Economic convergence across German regions in light of empirical findings

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This paper challenges the convergence hypothesis advanced by R. Barro and X. Sala-i-Martin as it is applied to explain the forces behind, patterns exhibited by and time line for German regional convergence. Exposed in some detail are the spurious neoclassical and marginalist assumptions, purporting that 'automatic' forces would indeed bring about a convergence in per capita incomes between two German regions. A trend exhibiting slow growth in per capita income in Germany's eastern region renders a Beta coefficient so low as to rule out convergence altogether. In addition, capital fails to move between German regions in the pattern assumed by the convergence hypothesis.

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JEL classifications: B13, P17, P27, P40, R11

1. Introduction

In October 1990, Germany was reunited. Reunification of Germany has involved a multi-dimensional programme affecting national security, property rights and society. The list of institutions undergoing change as part of Germany's reunification effort is indeed long. The economy is certainly one dimension deserving of consideration. As part of German reunification, a comprehensive effort has been made to foster economic activity and

thereby raise the level of per capita income and product in the eastern region—to a level comparable with the more prosperous, western region.[1]

Progress has indeed been made. Per capita output in the eastern region of Germany has increased by more than 60% since 1991. The capital stock has improved dramatically, absorbing investments in new technologies. Labour has benefited from education and training programs. By 2000, labour productivity in manufacturing, as measured for the eastern region of Germany, had achieved parity with the western region.

With these achievements in mind, can we expect at some point in the future that per capita income or product in Germany's eastern region will achieve parity with the western region? If and when economic convergence takes place between German regions, should we remark that such an achievement is the result of 'automatic forces?' Or, shall we have observed concerted policy efforts with some hard won successes and some notable failures?

In this paper, we rely on empirical findings to point out and illustrate some of the shortcomings for which we find evidence in economic convergence theory and policy. We direct our critique against a neoclassical school of convergence theory as advanced by Robert Barro and Xavier Sala-i-Martin, as both independent authors (Barro, 1996; Sala-i-Martin, 1996) and coauthors (1991, 1992, 1995). Of special interest is their article 'Convergence across states and regions' in *Brookings Papers on Economic Activity* (1991) and in Barro's *Getting It Right* (1996), in which the coauthors and author introduce assessments of and predictions for economic convergence between the eastern and western regions of reunified Germany.

2. Range of critiques

Shortcomings found in convergence theory, generally, and that version advanced by Barro and Sala-i-Martin, specifically, have been suggested. In his study noting problems facing Scotland's economy within Great Britain in the 1960s, Kaldor (1970) argued that processes of circular and cumulative causation could dominate the neoclassical paradigm of regional convergence.

Barro and Sala-i-Martin tend to limit their focus primarily to convergence between regions and states within national borders, especially within the US and Japan. Their work on Europe examines convergence between national borders, but the nations considered exhibit higher degrees of supranational integration than do most nations not belonging to an organisation such as the European Union.

As their studies of convergence have focused on such nations and states, one critique argues that convergence through an equalisation of per capita income between regions is more likely to be found in higher income countries than in lower income countries. Consequently, Funke and Strulik (1999, pp. 489–90) use the term 'convergence club' to

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[1] In this paper, we write of Germany's eastern and western regions. The eastern region is defined as the geographic area that became the Soviet Occupied Zone at the end of World War II. In 1949, this region became a nation in its own right, the German Democratic Republic. While in the Soviet sphere of influence, the eastern region undertook a 40-year experiment in planned economy, until it ceased to exist as a nation in 1990. The western region, in contrast, was that part of Germany occupied by the western allies at the end of World War II—the US, Great Britain and France. In 1948, this region emerged as a nation in its own right, the Federal Republic of Germany. In contrast to the planned economy of the eastern region, the western region organised production and distribution under conditions of market capitalism, but with a sizeable portion of GDP accounted for by public-sector spending, rendering what has often been termed a 'social' market economy. German unification has essentially meant that the western region annexed the eastern region, and the eastern region has had to make adjustments toward organising its regional economy under conditions of market capitalism.

describe the tendency for convergence between regions to be exhibited in relatively high income countries, such as OECD members.

