

# Growth, Reform indicators and Policy complementarities

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## **Abstract**

*This paper relates the design and the scope of structural reforms to economic performance and welfare by computing a complementarity index among the structural reforms indicators compiled by the EBRD for countries in transition; assuming that the run-up to EU integration corresponds to a nearly complete policy cycle. The level and complementarity of reforms are found to be positively related to output growth, corrected for endogeneity, and given initial conditions and the extent of macroeconomic stabilisation.*

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## 1. Introduction

Liberal economic reforms need internal coherence because the different reform areas are mutually interdependent. If carrying out one reform without the others may not improve welfare, how can a broad-based, coherent, reform strategy can be achieved for a well-balanced and functional economic system? We define a complementarity index across structural reforms and show that during the transition from central planning to market economy, an increase in the index is associated with faster economic growth in new EU Members.

The theory of second-best originated in Lipsey and Lancaster (1956) shows that in the presence of a large number of distortions the abolition of single distortion may lead to a reduction of welfare. As a consequence, a piecemeal approach to reform is unlikely to produce a good reform strategy. The difficulty and time needed to build institutions often leads to adopt a compromise: some short-term deadweight losses are accepted to reap the long-term benefits of reforms. A piecemeal approach to reform has been also justified on the grounds of political constraints as political cycles are often too short to engage several reform fronts in parallel. Nonetheless, a reform strategy achieving proportional reductions in *all* distortions at the same time can be shown to improve welfare. This result is due to Foster and Sonnenschein (1970) and was generalised by Rader (1976) and Bergstrom (1996).

To engage several reform fronts in parallel may also reflect the idea that reforms are mutually interdependent and therefore complementary. This goes back to Edgeworth ("doing more in one thing increases the returns to doing more of another") but it has been generalised in such a way that it does not require any particular differentiability or convexity assumptions. This framework has been applied to industrial organisation and to institutional analysis.

Nevertheless, little attention has been paid to complementarity in the vast literature relating the design and the scope of reforms to economic performance (*e.g.* GDP per capita growth). To be sure, cross-section or panel regressions of composite reform indicators on growth have provided mixed or inconclusive evidence and the link between liberal reforms and growth was been questioned by Rodrik (2003). His general point is that there is not a unique mapping from institutional function to form and therefore that liberal economic reforms are not the only path to achieving the goal of creating a full-fledged market economy capable of sustaining growth. Indeed such reforms are more likely to fall prey to the second-best argument when there is a tendency for ready-made policy packages (*e.g.* Washington-consensus type) and much less is known about local conditions. Independently of whether results are favourable to the presumption that reforms improve an economy's prospects, Rodrik (2005) criticises regressions of composite reform indicators on the rate of GDP growth. He stresses that we know much more about sustaining growth in high-income countries, but much less about igniting growth in poor countries. For the latter, non-orthodox policies could be appropriate to trigger a growth process. Growth, in turn, would help sustaining reform.

This has two important consequences. First, Rodrik's analysis suggests that rather than a broad-based reform, the lesson is to concentrate on the key barrier(s) to growth, rather than trying to undertake all reforms at once. Second, policies are typically endogenous to the growth process. In many countries, the policy sequence was rather first high growth, then better institutions rather than the reverse. In this context, the usual regressions of economic growth on policies may not give many insights on how economic development unfolds (Rodrik, 2005).

Against this background, this paper proposes a framework aiming at somewhat reconciling the core result of second-best theory, according to which a liberal reform package has to be comprehensive by nature, with the fact that igniting growth may sometimes require focusing on the main distortions blocking the take-off of the economy. The paper relates the properties of complementarity of reforms to economic performance, defined first as output growth and, in a second stage, integrating other sustainability indicators (e.g. social and environmental). We used a set of structural reform indicators compiled by the EBRD for Central and Eastern European countries in transition. While broadly qualitative, these indicators provide a sufficiently comprehensive and consistent evaluation by the EBRD experts of the structural transformation transition process. Taking the transition process, as a policy experiment is particularly attractive. Allowing for different initial conditions, at the outset all transition countries were offered roughly the same liberal policy package designed to make use of market mechanisms to obtain the best possible allocation of resources. Countries have implemented this package in different ways and extent leading to a wide and rich variation of outcomes. Starting in the early 1990s up to the integration of in the EU, this period also corresponds to a nearly complete policy cycle.

The insights gained from the study of the management of the transition process can be applied into the broader context of the EU integration process and reform. Like the former socialist countries faced the challenge of the transition to a market economy, the EU countries are also facing the challenge of globalisation. This new shock is putting pressure for reform on what could be seen previously as the relatively coherent 'European model', combining rigid labour markets, highly regulated product markets, together with some degree of financial centralization (Amable, 2003). Currently, the EU economy is diverging from the more dynamic economic areas, in particular the US and Asia. But, this divergence could be seen as the result of a strict definition of performance based solely on output growth. In order to put some empirical content on a wider definition of economic performance, we plan to use the structural indicators gathered by Eurostat in the context of the so-called 'Lisbon Agenda' to enrich our information set.

The structure of the paper is as follows. The next section briefly discusses the basis for the second-best result and the mathematics of complementarity. This is followed by an analysis of main reform areas and the interdependence of policies in the context of OECD country surveys for emerging markets and transition countries. Section 4 describes the content and some features of the EBRD reform indicators and constructs an index of complementarity. Section 5 constructs several composite indicators capturing the different features of the reform process, focusing on reform level and complementarity. Using these composite indicators, we then test the impact of different level of reforms and their complementarity on output growth by means of an econometric panel estimate. The paper ends with a summary and thoughts for further research,

especially on how to draw the insights from the previous analysis and results to EU reform strategy.

## 2. Second-best and Complementarity

The seminal paper by Lipsey and Lancaster (1956) proved that starting from a second-best situation, the only way to ensure a non-ambiguous increase in welfare is to remove all the distortions simultaneously. From this rather pessimistic view on the impact of economic reform on welfare, Foster and Sonnenschein (1970) proved that, under some conditions, the following result holds in single-equilibrium theory:

*Theorem (Foster and Sonnenschein, 1970): With a flat production function and if no commodity is inferior in the production function, then a radial increase in distortion is associated with a reduction in utility.*

A radial increase in distortion derives from the comparison between two  $d$ -equilibrium  $D^1$  and  $D^2$ , where  $D^2 = k \cdot D^1$  where  $k > 1$ . The index  $k$  can be seen as a proportional shift in all distortions simultaneously. This isomorphic shift is required in order to ensure that the mapping  $d$ -equilibria and distortion is unique.

The conditions are restrictive. A flat production rules out any peculiarities in the indifference curves. Together with the isomorphic distortion these conditions avoid multiple *equilibria*. The theorem says implicitly that a reform path reducing progressively all distortions in the same proportionate manner maximises the chances of unambiguously increasing welfare. While the intuition for a 'radial' reform strategy is strong, in the sense that there are no welfare gains from piecemeal reforms, the conditions appear very demanding even in a static framework.

In view of the empirical application we are seeking, the modern concept of complementarity (Topkis, 1978) provides a more flexible framework in which to address reform interdependence. It says that a change in only one coordinate of a system is less than that associated with a parallel move across several dimensions, i.e. raising one variable increases the return to raising other. This concept has been applied by Milgrom and Roberts (1995); Amable (2003) and Amir (2003).

