to an unemployed worker in the destination region ("West Germany"). Upon receiving a new draw of the disutility κ, the worker will move, iff $U \leq \bar{U} - \kappa$. Let κ^* be value, for which equality is achieved. This modelling assumption can be seen as a rather stylized way of capturing the fact that young people in practice find it easier to move for a variety of reasons - family considerations, social networks, habits, etc. - than older people. With this interpretation, the probability ϕ is the probability of "rebirth", with an age (parameterized as moving disutility) randomly drawn from the population distribution. The alternative would be to model a labor search market with life-cycle considerations which gets elaborate fairly quickly. I let ι be the rate of immigration into the region. For the West, ι should be thought of

as positive. Since migration is from East to West Germany, and since West Germany is about three times as large as East Germany, I shall ignore the immigration term, and use the approximation $\iota = 0$ for simplicity.

The other features are standard and are taken from Rogerson, Shimer and Wright (2005), section 4, modified to allow for non-networked as well as networked matches. I assume that workers can be unemployed, or produce in a match. While unemployed, workers receive benefits b. Firms can post vacancies at a flow cost rk per unit of time of posting the vacancy. There is free entry to posting vacancies. Let u be the mass of unemployed workers and v the mass of vacancies. Matching between vacant positions and workers happens according to a constant-returns-to-scale matching function. I write $\alpha_w = \alpha_w(v/u)$ for the rate at which unemployed workers find a job, and $\alpha_e = \alpha_e(v/u) = \alpha_w(v/u)/(v/u)$ be the rate, at which vacancies are filled, with $\alpha_w(\cdot)$ increasing and $\alpha_e(\cdot)$ decreasing in their argument.

In a match, continuous bargaining assures that the worker receives a share $0 < \theta < 1$ of the joint remaining surplus from production, which I denote with S_n for matched, but not yet networked firm-worker pairs, and S_n for networked firm-worker pairs. I assume that there is an exogenous separation rate λ, regardless of whether the match is networked or not. I assume that workers and firms discount the future at rate r.

3.2 Analysis and Results

The value of being unemployed is given by

$$rU = b + \phi\chi(\kappa^*) + \alpha_w\theta S_m \tag{2}$$

where

$$\begin{aligned}\chi(\kappa^*) &= F(\kappa^*)\left(\bar{U} - U - E\left[\kappa \mid \kappa \leq \kappa^*\right]\right) \\ &= \int_0^{\kappa^*} F(\kappa)d\kappa\end{aligned}$$

is the "option value" of moving to the outside region. It depends on U via the cutoff-level $\kappa^* = \bar{U} - U$. Equation (2) shows that the possibility of moving to another region is tantamount to increasing the benefit level b to

$$\tilde{b} = b + \phi\chi(\kappa^*)$$

since the option value of moving increases the value of being unemployed[2].

The two equations for the surplus S_m and S_n are given by

$$\begin{aligned}(r+\lambda+\nu)S_m &= y_m - rU + \nu S_n \\ (r+\lambda)S_n &= y_n - rU\end{aligned}$$

I.e., the flow value of the surplus in the networked state is given by current production minus the flow value of being unemployed (noting that the value of a firm is zero, due to free entry). The flow value of the surplus in the non-networked state also reflects the possibility of transiting into the networked state.

These two equations can be combined to yield

$$(r+\lambda)S_m = \tilde{y} - rU \tag{3}$$

where

$$\tilde{y} = \tilde{y}(\nu) = y_m + \frac{\nu}{r+\lambda+\nu}(y_n - y_m) \tag{4}$$

is an average of the labor productivities[3]. A higher rate of joining a network increases ceteris paribus the surplus in the same way that a higher productivity would.

The vacancy posting condition is given per

$$k = \alpha_e(1-\theta)S_m \tag{5}$$

As in equation (43) of Rogerson, Shimer and Wright (2005), it follows that the matching rates α_e and α_w satisfy

$$\frac{r+\lambda+\alpha_w\theta}{(1-\theta)\alpha_e} = \frac{\tilde{y}-\tilde{b}}{k} \tag{6}$$

[2]Equation (2) can be seen from the heuristic equation

$$U \approx b + \exp^{-r\Delta t}\left((1-(\phi+\alpha_w)\Delta t)U + \phi\Delta t\int_\kappa \max\{U, \bar{U}-\kappa\}dF(\kappa) + (\alpha_w\Delta t)\theta S_m\right)$$

as $\Delta t \to 0$.

[3]This averaged labor productivity $\tilde{y}$ is generally slightly different from the population average labor productivity, which is given by

$$y^a = y_m + \frac{\nu}{\lambda - \phi F(\kappa^*) + \nu}(y_n - y_m)$$

This equation amounts to a fixed point problem. Given a "guess" for the cut-off value κ^*, calculate $\chi(\kappa^*)$. Under standard conditions on the matching function, the left-hand side has a unique solution for the matching rates $\alpha_w = \alpha_w(v/u)$ and $\alpha_e = \alpha_e(v/u)$ and the ratio of vacancies to unemployment v/u. Given values for α_e and α_w, calculate S_m and U per (5) and (3), and calculate a new value for $\kappa^* = \bar{U} - U$. This new value has to be consistent with the initial "guess" in order for this to be a valid fixed point. Given that there is a unique solution, if $\phi = 0$, a standard perturbation argument then shows that there is a unique fixed point as a continuous function of ϕ for ϕ near zero.