What could be described as a 'Mezzogiorno' school tends to rule out convergence altogether. This school holds that Germany's eastern region faces serious, developmental problems related to deep-seated, economic relations with the higher income, western region. This school finds similarities between post-Cold War eastern Germany and the Mezzogiorno region of southern Italy. (See, for example, Boltho *et al.*, 1999; Funke and Strulik, 1996; Hughes Hallett and Ma, 1993, 1994; Sinn and Westermann, 2001). In a similar vein, Sinn (2000) and particularly Busch (2002) note how fiscal transfers from west to east—to support incomes in the eastern region of Germany—became institutionalised into a stable structure, but with an effect that undermines the advancement of the economy in Germany's eastern region.

Page (2003) writes of an institutional 'mismatch', especially of wage rates and productivity, which has caused the eastern region to exhibit a disappointing economic performance. His concerns over the lagging eastern region are not so much related to interregional relations in Germany. Instead, he speculates that the effects of significantly lower labour costs in adjacent countries—entering the European Union through its eastern enlargement programme—would undermine eastern Germany's economic growth, and thus thwart convergence with the western region.

In this paper, we take an altogether different approach from that of the authors noted above. First, rather than introducing yet a more refined approach to econometrics, we, instead, rely on a more traditional method of carefully combing through and then selecting empirical findings borne out in national and regional accounts. We compare selected data with estimations of the coauthors Barro and Sala-i-Martin. Our research suggests they base their understandings of—and predictions for—German regional convergence on a theory that appears to be founded on spurious assumptions regarding the forces driving an interregional movement of capital, forces that are not substantiated in practice: they are not borne out in the national and regional accounts.

Second, we find that the coauthors subsequently introduce serious estimation errors for German regional convergence. They take Beta and Sigma convergence values derived from one set of studies, and then blindly apply them to forecast growth rates in per capita income in a region far from where they were originally derived, a region with historical forces we suggest are deserving of consideration.

Finally, we pose and seek to answer the question: Do the convergence studies of Barro and Sala-i-Martin—relying on spurious theoretical assumptions combined with advanced computing methods—result in refined estimations of doubtful surface phenomena, while the more important, and deeper-seated, economic relations between regions remain hidden from view?

3. Convergence in theory

Barro and Sala-i-Martin (1992, p. 223) pose the question: are there indeed 'automatic forces that lead to convergence over time in the levels of per capita income and product?' The thrust of their publications on the topic of convergence answer their question affirmatively: 'automatic' forces do indeed lead to convergence between regions over time. Martin and Sunley (1998, p. 220), in particular, categorise that in their approach Barro and Sala-i-Martin represent what is widely known as 'new endogenous growth theory', since their work seeks to bring into their models variables that neoclassical theorists, in

particular, had left as external variables. In short, technology, human capital and increasing returns are viewed as endogenous variables by Barro and Sala-i-Martin, and thus their endogenous approach to regional growth is considered by some as more advanced than, let us say, those viewing such variables as external to regional growth processes. Our view is much less generous. We are not especially concerned whether the coauthors present an endogenous or an exogenous growth model. As will be borne out throughout this paper, we find that the explanatory power of their approach is hindered by deeper-seated assumptions that we shall suggest are far removed from economic reality, and are refuted by our empirical findings. Upon closer examination of their approach, what we find disturbing is that their assumptions regarding economic convergence are quintessentially neoclassical and marginalist in the traditions traced back to writings of nineteenth-century thinkers: in particular, Carl Menger's *Principles of Economics* (1871), Leon Walras' *Elements of Pure Economics* (1844–77), William Stanley Jevons' seminal contribution, *The Theory of Political Economy* (1871), and Alfred Marshall's *Principles of Economics* (1890).

Barro and Sali-i-Martin borrow uncritically—and perhaps unknowingly—from core ideas in these seminal writings. Without acknowledging an intellectual debt, the coauthors take on assumptions drawn from marginal analysis and diminishing returns, raising these to a set of general laws for explaining convergence between regions: in some cases *ex post*, and—in our case under consideration—*ex ante*. They not only predict that German regional convergence will occur, but that it will take place at a suggested rate and based primarily on an assumed pattern of an interregional movement of capital—as this capital avoids diminishing returns.