The basic idea is as follows. Assume a given objective function  $F(.)$  depending from two policy instruments  $(x, y)$ . A given policy can have two states either reform  $(x)$  or *no*-reform  $(\bar{x})$ . In this context, the two policies are said to be complementarity if:

$$F(x, \bar{y}) - F(\bar{x}, \bar{y}) \leq F(x, y) - F(\bar{x}, y) \quad (1)$$

This means that return of moving from minimum  $(\bar{x}, \bar{y})$  to  $(x, \bar{y})$  (or to  $(\bar{x}, y)$ ) is less than the move from  $(x, \bar{y})$  (or from  $(\bar{x}, y)$ ) to the maximum. This formalises the fact that having done one reform maximises the return of doing another reform. Note that Edgeworth complementarity is a special case where the complementarity can be defined in a differential way:  $\partial^2 F(x, y) / \partial x \partial y \geq 0$ .



to achieve and maintain budget discipline are undermined where enterprises face weak budget constraints and draw resources from the public sector. The channel for this is often not direct subsidy from the budget, but instead over-easy access to credit from the banking system, often itself in full or partial state ownership. Another example of indirect support is where the state maintains an artificially overvalued exchange rate in order to facilitate imports of raw materials or energy to un-restructured heavy industries. This situation persists until firms that fail to add value are forced out of the market. During transition, privatisation and restructuring were all used to encourage this outcome. But often this process was held back by insufficient use of liquidation, the result of ineffective bankruptcy procedures and weak creditor rights.

Lack of progress in one area affects other structural reforms. For example, large enterprise restructuring is undermined in the absence of external financial discipline, typically imposed by the banking sector. Either banks do not lend, regardless of companies' creditworthiness, to prevent a new accumulation of bad debts, thus reinforcing existing credit constraints. Or else, under pressure to resume the flow of lending to un-restructured enterprises, financial problems in the banking sector re-emerge. Likewise, if bankruptcy proceedings are not effective, banks cannot both provide credits and impose financial discipline. More generally, positive structural interactions do not necessarily follow policy implementation. The problem is not only to solve the question of *stocks*, such as bad debts, but also to ensure that the *flows*, namely exit and entry of firms, new financing and investment, are adequately balanced. When the flow problems have not been solved, the stock problems tend to re-emerge, with the risk that their resolution becomes even more costly. Where exit mechanisms are enforced and induce enterprise liquidations but where the conditions for entry of new enterprises are not in place, the pace of restructuring may become politically unsustainable as unemployment rises and the economy fail to recover rapidly.

Table 3.1 summarises the main policy interdependences just discussed and provides examples of the policy feedbacks, in the sense that implementing a reform block induces helps implementing another one. This provides a first snapshot of the potential complementarities existing across reform blocks. These linkages are at the centre of the transition process. Several OECD studies in this area concluded that it was more important to ensure that these *links* operated adequately rather than pushing reform in any single area, including institutional development (OECD, 1998, 1999, 2000, 2002). One important implication of what amounts to an implicit preference for "radial" strategies is that policy reversals can magnify the costs of transition (reduce the benefits of reform) perhaps threatening progress in the most advanced policy areas.

*[Table 3.1 Examples of policy linkages during transition]*

#### **4. Data: the EBRD Transition indicators**

The empirical basis for the observation of the reform process in transition countries was taken from the EBRD *Transition Report*. This report provides indicators available for 27 transition countries since 1989. The countries are listed in Annex 1, together with the coverage of the three groupings considered, reflecting initial conditions but also expected terminal conditions in what

pertains to EU membership, where European countries are distinguished from the New Independent States (NIS) of the former Soviet Union. The results below focus on European countries, but econometric tests were also carried out for the entire sample are available from the authors upon request.

The indicators cover the eight main structural reform areas described in Figure 4.1, consistent with the OECD interdependence framework reproduced in Figure 2.1, plus an indicator of physical infrastructure development which proxies the attractiveness of the economy to domestic and foreign investors. The EBRD indicators are ranked from 1 (no-reform) to 4+ (full reform) and recorded in Table 4.1. Figure 4.1 also shows that macroeconomic stabilisation is proxied by one indicator alone, the rate of consumer price inflation (labelled CPI).

*[Table 4.1 EBRD Reform Indicators]*  
*[Figure 4.1 Policy linkages and EBRD Reform indicators]*

## 5. Composite Reform Indicators and Complementarity

The EBRD indicators can be combined in order to further assess the characteristics of the reform process in terms of Speed, Comprehensiveness and Consistency of reforms.

### 5.1 Composite indicators and features of the reform process

The simplest composite indicator to measure the degree of reform effort is the average year by year of the nine sectoral indicators, denoted as reform level (*RL*). This indicator is displayed in Figures 4.1a-b, for the New EU Members (NWEU) and for the European not yet in the EU (NEU), respectively. It enables to rank countries, but does not discriminate among different ways of managing reforms.

*[Figure 4.1a RL Indicator; New EU Members]*  
*[Figure 4.1b RL Indicator; Non-EU Members]*

Indeed, the reform process is characterised by certain phases when it gains a strong momentum. Computing a composite reform momentum indicator (*RM*) illustrates this fact:

$$RM = \sum_j (R_{j,t} - R_{j,t-1}) = N \cdot \Delta RL \quad (3)$$

where N is the number of reform areas. This indicators is displayed in Figures 4.2a-b. It can be seen that for the countries in the fast track for the European integration process, the ignition of economic reforms started much stronger than for the Non-EU group. The dynamics is also different as the marginal momentum of reforms tends to decrease uniformly in the first group, whereas it displays a much more erratic pattern in the second group, and includes policy reversals.

*[Figure 4.2a RM Indicator, New EU Members]*

*[Figure 4.2b RM Indicator, Non-EU Members]*

Actually, the most striking case of policy reversals was in Russia where during the 1998 crisis, three policy blocks were reversed (T&FES, BR&IRL, SM&NB); two policies were also reversed in 1999 (G&ER, BR&IRL).

*[Figure 4.3 Reform Indicators and policy reversals, Russia]*

In the overall sample there are around 8% of cases where at least one reform was reversed. The peak of reversals occurred during 1997-1999, which corresponded to the emerging market crises.

### **5.2 An index of reform complementarity**

The question is whether this reform momentum is concentrated in some reform areas or more evenly distributed. A sustained transition process would tend to minimise the gap between the different reform areas, while increasing the average level. To evaluate it we need to measure policy complementarity. The basic idea is that a broad-based reform strategy should be reflected into an evenly distributed reform indicators. A simple way to capture this idea is to measure the concentration of reforms by means of the usual Hirschmann-Herfindhal indicator and take the reciprocal of it, as an index of reform complementarity (*RC*):

$$RC = \frac{1}{\sum_i \left( \frac{R_i}{RL \cdot N} \right)^2} \quad (4)$$

This indicator shows that the reform process was characterised by a significant decrease of complementarity at the beginning of transition (Figures 4.4a-b). In some sense, the former socialist system had a high complementarity, but totally rigid. In order to change this system, not all reform areas could be changed at the same time so complementarity decreased. Transition is about moving towards a market system that displays a high complementarity but is also flexible.

Interestingly, the most successful transition countries were able to resume the complementarity of reforms during the transition process, whereas the lagging or slow-reformers were not able to implement the reform process in the same way. Therefore, as it could be expected, reforms have been more complementary in the more advanced transition countries that integrated recently the EU market.

*[Figure 4.4a RC Index; New EU Members]*

*[Figure 4.4b RC Index; Non EU Members]*

### **5.3 Relation between Reform level and complementarity**

There is an interesting relationship between the level and the complementarity of reforms. In order to draw this relation, let us first analyse the range of variation for the two indicators:

$$\begin{aligned}
RL &\in [R_{\min}, R_{\max}] \\
RC &\in \left[ \frac{(R_{\max} + (N-1)R_{\min})^2}{R_{\max}^2 + (N-1) \cdot R_{\min}^2}, N \right]
\end{aligned} \tag{5}$$

where  $R_{\min}$  and  $R_{\max}$  stand for, respectively, the minimum and the maximum reform score (in this case 1 and 4+), and  $N$  for the number of reform areas. We constructed a hypothetical case where the reform process starts strongly in one or two reform areas and then, progressively, is extended to all reform areas up to the point where all reform indicators reach the maximum reform score. This point can be viewed as the end of the policy cycle. This produces a non-linear relationship between  $RL$  and  $RC$ , the average level of reforms and the complementarity index, as illustrated in Figure 4.5.