Equation (6) provides a number of key insights into this model. The averaged labor productivity $\tilde{y}$ and the "modified" unemployment benefit $\tilde{b} = b - \phi\chi(\kappa^*)$ play the same role as in the standard model, and provide the channel for the networking and migration effects here. A lower networking rate ν and a larger migration rate $\phi\chi(\kappa^*)$ both have the effect of discouraging job creation, decreasing the job matching rate α_w for workers, increasing the vacancy filling rate α_e for firms and thus increasing the surplus of a non-networked match S_m according to equation (5). A lower job matching rate α_w decreases the value of being unemployed U and consequently increases the migration treshold κ^*, i.e. makes emigration more likely.

For the dynamics of the population of workers, let u_t be the mass of unemployed workers, and recall that m_t is the mass of workers in a non-networked match and n_t the mass of workers in networked matches. The evolution of these masses is given by the differential equations[4]

$$\begin{aligned} \dot{u}_t &= -(\phi F(\kappa_t^*) + \alpha_{w,t})u_t + \lambda(m_t + n_t) \\ \dot{m}_t &= \alpha_{w,t}u_t - (\nu + \lambda)m_t \\ \dot{n}_t &= \nu m_t - \lambda n_t \end{aligned}$$

(where it may be good to recall that immigration has been assumed or approximated to be zero). Generally, there will be migration out of the region, and therefore, u_t, m_t

[4]I implicitely assume that only unemployed workers find it beneficial to move, if they draw a low value for the moving cost. Other interesting possibilites are not analyzed here. For example, if the discrepancy between the two regions is large enough, the value of having work $U + \theta S_m$ or even $U + \theta S_n$ for networked firms in the region under consideration may be lower than the value $\bar{U}$ of being unemployed in the destination region. In that case, agents drawing a sufficiently low moving cost will quit their current job and move. This additional reason for job separation would give rise to modifications of the surplus calculations above.

and n_t will not have a constant steady state. Let

$$\pi_t = u_t + m_t + n_t$$

be the total population in the region. Define

$$\tilde{u}_t = \frac{u_t}{\pi_t}, \quad \tilde{m}_t = \frac{m_t}{\pi_t}, \quad \tilde{n}_t = \frac{n_t}{\pi_t}$$

as the shares of the total population of workers for each of the three possibilities. I shall concentrate on the case where these shares are constant. Note that the rate of population decrease is given by

$$\frac{\dot{\pi}_t}{\pi_t} = -\phi F(\kappa_t^*)\tilde{u}_t \tag{7}$$

With a constant share of unemployed $\tilde{u}_t \equiv \tilde{u}$, the population decreases exponentially.

Let $\hat{u}_t$ be the relative change of $\tilde{u}_t$, i.e., the time derivative of $\tilde{u}_t$ divided by $\tilde{u}_t$. Define $\hat{m}_t$ and $\hat{n}_t$ likewise. Exploiting e.g. $\hat{u}_t = \dot{u}_t/u_t - \dot{\pi}_t/\pi_t$

and imposing $\hat{u}_t \equiv 0, \hat{m}_t \equiv 0$ and $\hat{n}_t \equiv 0$ yields

$$\tilde{u}\alpha_w = (1-\tilde{u})(\lambda - \phi F(\kappa^*)\tilde{u}) \tag{8}$$

$$\nu\tilde{m} = (\lambda - \phi F(\kappa^*)\tilde{u})\,\tilde{n} \tag{9}$$

$$1 = \tilde{u} + \tilde{m} + \tilde{n} \tag{10}$$

Given the solution for κ^* and α_w, the first equation is a quadratic equation for $\tilde{u}$, with the relevant of the two solutions coinciding with the standard solution

$$\tilde{u} \to \frac{\lambda}{\lambda + \alpha_w} \tag{11}$$

as $\phi \to 0$. Given $\tilde{u}$, the remaining two linear equations can now be solved for $\tilde{m}$ and $\tilde{n}$.

With equation (6) and for ϕ sufficiently low, a lower networking rate ν results in a lower job finding rate α_w and a higher emigration rate $\phi F(\kappa^*)$. Equation (11) furthermore shows that the share of unemployed is also higher. Both, the higher unemployment share $\tilde{u}$ as well as the faster emigration rate result in a faster rate of population decrease, see equation (7).