To summarise their use of marginal assumptions, the coauthors view that capital's movement between states and regions serves as the primary instrument driving economic convergence. Convergence is thought to occur as poorer countries or regions exhibit higher rates of growth over time. This happens as capital in a higher per capita income region is subject to (Barro and Sala-i-Martin, 1991, p. 109) 'diminishing returns'. Capital thus moves outward (Barro and Sala-i-Martin, 1991, 1995; Barro, 2000) seeking opportunities in a region with a comparatively lower per capita income: where new investments can be expected to benefit from a relative increase in rates of output per unit of capital input, as each addition to capital stock generates (Sala-i-Martin, 1996, p. 1343) 'enormous additions to output when the capital stock is small'. The coauthors assume that unit labour costs are comparatively lower in the lower income region, thereby creating a higher level of capital efficiency (assuming similar technology) per unit of relatively cheaper labour. In sum, the movement of capital serves as the key and 'automatic' force driving regional convergence. Economic convergence—at least in theory—is attained when differences in rates of marginal returns (Barro and Sala-i-Martin, 1991) to capital between regions is equal to zero. When such occurs it is assumed that income per capita would also have equalised between regions.

That capital moves from the higher per capita region to the lower per capita region is presented as a given, and the details of its movement and the institutions through which capital is suggested to move are left to the economic imagination. We could, however, infer that economic convergence is purely a market-driven process. So powerful are markets in driving economic convergence that the coauthors argue that, if certain, basic, preconditions are met regarding functioning markets, including underlying parameters for technology and preferences, market forces facilitate regional convergence, even when institutions such as state-funded income subsidies for lower income groups create market distortions.

4. Beta and sigma convergence

In addition, the coauthors' empirical studies suggest that as capital moves between states and regions, averting diminishing returns in a higher income region, and seeking relatively higher rates of return in a lower income region, this process drives β (Beta) and σ (Sigma) convergence. More emphatically, the coauthors assert that Beta and Sigma convergence will, indeed, take place between states and regions over time.

When two regions are considered at some, chosen starting point, differences in their levels of per capita income can be expressed as a 'gap'. Thus, Beta convergence involves a closing of this gap in per capita income over time. Stated more systematically, Beta convergence occurs as the gap in per capita incomes between two regions is reduced through a flow of capital out of the higher per capita income region where capital efficiency is suggested to be lower—as it is assumed to face diminishing returns—to the lower per capita income region where the coauthors suggest there is a relatively higher level of capital efficiency. Beta convergence is necessary for Sigma convergence. That is, as Beta convergence occurs through a reduction and closing in the gap of per capita income between regions over time, there likewise occurs Sigma convergence, involving a closing of a gap over time in the cross-sectional dispersion of per capita income or product (Barro and Sala-i-Martin, 1991, p. 112). In conclusion, the flow of capital between regions is suggested as the primary instrument closing a given per capita income gap and leading to Beta and Sigma convergence. So confident is Sala-i-Martin (1996, p. 1326) in the outcome of these automatic forces that he stresses that the neoclassical model provides the likeliest explanation of the convergence phenomenon, with or without perfect capital mobility and technological diffusion.

At the core of their discussion stands an identity that is suggested to model the transitional growth process:

$$(1/T)^\star \log(y_{it}/y_{i,t-T}) = x_i^\star + \log(\hat{y}^\star/\hat{y}_{i,t-T})^\star(1 - e^{-\beta T})/T + u_{it}$$

where i indexes the economy, t indexes time, y_{it} denotes per capita output or income, $x^\star$ is the steady state per capita growth rate, $\hat{y}_{it}$ is output per effective worker (numbers of workers adjusted for the effect of technological progress), $\hat{y}_i^\star$ is the steady state level of output per effective worker, T is the length of the observation interval, β is a coefficient noting rate of convergence, and u_{it} is an error term.

On the production side, this model assumes diminishing returns to capital, exogenous technological progress, full employment, a fixed relation between labour force and population, and exogenous growth of population. On the consumption side, this model assumes the saving rate derives from the choices made by utility maximising households over an infinite horizon. The steady state value of output per effective worker $\hat{y}_i^\star$ depends on parameters of technology and preferences (Barro and Sala-i-Martin, 1991, pp. 108–9; represented mostly verbatim).

Support for Beta and Sigma convergence and thus convergence between states and regions is derived from these coauthors' econometric studies, especially studies that consider the US, part of Western Europe and Japan (1991). Their studies have yielded results suggesting that Beta convergence between regions takes place at a rate of about 2% per year. So correct and so stable is their 2% value for a Beta coefficient that Barro (1996, p. 14) notes that Larry Summers was apparently so taken by the robustness of the 2% convergence coefficient that he coined the term 'iron law of convergence'.