*[Figure 4.5 Reform Level and Complementarity: a hypothetical case]*

## 6. Reform level, complementarity and growth

The indicators presented in the previous section, especially  $RL$  and  $RC$ , are now related to the growth rate of real output. The fact that the ignition of reforms is reflected in a decrease of complementarity is equivalent to say that not all distortions could be removed at the same time. As discussed in the introduction, this is typically a second-best situation, which can entail a loss of welfare. This transitional cost should be reflected in income losses at the beginning of the transition. This theoretical intuition is verified in our sample for the New EU Members, as the relationship between the average level of reforms and GDP growth shows an initial decline followed by an increase until the end of the policy cycle (Figure 5.1).

*[Figure 5.1a Growth and Reform levels; New EU Members]*

*[Figure 5.1b Growth and Reform levels; Non-EU Members]*

No such a pattern appears for the Non-EU group where growth displays a much more erratic relation with the level of reforms.

### 6.1 Reforms and growth: an empirical test

Our empirical test takes as a starting point the Falcetti et al. (2002)'s investigation on the relative importance of three sets of factors – initial conditions, macroeconomic stabilisation and structural reforms – as determinants of growth in transition economies. They argued that the usual debate on the role of initial conditions is much driven by the way the econometric test is conducted. A simple cross-section analysis tends to give a much greater weight to initial conditions. This is due to the fact that commitment to reform accelerates convergence. This effect can be better captured by a panel regression, where the role of reforms emerges strongly. Their main result is that "...countries that 'defied the odds' by reforming more rapidly and extensively than predicted by a simple non-linear time trend, have reaped substantial growth dividends and this time the effect is highly significant."

In their final remarks, they also point out that the literature on reforms and performance has so far largely failed to address the question of “the complementarities between further liberalization and privatisation and deeper institutional reform, which have recently received so much emphasis in the policy debate... Responding effectively to the challenges of the next decade will require more than the recipes of the past.” By integrating both level and complementarity of reforms, this paper aims at closing this gap. Indeed, if transition countries –mainly those integrating the EU– were able to trigger a reform process and overcome the costs of the initial economic recession, our theoretical analysis (section 2) suggests that sustaining growth requires a broader reform strategy.

Along these lines, our econometric test was carried out through a panel regression (27 countries by 16 years). Like Falcetti *et al.* (2002) we include initial conditions, a measure of stabilisation and the level of reforms, but with different proxies for the first two regressors. In addition, we included the complementarity index defined above. The tested equation is as follows:

$$GDP\ growth = f(Initial\ conditions, CPI\ growth, RL, RC) \quad (6)$$

Initial conditions were taken to be the initial level of GDP per capita before the transition, rather than the composite indicator used by Falcetti *et al.* (2002). In order to test for the robustness of the results the estimates were carried out through different estimators. The above equation was estimated first using the usual fixed-effect estimator, not allowing incorporating the time invariant variable related to the initial conditions. Then the initial conditions were added in the context of a GLS random-effects model. Finally, a dynamic GMM model was estimated in order to correct for possible endogeneity bias between growth, inflation and the level of reforms. This addresses Rodrik (2005)’s critique of the endogeneity of policy indicators in growth regressions.

*[Table 5.1 Growth, Reform level and Complementarity: An econometric test]*

The results provide relatively robust evidence that the reform indicators play a more important role than the initial conditions for the group of the most advanced transition countries. Both the level and the complementarity of reforms display positive and significant coefficients. Interestingly, the effect of complementarity appears the strongest in the GMM model. This could be expected, as the catch-up process in this group lessens the role of the starting conditions. In the less advanced group, the impact of pre-transition GDP level is negative, no doubt a consequence of the conflict in the Balkans.

## 7. Conclusions and further research

Liberal economic reforms are seen as reducing distortions, thereby raising profitability in the more productive sectors of the national economy. If there are many such distortions, then eliminating only one may be perverse for national welfare, threatening the sustainability of the reform process. But, if it started under duress, say as part of a macroeconomic stabilisation package, a comprehensive reform is also less likely to be sustained. The complexity of the relationship between reforms and growth is thus one reason why it has been so difficult to

capture empirically. Here we introduce the concept of reform complementarity, in addition to the level of reforms, and use it to explain the relationship between reforms and growth in transition countries. We show why growth initially declines with reforms, while avoiding the perverse second-best result. Note that this approach should be embedded in a time-consistent framework, by defining a reform strategy that is not only radial on the space of reforms but also in the time dimension. This remains an item for future research, however.

The paper attempted to reconcile the usual presumption that a liberal reform package has to be comprehensive by nature with the fact that igniting growth may sometimes require focusing on the main distortions blocking the take-off of the economy. Relating the level with the complementarity of reforms provided a basis for regressing them on output growth. A set of structural reform indicators compiled by the EBRD for Central and Eastern European countries in transition was used, assuming that the run-up to EU integration corresponds to a nearly complete policy cycle.

The insights gained from the study of the management of the transition process can be applied into the broader context of the EU integration process and reform. Like the former socialist countries faced the challenge of the transition to a market economy, the EU countries are also facing the challenge of globalisation. Currently, the EU economy is diverging from the more dynamic economic areas, in particular the US and Asia. Whether this divergence can be seen as the result of a strict definition of performance based solely on output growth – rather than on a wider concept of welfare or sustainable growth - remains to be seen. In particular, the Lisbon indicators refer mainly to outcomes rather than to policy instruments.

We found the level and complementarity of reform indicators to be positively related to output growth, given initial conditions and the extent of macroeconomic stabilization as proxied by the rate of inflation, correcting for possible endogeneity bias between these variables.

The same paradigm can be applied in the present juncture of the EU integration process. Like the transition countries faced the challenge of creating a market economy, Europe as a whole, now faces the challenge of transforming its economy in face of the globalisation process. The latter requires a degree of flexibility higher than the one currently displayed by the so-called 'European model'. Since it does not seem a good idea to integrate Europe by 'dis-integrating' it from the global economy, the complementarity index presented here must be refined to take into account more complex outcomes than the annual rate of growth, on the hand, and several levels of decision making on the other. In effect, complementarity at the national level will certainly not suffice when it comes to common policies. Even in what pertains to national policies, the interaction between levels of government must be taken into account. We believe though that complementarity will remain a useful concept in understand economic growth and development.

## Appendix: Complementarity, Supermodularity and Optimisation

Edgeworth was the first propose the idea of complementarity. Factors are Edgeworth complements if having more of one factor increases the return on the other factor. Assuming mixed partial derivatives of the objective function exist, the sign of the mixed partial derivative would be positive. However, in most economic applications smooth mixed partials are restrictive -hence the interest in developing a system where this is unnecessary. Lattice theory is a branch of mathematics that provides a formal foundation for complementarity and supermodularity.

A lattice  $(X; \geq)$  is a set  $X$  with the property that for any  $x$  and  $y$  in  $X$ , there exist an element in  $X$  larger than or equal to  $x$  and  $y$ , and there exist an element smaller than or equal to  $x$  and  $y$ .

$x \vee y$  denotes the smallest element larger than or equal to  $x$  and  $y$  (join operation)

$x \wedge y$  denotes the largest element smaller than or equal to  $x$  and  $y$  (meet operation)

A sublattice is a subset of a lattice that is closed under the operations of meet and joins. For example, the real numbers is a lattice and any subset of the real numbers is also a lattice. A sublattice mathematically expresses a kind of technical complementarity. If a solution  $x$  is chosen from a sublattice of  $\mathfrak{R}^n$  (representing  $n$  inputs for example), then it means that increasing the value of some variable never prevents increasing the others as well. Thus complementarity is only really relevant if the space we are considering is a lattice.