So far, I have not determined the networking rate ν. A solution to the equations above exists both for $\nu = \nu_h$ and $\nu = \nu_l$. Equation (9) then shows, that the equilibrium ratio of m_t to n_t is given by imposing $\hat{n}_t = 0$ in the equation

$$\hat{n}_t = \nu\frac{m_t}{n_t} - (\lambda - \phi F(\kappa^*)\tilde{u}) \tag{12}$$

With (1), the calculated equilibrium is consistent with the step function assumed above for $\nu = \nu(m_t/n_t)$, provided ϕ or $F(\kappa^*)$ is sufficiently small.

A graphical representation of equation (12) is provided in figure 13. There are two equilibria relevant for our discussion. The "highly networked" equilibrium is the equilibrium, in which $\nu = \nu_h$, unemployment is low, and average labor productivity $\tilde{y}(\nu)$ is high. In a full general equilibrium, this equilibrium ought to characterize the destination region ("West Germany", "vibrant city", "industrial core") for migrants, thus fixing $\bar{U}$. In that region, there is no outward migration. Ignoring inward migration, the equilibrium is given by the point W in figure 13. The "weakly networked equilibrium", given by point E in figure 13, is the network with $\nu = \nu_l$, high unemployment and persistent emigration. One may want to think of this equilibrium as characterizing "East Germany" or, generally, a dying region. Emigration in this model never stops, eventually turning a dying region into a wasteland. The two equilibria balance two offsetting forces. The relatively higher unemployment in equilibrium E attracts more vacancy creation than in equilibrium W. However, the surplus from production is lower in the E equilibrium, due to the lower networking rate, discouraging vacancy creation.

The two other solutions to (12), shown as points A and B in figure 13, require additional differences between the two regions. At point A, emigration persists despite a high networking rate. At point B, no emigration takes place despite a low networking rate. While point B can be understood as the equilibrium in an economy without the possibility of emigration to a more vibrant economy (or with prohibitively high moving costs for all), point A requires that the destination region remains more attractive, even if the rate of networking in both regions is equal.

Interestingly, for large enough values of ϕ, the equilibrium E disappears. Essentially, if emigration is fast, new matches come on line rarely, and existing matches are relatively long lived. As a result, networked matches dominate more than they would in the absence of migration. Whether this feature should be regarded as a somewhat artificial property of this model or a valid prediction requires further research[5]. The flip-side to this argument is that the highly networked equilibrium W may also disappear with a high rate of immigration (which we have ignored in the analysis above), as this triggers the creation of many new non-networked firm-worker pairs, overloading the capacity of existing networks to integrate new members. The slump in West Germany likely

[5]This feature may be useful for constructing a fully dynamic multi-region version of this model, as it can be utilized to eventually stop the population collapse.

has many causes, but absorbing and integrating a new workforce arriving from East Germany - as this model would then indicate - may be one of them.

The emergence and importance of clusters in East Germany has recently been studied and documented in Rosenfeld et al. (2004). In future research, their cluster data should be combined with the migration data of section 2 to investigate the implications of the theory here empirically.

The networking externality gives rise to a coordination failure in this model, see e.g. the survey by Cooper (1999). The coordination failure is slightly unusual, though, in that it is not a collective failure of firms to decide in favour of networking, but rather a problem of congestion. Given the masses of non-networked and networked firm-worker pairs m_t and n_t, there is nothing that can be done further, as the networking rate is assumed to be exogenous. If there is a coordination failure in this model, then it occurs earlier: given a certain number of networked firms n_t, a lower rate of entry (and thus higher unemployment!) would result in a higher ratio of networked to non-networked firms and would trigger the switch to a higher networking rate ν_h. One solution would be to tax entry of firms in an already depressed region in order to give existing but small networks a chance to grow at a healthy pace, thereby giving the existing unmatched firms a better chance to join. This is likely stretching the implications of this model too far, though. Rather, a more detailed modelling of the networking process should be attempted before embarking on policy recommendations. Structural policies, which aim at providing fertile grounds for networks of firms, or which encourage entry of key firms, around which networks can crystalize, then seem likely candidates for yielding beneficial results.

But skepticism is in order. In his Wall Street Journal op-ed piece on German reunification, Robert Barro (1991) wrote: "*No doubt, the slowness of the adjustment and the substantial movement of persons will create pressures for the German government to speed up the process. There is, however little in the history of regional growth in the U.S. and Western Europe to suggest that governments can accelerate convergence... . The forces of convergence are powerful in the long run, but anything approaching parity between eastern and western Germany is unimaginable anytime soon.*". Nearly 15 years later and given the massive fiscal transfers from West to East Germany, these insights may - unfortunately - still be correct.