5. Beta convergence between German regions

Barro and Sala-i-Martin (1991) and Barro (1996) express confidence that the eastern region of Germany will converge with the western region. They note that, on average, the gap between poorer and richer regions diminishes at about 2% per year (their iron law). German regional convergence is recognised as more problematic, since estimates of east German productivity prior to unification in 1990 were somewhere between one-third and half the west German levels, as Akerlof *et al.* (1991) noted. Barro (1996, p. 14) extrapolates from the experience of the US and suggests that rates of regional per capita growth in the eastern region of Germany would be 'initially 1.5 to two percentage points per year higher than the western region'. This estimated growth advantage displayed by the eastern region was expected to decline as both regions converged. Barro (1996, p. 14) succinctly states: The eastern region's

growth advantage … means that it takes about fourteen years to eliminate one-quarter of the initial productivity gap (measured in output per capita), about thirty-five years to eliminate one-half of the gap, and almost seventy years to eliminate three quarters of the gap. Germany's regional convergence is thus expected to take about two generations.

6. Convergence in practice, stylised facts

Did capital move from the high income western region to the low income eastern region in Germany, as the coauthors suggest? The answers are both 'yes' and 'no'.

Yes, capital moved from western Germany to the lower per capita income region of eastern Germany. However, its movement is not explained by the assumptions underlying the coauthors' use of neoclassical theory for explaining economic convergence between regions. Our research findings fail to support the neoclassical assumption that diminishing returns to capital in the higher income, western region drove capital to the lower income, eastern region, and that such behaviour exhibits signs of leading towards Beta and Sigma convergence between the two German regions, over time.

Consequently, Barro and Sala-i-Martin's assessments of and predictions for German regional convergence appear far from the mark. For one thing, they assume a Beta or β coefficient of 1.5 or 2.0 to calculate the numbers of years needed for regional convergence. However, they fail to consider that average growth rates in the eastern region could fall so low relative to the western region as to render any future economic convergence arithmetically impossible. We find that problems arise with their 'one or two sizes fits all' application of Beta coefficients to a regional structure as complex as Germany's.

Our empirical findings suggest that capital did indeed flow from the western to the eastern region of Germany. However, this movement of capital under consideration appears not to have been driven by 'diminishing returns' to capital in the western region relative to the eastern region. Instead, the movement of capital from the higher to the lower income region was driven by state funds that raised the rates of return in the east relative to the west, with the explicit intention of inducing interregional capital movement.

Starting in 1990, the German state assumed a formal role in facilitating the reunification of the two German regions. Rebuilding the economy of the eastern region was recognised as an essential part of reunification. Thus, state subsidies were used to encourage the flow of capital to the lower income region of eastern Germany. State subsidies took the form of:

(A) Tax write-offs (*Steuerliche Abschreibungen*) for investment into residential and non residential construction;

(B) Investment premiums (*Investitionszulage*) that took the form of direct state funding for a share of private investment. '*Zulage*' is a legal term meaning the state is obliged to provide a specified proportion of private investment.

(C) Investment grants (*Investitionszuschusse*) were used to fund selected projects. The level of state funding involved the state (*Land*) and investors. All three of these instruments were used at the start of unification. Each was used individually and as part of a collective strategy to lure capital from the higher per capita, higher wage region to the lower per capita, lower wage region. While these capital flows are difficult to find in the statistics, we think that 'capital efficiency' is a useful indicator, pointing the direction of capital flows. We measure capital efficiency as a relation between value of output per unit of 1000 euros of capital stock. A rising capital efficiency indicates rising value of output per unit of capital stock.[1]

Capital efficiency did rise in the eastern region of Germany from 1991 to the end of 1994. It then began to decline and exhibited a clear tendency for a secular decline from 1994 to the end of 2002 (see Table 1). A pattern of rising and falling capital efficiency coincides with the use of state subsidies that were integral to the reunification programme during the initial years.

However, it should be noted that tax write-offs for construction were reduced in the mid-1990s, and fully cancelled as a policy instrument in 1997. Investment premiums and investment grants originally came as spending from Germany's federal budget allocation to the states (*Länder*), and from there the *Länder* allocated these funds to the communities. It should also be noted that funds as investment premiums and investment grants diminished significantly after 1995.