In this context, supermodularity can be defined as: given an objective function  $f$  on a lattice  $X$ ,  $f$  is supermodular and its arguments are complements if and only if for any  $x$  and  $y$  in  $X$ :

$$f(x) - f(x \wedge y) \leq f(x \vee y) - f(y) \quad (A1)$$

In two dimensions we can replace the meet and join operators by explicitly writing out each coordinate, as given in the section 2 in the text.

### ***Supermodularity and optimization***

Supermodularity also has interesting applications for optimizing an objective function. If  $x$  and  $y$  maximize a supermodular  $f$  on a sublattice  $S$ , then  $x \vee y$  and  $x \wedge y$  also maximize  $f$ .

Quick proof: Since  $f(x) = f(y)$ , then from supermodularity:  $2 \cdot f(x) \leq f(x \vee y) + f(x \wedge y)$ . But since  $x$  maximizes  $f$ :  $f(x) \geq f(x \vee y)$  and  $f(x) \geq f(x \wedge y)$ . Thus  $f(x) = f(x \vee y) = f(x \wedge y)$ . This means that the maximizers of  $f$  have an interesting pattern:

- 1) Either they are strictly ordered (component by component)
- 2) For any unordered pair of maximizers, there must be maximizers strictly greater or less than either of these two maximizers.

Supermodularity also enables the decision maker to more easily check if  $x$  maximizes an objective function  $f$ , because one can restrict the search only to those points greater or less than  $x$ . This reduces the search space dramatically from  $2^n$  orthants to just 2. If this restricted search space does not contain a point  $x'$  such that  $f(x') \geq f(x)$ , then there are no points in the entire lattice  $S$  that gives a higher payoff.

It is interesting to also note that simply optimizing over this restricted domain will give at least 50% of the potential gains in an unrestricted optimization. The proof is relatively simple:

Since Equation A1 is true for all  $x$  and  $y$ . The following is also true:

$$f(y) - f(x \wedge y) \leq f(x \vee y) - f(x) \quad (\text{A2})$$

We can change the sign of Equation A2:

$$f(y) - f(x \vee y) \leq f(x \wedge y) - f(x) \quad (\text{A3})$$

Combining the previous two equations, and simplifying we get:

$$[f(x \wedge y) - f(x)] + [f(x \vee y) - f(x)] \geq f(y) - f(x) \quad (\text{A4})$$

Assume that  $y$  is the global optimum of  $f$ . Let  $x'$  be the maximum of  $f$  subject to  $x' \leq x$  or  $x' \geq x$ . Since  $(x \wedge y) \leq x$  and  $(x \vee y) \leq x$ , it follows that:

$$2 \cdot [f(x') - f(x)] \geq [f(x \wedge y) - f(x)] + [f(x \vee y) - f(x)] \geq f(y) - f(x) \quad (\text{A5})$$

This implies that:

$$f(x') - f(x) \geq [f(x) - f(y)]/2 \quad (\text{A6})$$

## Data Annex: Country list and groupings

The list of the countries covered in the EBRD database and the regional groupings used in the text are as follows:

1 Albania	NEU
2 Armenia	NIS
3 Azerbaijan	NIS
4 Belarus	NIS
5 Bosnia	NEU
6 Bulgaria	NEU
7 Croatia	NEU
8 Czech Republic	NWEU
9 Estonia	NWEU
10 Federal Republic of Yugoslavia	NEU
11 Former Yugoslav Republic of Macedonia	NEU
12 Georgia	NIS
13 Hungary	NWEU
14 Kazakhstan	NIS
15 Kyrgyzstan	NIS
16 Latvia	NWEU
17 Lithuania	NWEU
18 Moldova	NIS
19 Poland	NWEU
20 Romania	NEU
21 Russia	NIS
22 Slovak Republic	NWEU
23 Slovenia	NWEU
24 Tajikistan	NIS
25 Turkmenistan	NIS
26 Ukraine	NIS
27 Uzbekistan	NIS

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Figure 2.1 Interdependence of reforms: a framework for transition