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Figure 1: *Productivity convergence, compared to the 2% convergence prediction of Barro. Productivity convergence appears to have been fast from 1991 to 1993, so the prediction based on the 1991 numbers is far from the facts. Applying the prediction on the basis of the numbers for 1993, however, works surprisingly well. The data is from Burda (2006).*

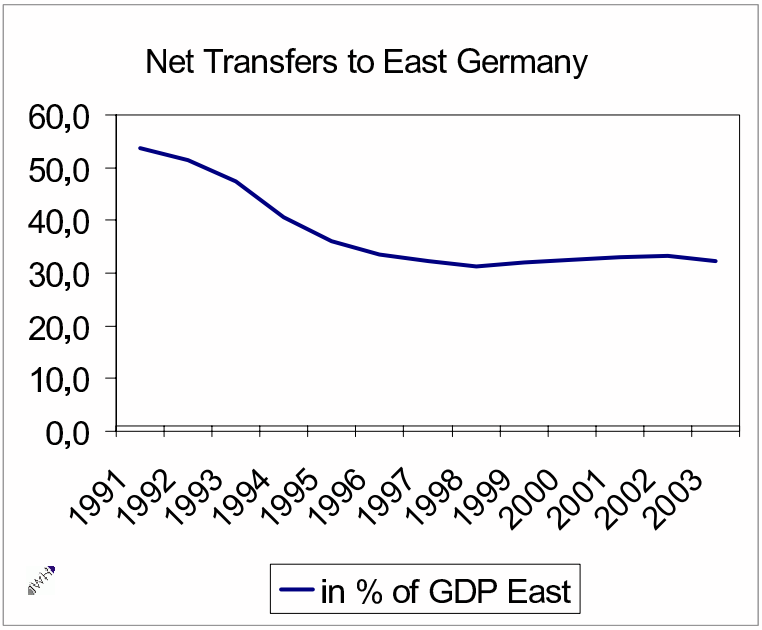

Figure 2: *Fiscal Transfers from West to East Germany.*

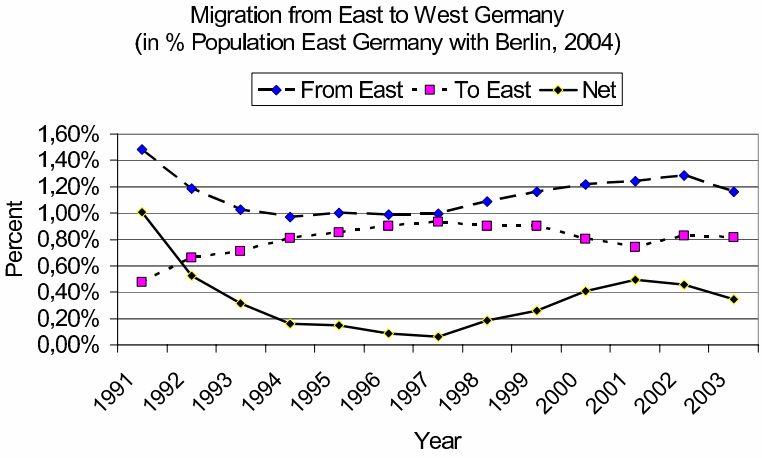

Figure 3: *Migration Pattern for Germany.*

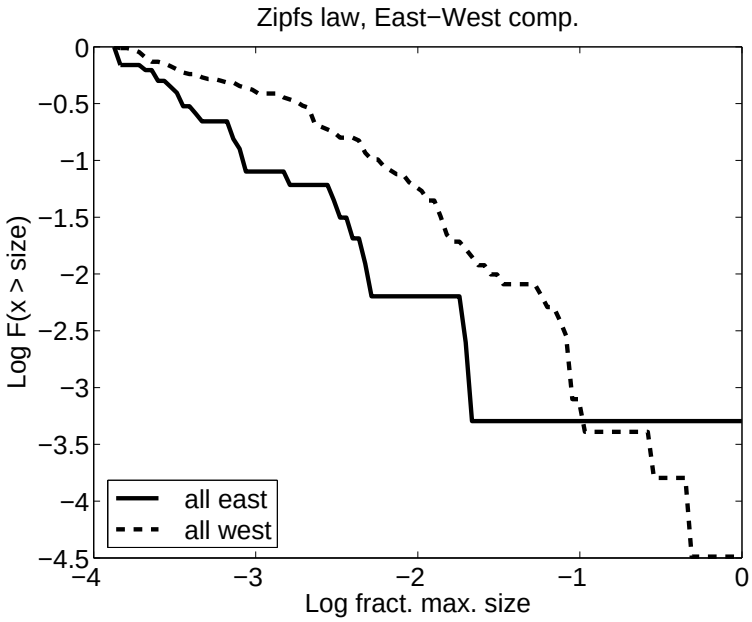

Figure 4: *Comparing the distribution of city sizes in East and West Germany.*

Figure 5: *Net migration rates for various age groups, East Germany. Only people above age 50 stay in East Germany, all others gradually leave.*

Figure 6: *Net migration rates for various age groups, East Germany, calculated for inner-German migrants, i.e., excluding migration crossing the German border.*