As these subsidies declined, flows of capital from the western to the eastern region also appear to have declined and even reversed in the second half of the 1990s. That is, the

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[1] Marginal capital efficiency is a key assumption for supporting neoclassical convergence theory. If we wanted to measure the validity of this assumption in order to test the explanatory power of neoclassical convergence theory, generally, and the contributions of Barro and Sala-i-Martin, specifically, this would be like measuring the validity of the assumptions used by Carl Menger in the nineteenth century for his construction of a scale of marginal utility theory—such data are not collected. This is why Menger and neoclassicals have to resort to explaining consumer behaviour *ex post*. In short, whatever bundle of goods consumers purchase were purchased in the individual consumer's interest in maximising marginal utility per unit of currency. Without informing the reader of their assumptions, the coauthors are dealing with capital similarly, and with an *ex post* approach to which Menger and his followers would take off their hats. That is, capital moves from a higher wage, higher income region to a lower wage, lower income region because of the law of diminishing marginal returns to capital. In short, an interregional flow of capital occurs because neoclassical theory assumes it.

Thus, we think it worth speculating that neoclassical theory has survived and dominated our profession for so many decades precisely because its basic assumptions are not practically testable, and thus are not easily subjected to verification or refutation by empirical findings. National and regional accounts are not constructed to measure diminishing marginal returns to capital. One practical reason is that capital is inherently lumpy. If capital moves between regions, it moves as lumps of funds that reform as plant and equipment, as infrastructure, as buildings in the poorer region. Such lumps of capital are substantial, not marginal.

What can be derived from the raw data we mined is a ratio between output per 1000 euro of capital stock. This is a readily gathered and useful measure of capital efficiency. And we note in Table 1 that this measure changes for the eastern and western regions of Germany over time. But we do not assume that these data express general laws that we can suggest apply to all other countries and regions, as neoclassical theorists tend to do. However, we should like to assert, that we are demonstrating the actual direction of capital between German regions from 1991 to the end of 2002, and capital's directions challenge the key assumption on which Barro and Sala-i-Martin base their work. Our attempt here is to establish that not all cases fit their assumptions: that there is, indeed, one thoroughly researched case in which capital does not follow the coauthors' spurious neoclassical assumptions.

Table 1. *Capital efficiency[a] in two German regions (measured in constant 1995 prices)*

Year	Eastern Germany	Western Germany	Western Germany=100
1991	238	215	110.7
1992	241	213	113.4
1993	248	202	122.8
1994	254	200	126.7
1995	241	199	121.1
1996	229	196	116.5
1997	215	195	110.2
1998	202	196	102.9
1999	195	196	99.3
2000	187	198	94.5
2001	179	196	91.0
2002	172	193	89.2

[a]Measured as regional output per 1,000 euros of capital stock.
   Sources: *Volkswirtschaftliche Gesamtrechnungen der Länder, 2005* (*National Accounts of States, 2005*); calculations of authors.

measure of capital efficiency in the western region outstripped the eastern region towards the end of the 1990s. From 1999 to 2002, the western region of Germany clearly exhibited higher levels of capital efficiency (see Table 1). This trend is also mirrored in the relative weakness of growth rates in output for the eastern region compared with the western region during this same period (see Table 2).

Regional measures of capital efficiency are readily calculable from Germany's national accounts. We would also suggest that a ratio of average capital efficiency will effectively express marginal capital efficiency, and vice versa. Based on our findings in Table 1, between 1991 and 1994 eastern Germany's capital efficiency index was rising. This mirrors the relatively high rates of economic growth reflected for the same period in Table 2. High rates of growth indicate a high level of effective demand relative to capital stock. A regional inflow of capital was encouraged by state subsidies, and this capital inflow meant the introduction of new technologies that raised levels of capital efficiency as output increased relative to capital stock.

As growth rates slowed during the mid-1990s, this would indicate a fall in demand relative to capital stock. A neoclassical assumption at the core of Barro and Sala-i-Martin's analysis explicitly rules out unemployment, and consequently the effects of business cycles. But official rates of unemployment in Germany's eastern region have remained above 15% over the past 15 years, even with a mass of early retirements coupled with a substantial out-migration of its qualified youth.

We note that Barro and Sala-i-Martin's model's assuming away unemployment is indeed far removed from Germany's economic reality.