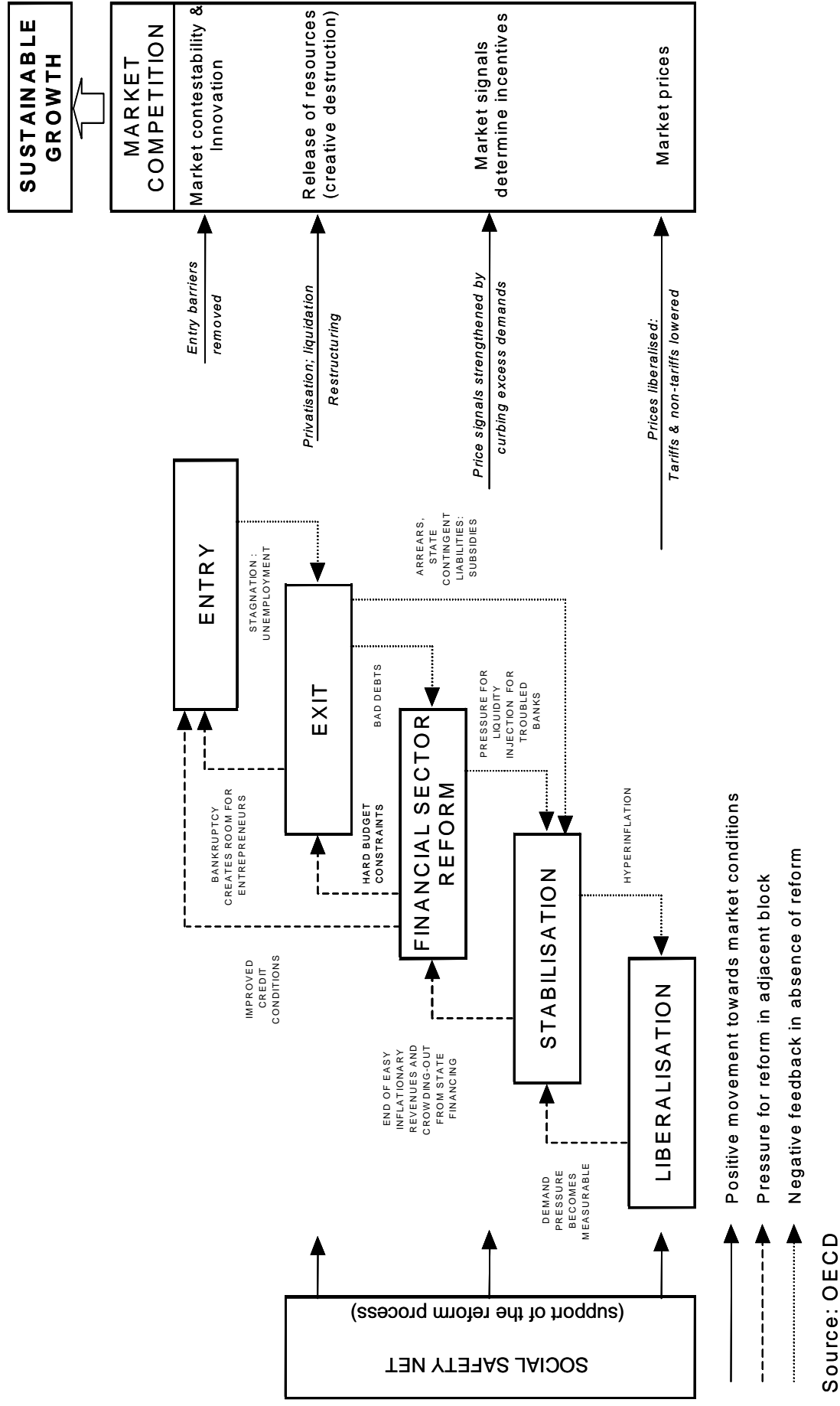


Figure 3.1 Policy linkages and the EBRD Transition Indicators

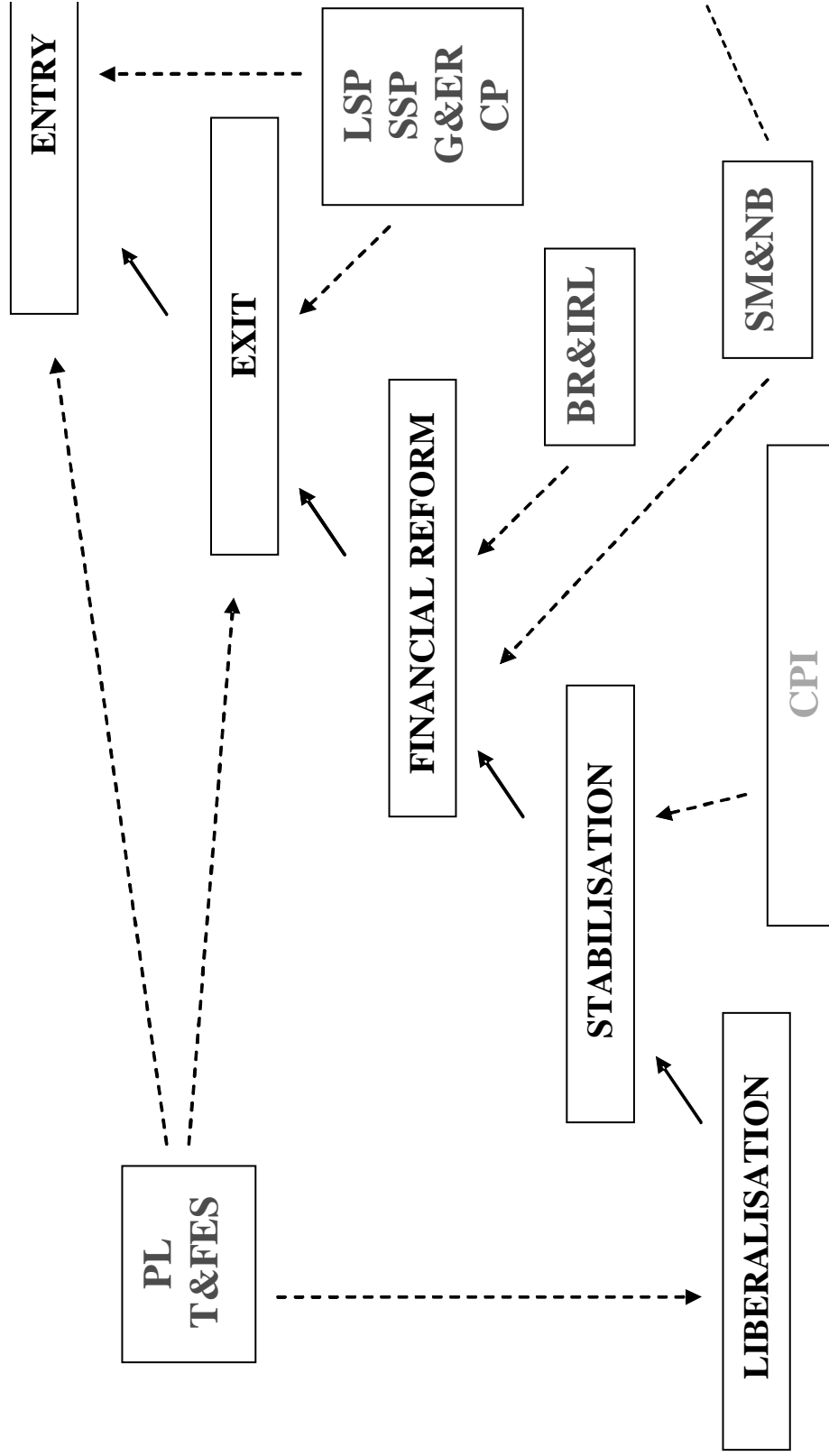


Figure 4.1a MREF Indicator; New EU Members

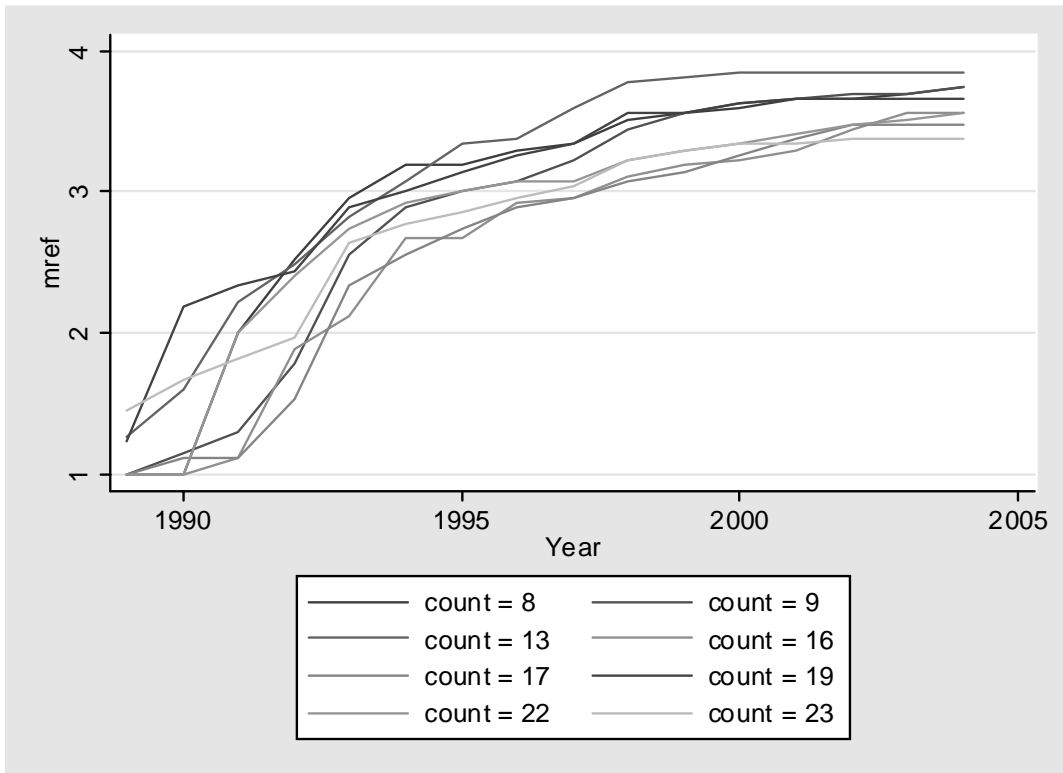


Figure 4.1b MREF Indicator; Non EU Members

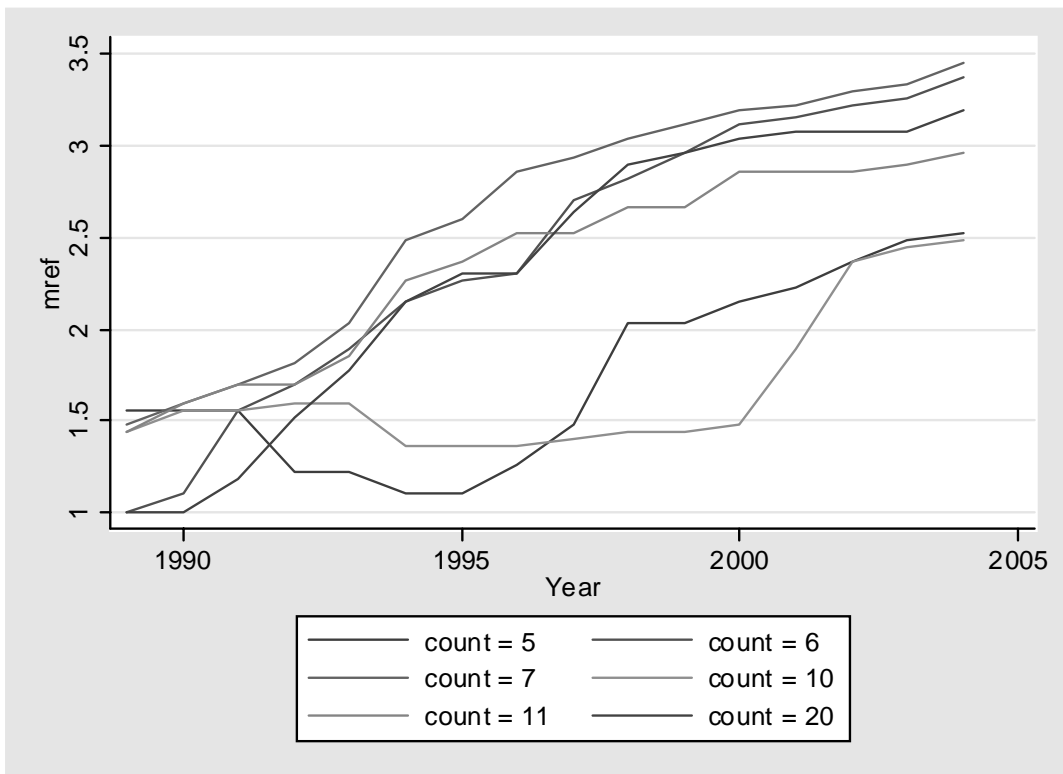


Figure 4.2a Reform Momentum; New EU Members

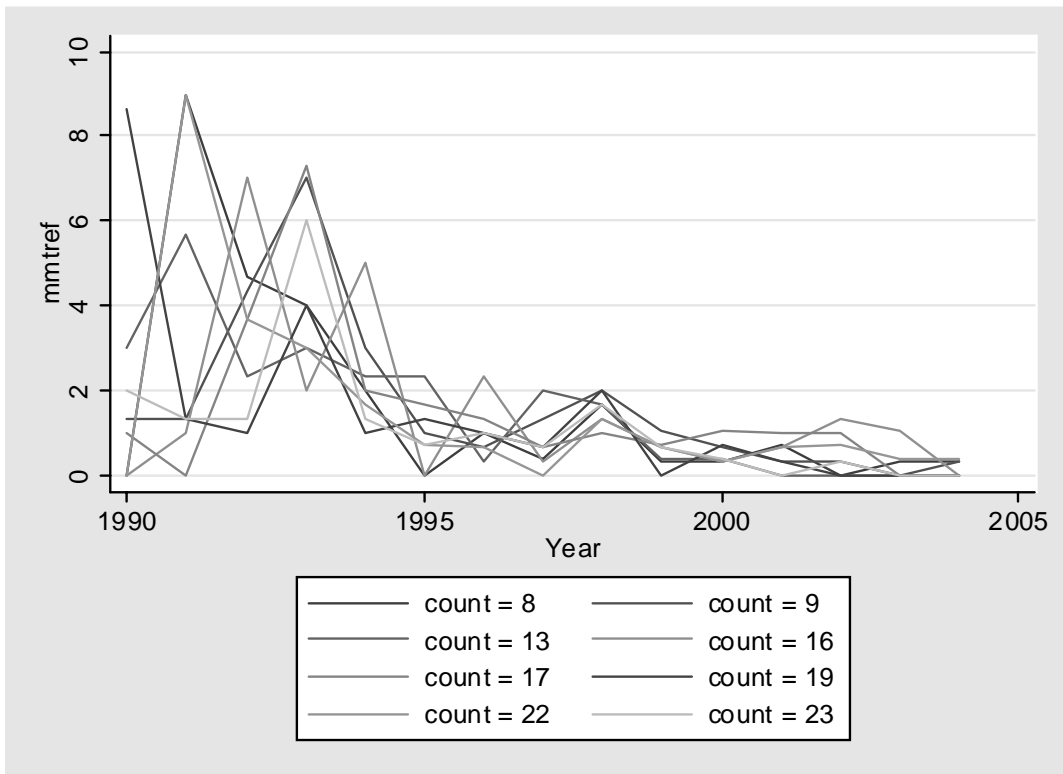


Figure 4.2b Reform Momentum; Non EU Members

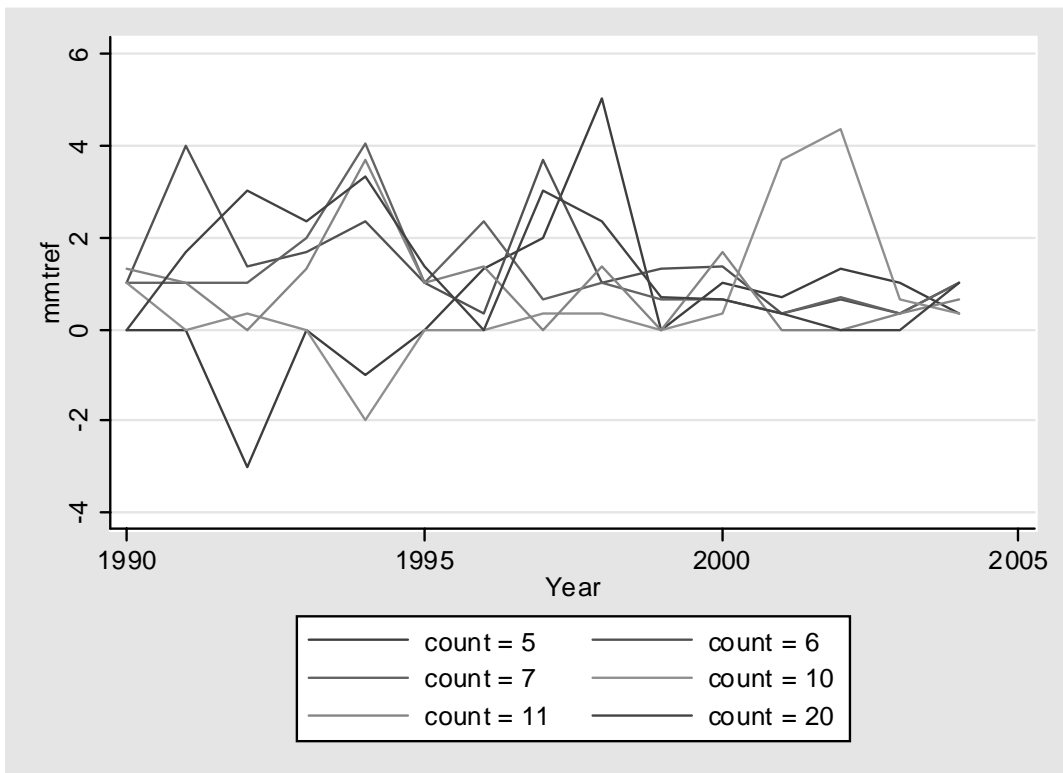


Figure 4.3 Reform Indicators and policy reversals, Russia

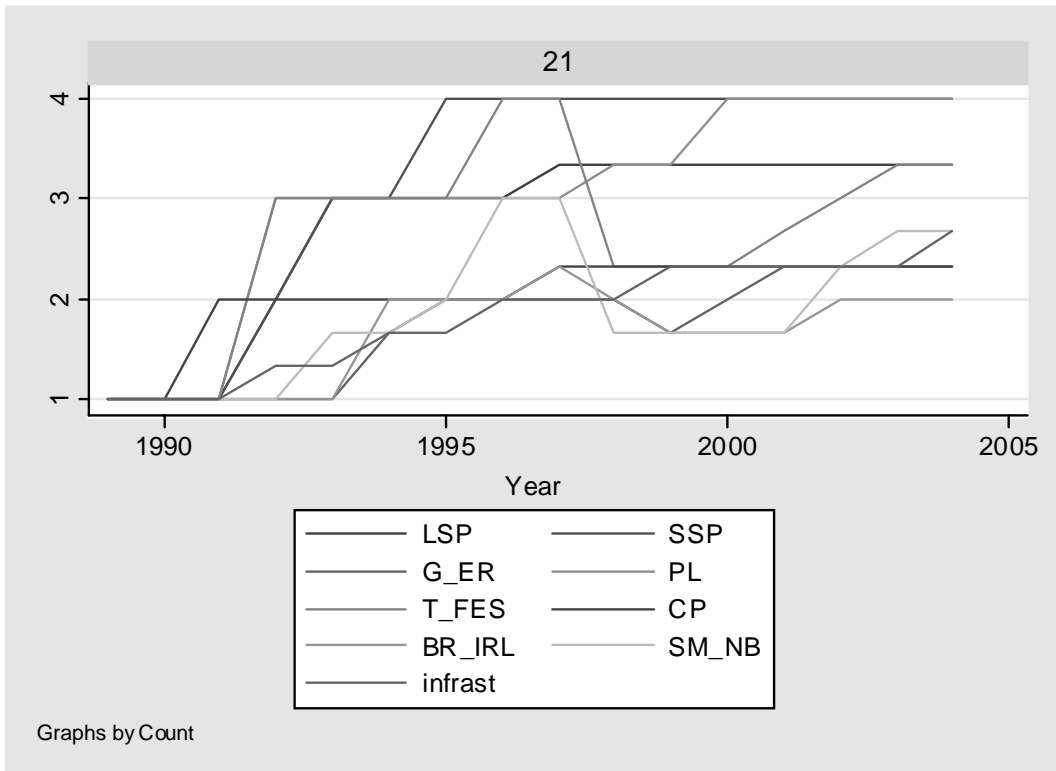


Figure 4.4a Reform Complementarity Indicator, New EU Members

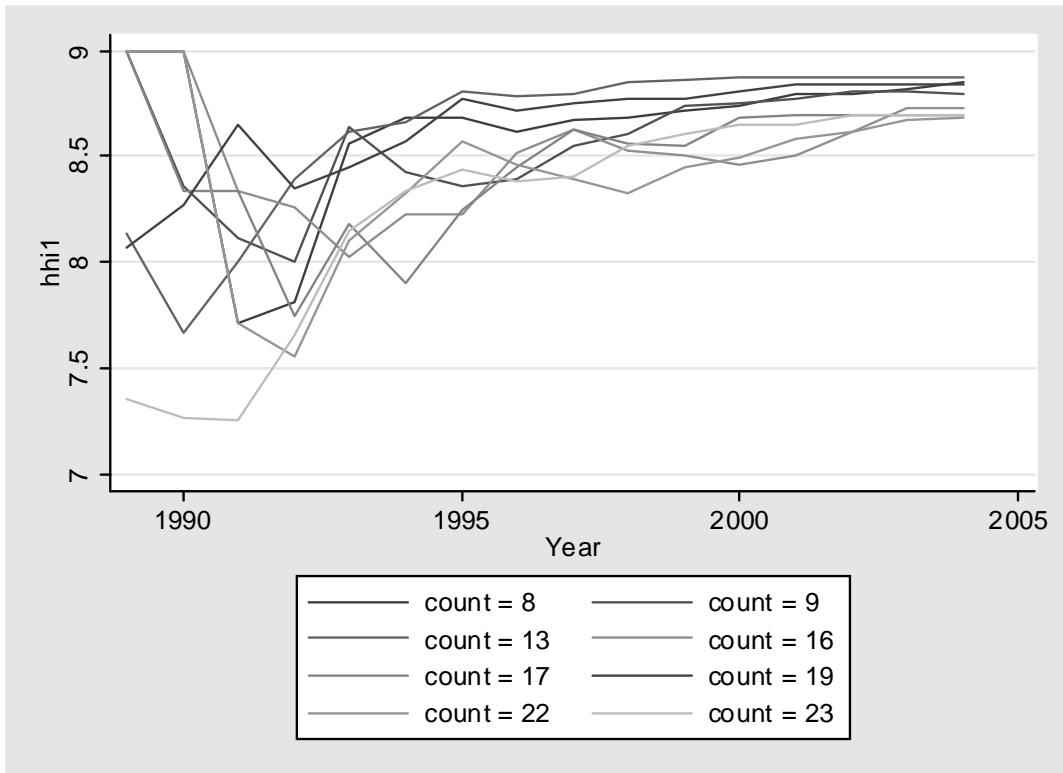


Figure 4.4b Reform Complementarity Indicator, Non EU Members

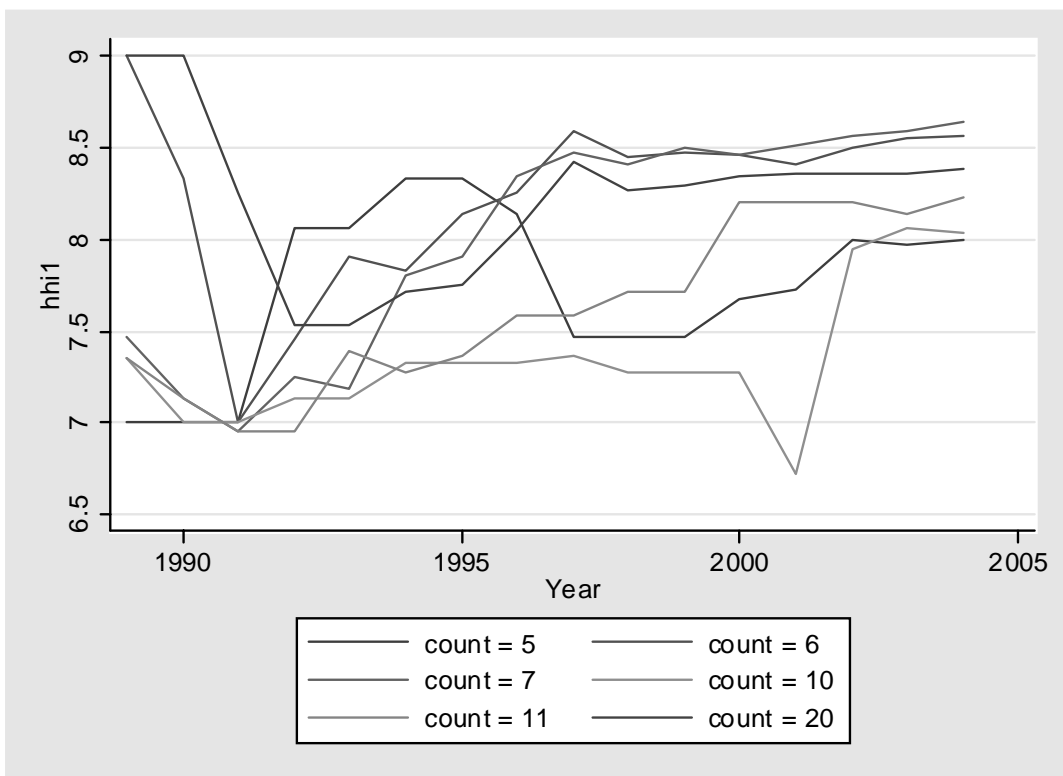


Figure 4.5 Reform levels and Complementarity: a hypothetical case

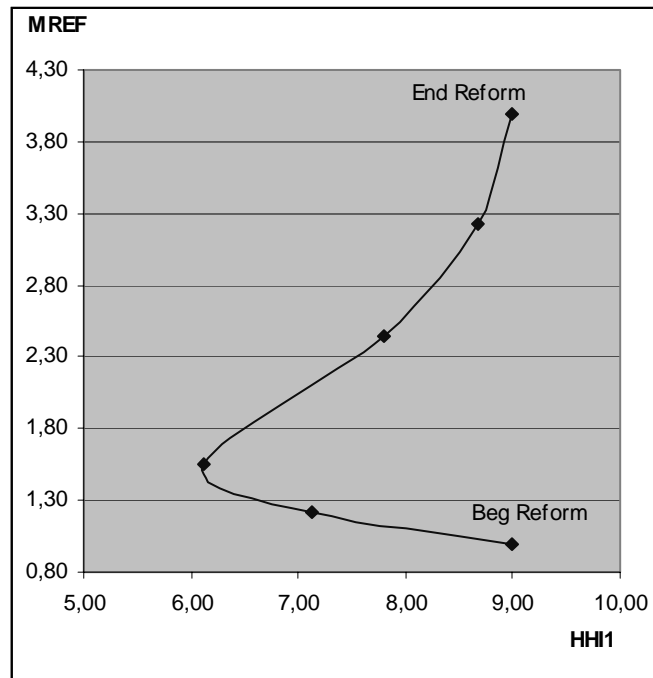


Figure 5.1a Growth and Average Reform levels: New EU Members

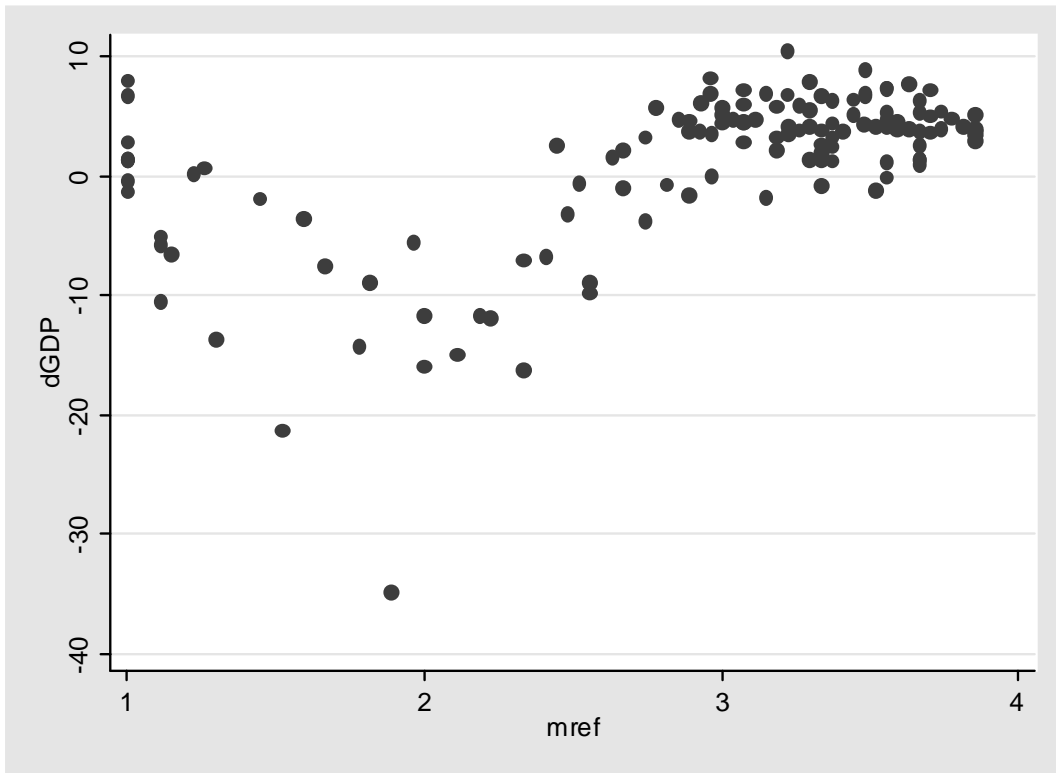