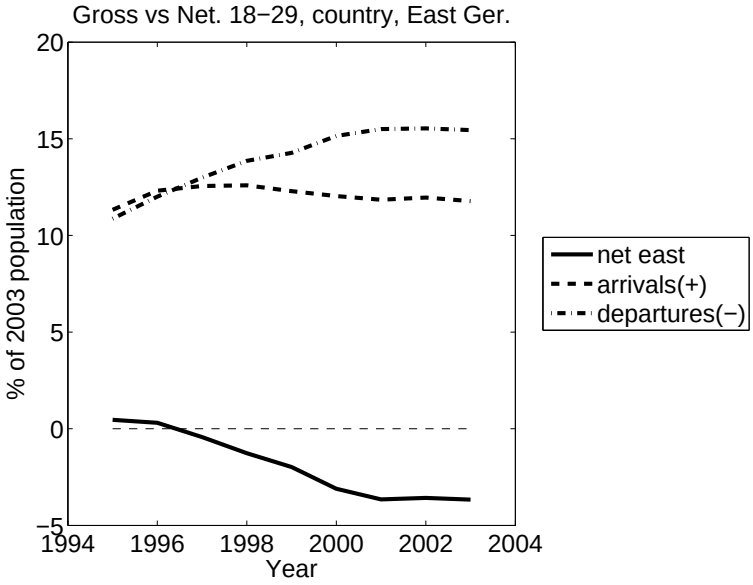

Figure 7: *Gross and net migration of people, aged 18-29, into East Germany, in percent of the 2003 population of that age group.*

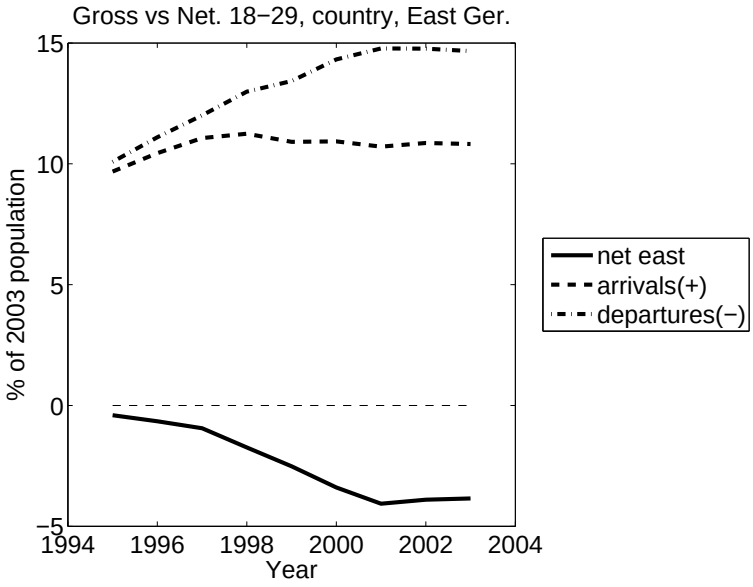

Figure 8: *Gross and net migration of people, aged 18-29, into East Germany, in percent of the 2003 population of that age group. Here, only inner-German migration is shown.*