In addition, their assumptions fail to consider that there was a building boom in the eastern region in the first half of the 1990s, funded in part by direct state spending on infrastructure and the restoration of monuments, many of which had been damaged during World War II, and only inadequately repaired during the Cold War era. The other dimension of the construction boom was driven by tax write-offs for investment in

Table 2. *Annual growth rates in regional output per capita for eastern and western Germany (measured in constant 1995 prices, rounded)*

Year	Eastern region[a]	Western region[b]	Growth coefficient
1992	7.7	1.7	4.5
1993	11.9	−2.3	
1994	11.4	1.3	8.8
1995	4.5	1.4	3.2
1996	3.2	0.5	6.4
1997	1.6	1.4	1.1
1998	0.4	2.2	0.2
1999	2.6	2.0	1.3
2000	1.3	3.1	0.5
2001	−0.3	1.0	
2002	0.7	0.0	0.5
2003	0.2	−0.2	
2004	1.5	1.6	
1992–97	3.7	0.6	10.3
1997–2003	0.8	1.4	0.6

[a]Eastern Germany without City of Berlin.
[b]Western Germany with City of Berlin.
  Sources: *Volkswirtschaftliche Gesamtrechnungen der Länder, 2005* (*National Accounts of States, 2005*); calculations of authors.

residential structures. By 1996, this boom had turned to bust. Growth rates fell, the numbers of unemployed increased, and unemployment rates remain higher than in the first half of the 1990s. Viewing the economic world through the thick lens of neoclassical theory, Barro and Sala-i-Martin assume that economic sectors are fully and completely homogeneous. A construction sector with its potential for turbulent swings is absent in their model.

By 1999, capital efficiency indices for eastern Germany were back to the same levels as for western Germany. Since 1999, these indices have fallen for the eastern region relative to the western region, defying the tendencies assumed and suggested by the coauthors. While they suggest that the lower income region will attract capital, increase per capita output and thereby close the income gap with the higher income region, this process had ended and even reversed itself. By 1999, the lower income region of eastern Germany exhibits lower levels of capital efficiency, and this can also be interpreted as the lower income, eastern region exhibiting diminishing returns to capital relative to the western region.

7. Godot convergence

What we term 'Godot convergence' occurs when the estimated time span for convergence is so distant in the future that occurrences—as unforeseen factors—might exert some effects on the value of the Beta coefficient. If the Beta coefficient value falls below what their 'iron law' suggests, Samuel's Beckett's (1982) mysterious Godot would probably arrive—well before the closing of the regional per capita income gap. Unforeseen factors might include world wars, plagues and a host of portentous environmental challenges

associated with global warming, such as, for example, the melting of polar ice caps and the associated rising sea levels.

We think it worth considering the past when forecasting the future, as the past could be taken as an indicator, as a portent for the future. Barro and Sala-i-Martin (1991) consider an approximate future time span for convergence between German regions. If we consider a similar length of time, but in the past, we can note that the eastern region of Germany has experienced some challenges that have contributed to the formation of the existing per capita income gap under discussion.

The eastern region of Germany has been on the losing side of two world wars, suffered hyperinflation with but few parallels in world history, a Great Depression with mass unemployment, a 40-year experiment in planned socialism—in a system on the road to eventual liquidation—as well as four different currency regimes and an array of political systems that range from genocidal to totalitarian to ostensibly democratic. The western region suffered some but not all of these challenges. Taking history as example, we should be open to the consideration that in the future Germany may also experience challenges that do not generate identical economic outcomes between its eastern and western regions.

In forecasting convergence between German regions, Barro and Sala-i-Martin (1991, 1995) note that, given the starting conditions: of eastern Germany's economy exhibiting but half the output level of the western region, 75 years would be needed to achieve three-quarters of Beta convergence. When this prediction was made first in 1991 and then again in 1995 with the hardback publication of Barro's *Getting It Right*, it was—apparently—not foreseen that that per capita growth rates in the eastern region would fall below that of the western region.

Growth rates in regional output and regional output per capita continued their sharp deceleration from a high of 11.4% in 1994 to 1.6 in 1997. If we examine the five-year time period—from 1997 to the end of 2003—the average growth rates in the eastern region were 0.8 against 1.4 for the western region (see Table 2).

If growth rates in per capita output in the eastern region remain below rates for the western region, then—arithmetically—the possibility of Beta convergence in the sample period suggested by the coauthors has to be ruled out. If the rate of per capita growth in the eastern region tops the western region but falls shy of the 1.5 or 2.0 (iron law), we should think of Godot convergence. This suggests that neither those writing nor those reading this paper can expect to be alive to assess the validity of Barro and Sala-i-Martin's forecasts: yet another dimension of the 'neoclassical mystique' to consider. Those of future generations with ongoing interests in this topic might well be drawing their observations from mountain tops or from boats—as the polar icecaps may well have melted.