Figure 5.1b Growth and Average Reform levels: Non-EU Members



**Table 3.1 Matrix of positive linkages during transition**

	<b>LIBERALISATION</b>	<b>STABILISATION</b>	<b>FINANCIAL REFORM</b>	<b>MECHANISMS OF EXIT</b>	<b>MECHANISMS OF ENTRY</b>
<b>LIBERALISATION</b> (Prices & Tariffs)	--	Demand pressure becomes measurable	Better assessment of credit worthiness	Competitive pressures (e.g. import discipline)	Lower entry barriers
<b>STABILISATION</b>	Prevents Hyperinflation	--	End of inflationary revenues & crowding-out of state financing	Positive real interest rates, reduction of distortionary subsidies	Stable environment for investment; level playing field
<b>FINANCIAL REFORM</b>	Support of foreign trade liberalisation	Prevents pressure for liquidity injection for troubled banks	--	Support of hard-budget constraints	Improved credit conditions and other financing sources
<b>MECHANISMS OF EXIT &amp; REGULATION</b> (Enterprise privatisation, liquidation and restructuring)	Support of liberalisation measures (e.g. public utilities)	Prevents accumulation of arrears & public contingent liabilities	Reduces financial indiscipline & bad debts	--	Release of resources; reduction of entry barriers
<b>MECHANISMS OF ENTRY</b>	Import competition & export promotion	Sustains tax base & eases demand pressure	Creates viable credit opportunities for banks	Easing of resource re-allocation; prevents stagnation & unemployment	--

**NB: Positive linkage from block A (in line) to block B (in column).**

**Table 4.1. EBRD Transition indicators**

(1) LSP: Large-Scale Privatisation
(2) SSP: Small-Scale Privatisation
(3) G&ER: Governance & Enterprise Restructuring
(4) PL: Price Liberalisation
(5) T&FES: Trade and Foreign Exchange System
(6) CP: Competition Policy
(7) BR&IRL: Banking Reform & Interest Rate Liberalisation
(8) SM&NB: Securities Markets & Non-Bank financial institutions
(9) INFRAST: Infrastructure

Table 5.1a Growth, Reform level and Complementarity: An Econometric test

Dependent variable: Growth rate of real GDP	NEW EU MEMBERS (NWEU)			NON EU (NEU)		