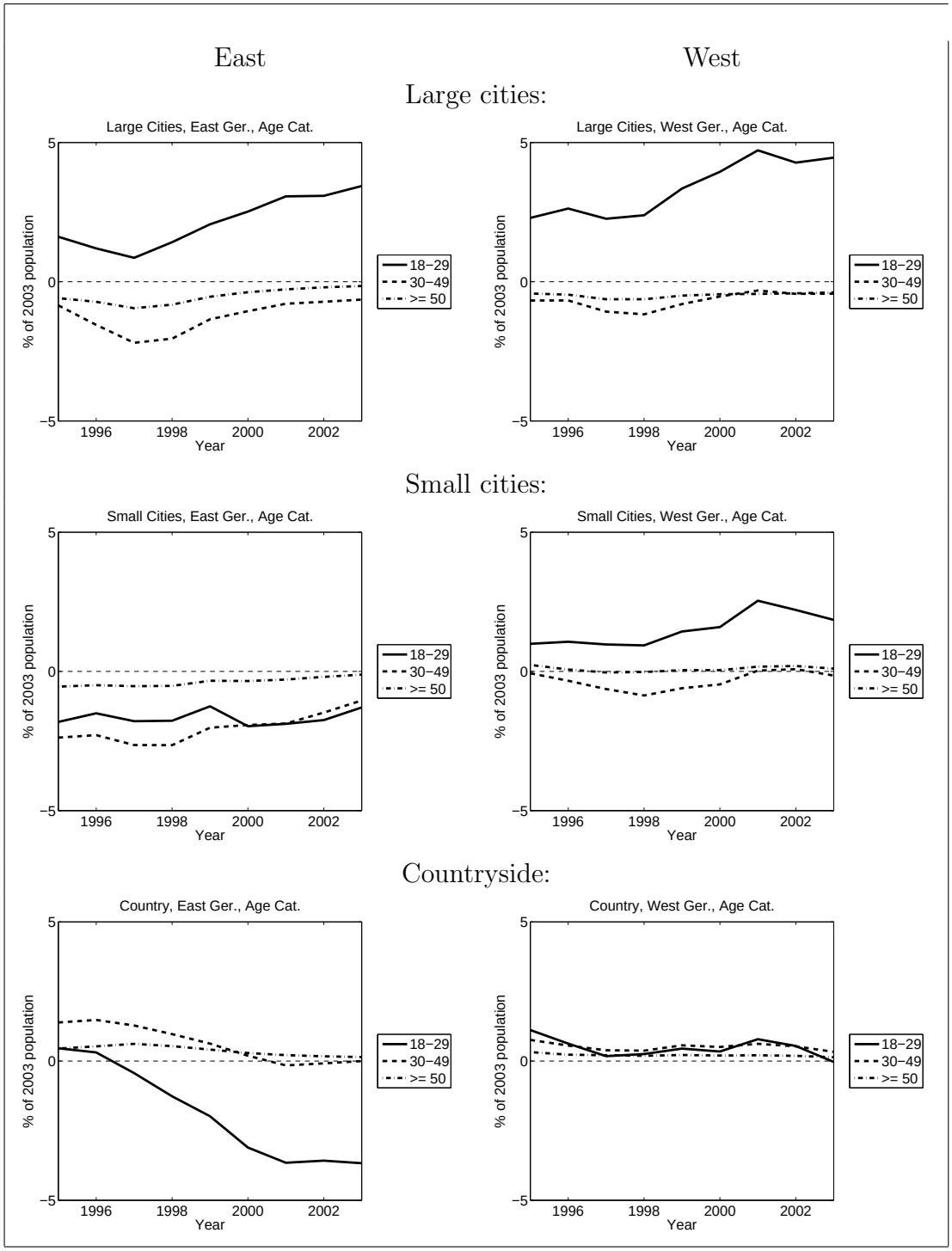

Figure 9: *Net migration rates for various age groups and regions, comparing East and West Germany.*

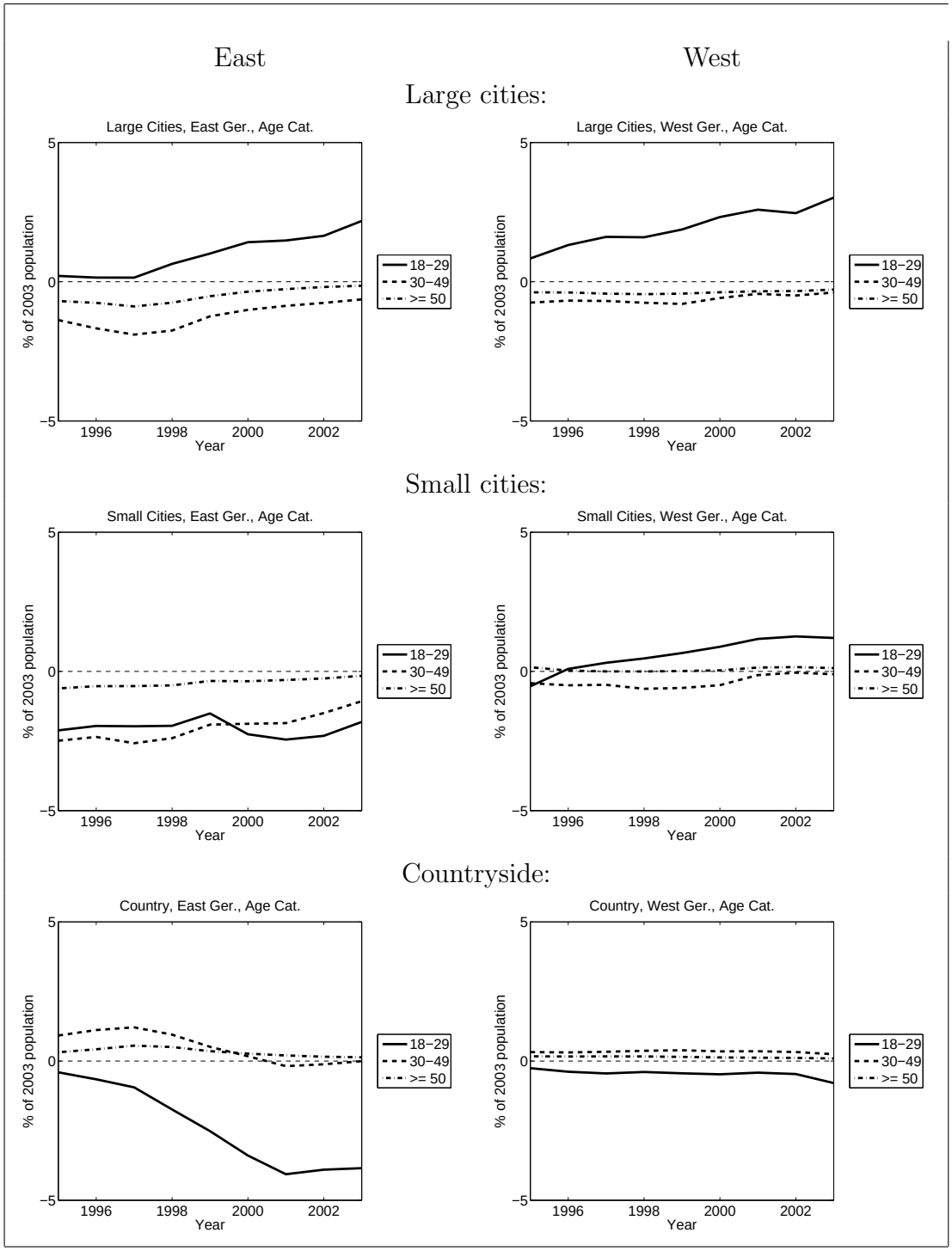

Figure 10: *Net migration rates for various age groups and regions, comparing East and West Germany, inner-German migration only.*