Funke and Strulik (1999) suggest in their study of per capita income growth and convergence between regions in the western part of Germany that regional income disparities tend to persist over the long term. They find little evidence of convergence toward a single per capita income level between west Germany's federal states. When comparing the higher income region of Hamburg with the lower income region of Saarland, Funke and Strulik (1999, p. 490) find that—over a 25-year period from 1979 to 1994—convergence shifted as a ratio from 2.1:1 to 2.0:1.

In their detailed study, Eckey and Schumacher (2003) conclude that poorer west German states outside successful clusters will probably stay poorer over the long term. They do note, however, that the eastern region exhibits a tendency for clusters to begin to emerge, with the most successful growth clusters established at some locations in the State of Saxony—in the southern part of the eastern region—and to a lesser degree in the

neighbouring State of Thüringen (Eckey and Schumacher, 2003). Prospects for other states in the eastern region, such as Saxon Anhalt and Mecklenburg Vorpommern, are less sanguine. Thus we suspect that, for the eastern region taken as a whole and with the growth clusters averaged in with the depressed and declining regions, the growth rates in per capita output or income will remain so low as to lead to persistent and enduring differences in output per capita between the two German regions considered.

8. Conclusions and discussion

Barro and Sali-i-Martin fail to consider that a lower per capita income region within a well-integrated and modern market economy like Germany's might not follow their suggested pattern for Beta and Sigma convergence. In spite of a common currency, a national language, and well-developed markets for technology and capital, the eastern region fails to exhibit a secular trend in the growth of per capita income or product that would lead to a convergence with the western region over time.

Solow (956, p. 65) teaches us

All theory depends on assumptions which are not quite true. This is what makes it theory. The art of successfully theorising is to make the inevitable simplifying assumptions in such a way that the final results are not very sensitive. A 'crucial' assumption is one on which the conclusions do depend sensitively, and it is important that crucial assumptions be reasonably realistic. When the results of a theory seem to flow specifically from a special crucial assumption, then if the assumption is dubious, the results are suspect.

We should like to suggest that the 'crucial' neoclassical assumption held by the coauthors: that capital will face diminishing returns in the higher income region and consequently move to increase output in the lower income region—leading to Beta convergence—is indeed spurious for the regions of Germany since the start of reunification. With this in mind, we think it far fetched to assume that output per capita in the lower income region would increase sufficiently to close the gap in per capita income and product between German regions over their suggested time span. With these assumptions in doubt, we find the explanatory power of neoclassical theory unable to account for the economic dynamic between the two German regions under consideration.

The coauthors' notion that there exist 'automatic' forces leading to convergence between regions fails to consider that investment takes place through institutions such as firms. We could interpret their approach as the 'theory of the no-firm'. Furthermore, they assume a certain homogeneity regarding investment. Investment in the higher income western region is tantamount to investment in the lower income eastern region. During the first part of the 1990s, concerns were raised that this was not the case. Concerns were raised that firms of the western region were investing in the eastern region in a style resembling branch plant industrialisation, evoking an investment pattern more typically associated with the literature of patterns of investment in the Third World, than in the European Union. Investment in the eastern region meant an additional production capacity where output could be increased or decreased, depending on the level of demand in a given business cycle. Meanwhile, corporate headquarters, research and development competences (DIW, 1993A)—as well as home bases for financial institutions—have tended to remain in the higher income western region. What remains peculiar regarding the eastern region is the failure of a *Mittelstand* (DIW, 1993B, p. 109) to emerge, in the same way that owners of small and medium-sized firms emerged in the western region in the one and one half decades after World War II. What the coauthors fail to consider is that

the regions under consideration could exhibit curious features that also include a dynamic that generate sets of outcomes for which their assumption and theory cannot account.

In a more general critique of the studies of Barro and Sala-i-Martin, we find their work relies on a set of spurious assumptions integral to their uses of marginal and neoclassical theory, and then these assumptions are applied carte blanche to explain how and when the two German regions will converge. The equation and model at the core of their understanding exhibits features and is based on assumptions far removed from the unique historical circumstances of the regions they consider. Consequently, their econometric studies based on advanced computing methods do little more than provide refined estimations of doubtful surface phenomena, while the more important, and deeper-seated, economic relations between the eastern and western regions of reunified Germany are effectively obfuscated.

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