	Fixed- effects	Random- Effects	GMM	Fixed- effects	Random- Effects	GMM
Initial conditions	--	0.0002 (0.0003)	--	--	-0.0016** (0.0007)	--
CPI growth	-0.0128*** (0.0024)	-0.0123*** (0.0024)	-0.192** (0.0069)	-0.002* (0.002)	-0.0041* (0.002)	-0.0005 (0.002)
Reform Level	2.150*** (0.558)	2.193*** (0.559)	2.346** (0.692)	4.733*** (1.143)	4.662*** (1.178)	5.511*** (1.460)
Reform Complementarity	6.299*** (1.421)	5.337*** (1.402)	7.616*** (1.724)	1.995 (1.583)	-0.189 (1.415)	2.178 (1.725)
Nb. Obs	128	128	128	84	84	77
R <sup>2</sup>	0.57 (within)	0.54		0.37 (within)	0.34	
F-test	53.01			14.53		
Hausman-test (p-value)		18.36 0.0004			4.59 (0.2048)	

NB: Country fixed-effects are not reported. The Hausman specification test of the fixed-effects vs. the random-effect model is also provided (p-values in parenthesis indicate cannot be rejected at the 95% confidence level). GMM indicates the Arellano-Bond dynamic panel-data estimation, one-step difference GMM results, using the complementarity indicator as an instrument.