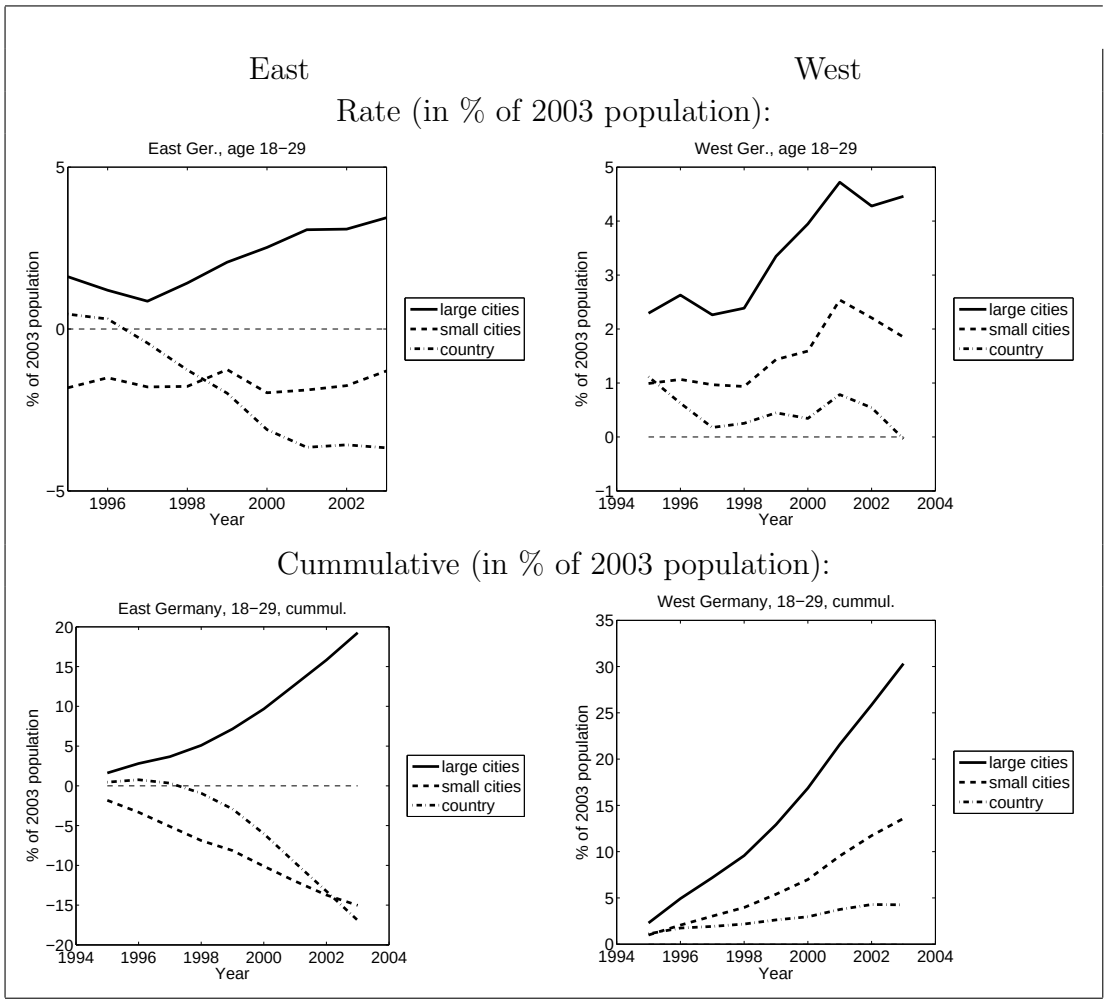

Figure 11: *Migration patterns of 18-29 year olds.*

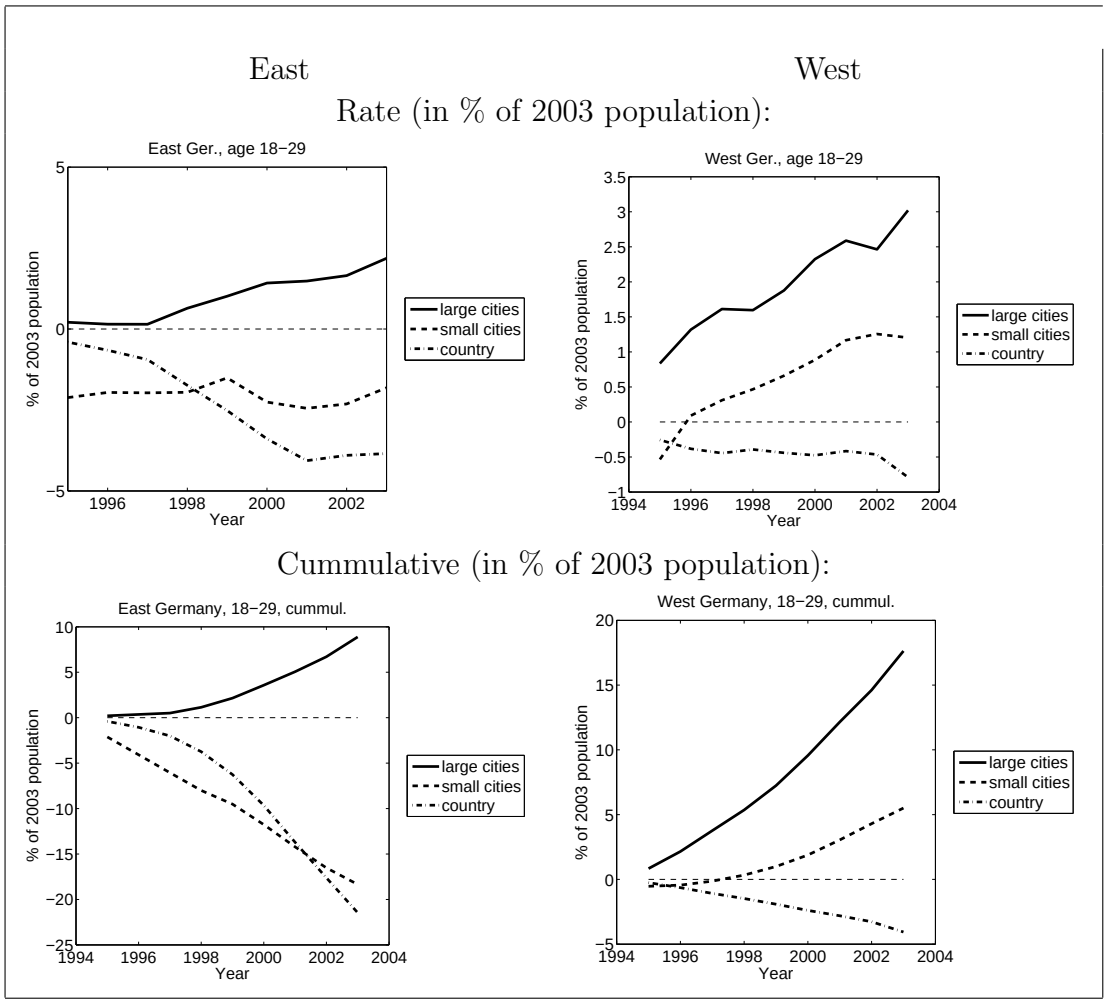

Figure 12: *Migration patterns of 18-29 year olds, inner-German migration only.*

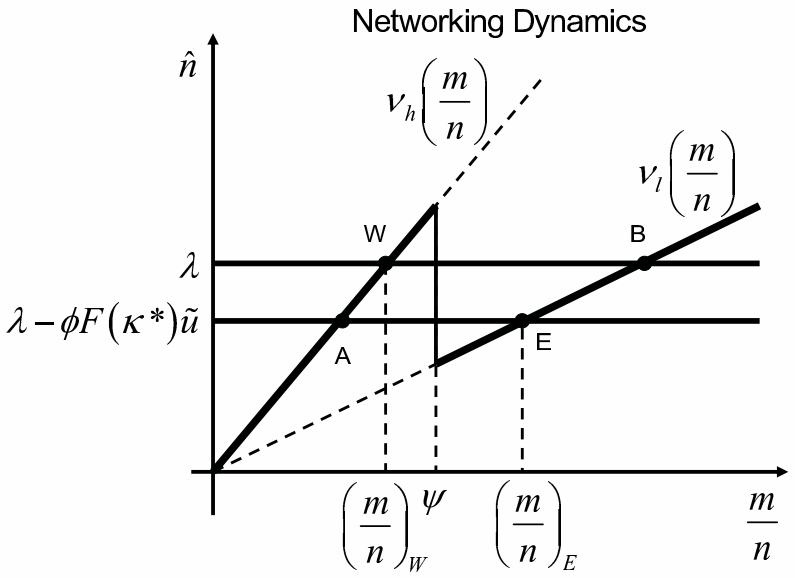

Figure 13: *A Graphical Representation of the Dynamics for the fraction $\tilde{n}$ of networked firm-worker pairs as a function of the ratio of non-networked to networked firm-worker pairs, m/n. The equilibrium E ("East Germany") exhibits low average productivity, high unemployment and persistent emigration, compared to the equilibrium W ("West Germany").*