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1990

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Bruinsma, F., Nijkamp, P., & Rietveld, P. (1990). *Regional economic transformation and social overhead investments*. (Serie Research Memoranda; No. 1990-55). Faculty of Economics and Business Administration, Vrije Universiteit Amsterdam.

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1990-55

Faculteit der Economische Wetenschappen en Econometrie

ET

05348

Serie Research Memoranda

Regional Economic Transformation
and
Social Overhead Investments

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Research Memorandum 1990-55
November 1990

vrije Universiteit *amsterdam*

Abstract

The paper aims to offer a methodological and applicable framework for assessing empirically the impacts of social overhead investments (or infrastructure investments) on the development of a region in terms of its investment and employment levels.

The paper begins with a concise overview of various theories/methods and puts forward the Tinbergen hypothesis that programme effects of infrastructure are far more important than direct and indirect expenditure (i.e., construction) effects.

Next, a brief discussion of impacts regarding various infrastructure compartments will be given, mainly seen from a macro perspective.

Then - in view of the lack of data for regional infrastructure programme impact studies - a set of three regions in the Netherlands is thoroughly analysed on the basis of survey questionnaires among industrial firms and in depth interviews among experts/planners. Contingency table analysis is used to identify direct and indirect links between infrastructure compartments and various types of firms. It is concluded that social overhead capital is indeed exerting a significant impact on regional business life. Apparently, the regional production environment is a critical success factor for economic development.

1. Infrastructure: A Road to Economic Progress

→ infra ↑ economic growth ↑ 1/2 regio

In recent years a clear increase in the interest in infrastructure as an engine behind economic development can be observed. The reasons for the new focus on infrastructure are manifold, but at least four motives of paramount importance can be identified.

First, there is the recognition that the process of economic and technological restructuring will be hampered, if the design and implementation of new infrastructure will not keep pace with the needs of a growing economy. There is a growing fear that 'missing links' or even 'missing networks' will have a negative influence on the competitive position of Europe (cf. European Roundtable of Industrialists, 1987 and 1988).

In the second place, the emergence and implementation of new transport, communication and information infrastructure has to be mentioned. Especially telematics offers an enormous potential, but it is not yet fully utilized (mainly because of problems of compatibility and org-ware).

Next, there is the growing awareness that Europe 1992 will increasingly move toward a network economy in which the nodes (i.e., metropolitan areas) will play a key role in a European spatial interaction system, where interactions (material and non-material) will take place along main corridors.

And finally, in many countries a new emphasis on infrastructure investments can be observed because of the presupposed causal link between these investments and their employment generating potential. In the latter framework infrastructure becomes an investment for socio-economic purposes. This renewed interest becomes once more manifest because of the significant reduction in public expenditures in infrastructure construction and maintenance which took place during the last decade.

Clearly, it has to be admitted that the importance of and interest in transport infrastructure shows also a cyclical pattern, and some authors even argue that transport infrastructure is exhibiting a mega-cycle. For instance, Andersson and Strömquist (1988) claim that historically major transitions in the European economic systems were always accompanied (or even introduced) by major changes in transport and communication infrastructure. These authors

distinguish even four main transport and logistic revolutions in the history of Western Europe, each of them characterized by the emergence, adoption and implementation of a new basic type of infrastructure. These four revolutions are:

- the period from the thirteenth century onward, in which water transport (inland and coastal transport) emerged as a new logistic system connecting cities along rivers and coastal areas (the so-called Hansa economy);
- the period from the sixteenth century (the Golden Age), characterized by a drastic improvement in sailing and sea transport and by the introduction of new banking systems, through which trade to the East Indies and West Indies was stimulated (with Lisbon, Antwerp and Amsterdam as major centres);
- the period from the middle of the nineteenth century, marked by the Industrial Revolution, in which the invention of the steam engine generated new transport modes (see transport, railways) which also created new market areas (e.g., North-America);
- the period from the seventies in our century, which is marked by informatisation and flexibilisation; in this framework JIT (just-in-time) systems and MRP (material requirements planning) evolved; besides, the rapid developments in the area of communication technology generated also the emergence of integral logistics (see Giaoutzi and Nijkamp, 1988).

The historical development of Europe, based on a close connection between economic growth and development of transport logistics has ultimately induced the European network economy. Europe has become an interwoven, multi-faceted network system, and this network will become even more evident after the completion of the internal market (1992) and the integration of (parts of) Eastern Europe.

Insufficiently functioning infrastructure may lead to a decline in economic development. On the other hand, reliable and modern transport and communication systems provide a stimulus for economic development. Bottlenecks in these systems in the form of either missing links or missing networks - be it unimodal or multimodal - cause economic inefficiencies. It is therefore no surprise that a very large share of the European Fund for Regional Development is spent on infrastructure; it is hoped that such investments would upgrade regional economies in backward

areas.

Given the large sums of money involved, a critical judgement of the performance of infrastructure investments seems justified and necessary. In our paper we will focus the attention on the regional socio-economic impacts (mainly employment effects) of new infrastructure investments, based on an analysis of some Dutch regions. Before presenting, however, these Dutch case studies, we will first deal with a typology of infrastructure and a methodology for assessing the impacts of infrastructure investments.

2 Identification of Infrastructure and Employment Effects

In our study the following infrastructure components were distinguished, according to a typology made by the Dutch Social & Economic Council (1987). It is noteworthy that infrastructure does not explicitly include publicly financed network projects. Clearly, an unambiguous classification is very hard to reach; for instance, universities belong to social infrastructure, but contribute indirectly to economic efficiency (and hence may be regarded as partial economic infrastructure). Furthermore, infrastructure is exhibiting drastic qualitative changes, for instance, from conventional physical networks to teleports and logistic chains linked to various transport modes. The following categories are dealt with in our study:

- TRANSPORTATION
 - * roads
 - * railways
 - * waterways
 - * airports
 - * harbours
 - * information transmission
 - * pipelines
- WATER AND ENERGY SUPPLY
 - * water supply
 - * natural gas supply
 - * electricity supply
 - * district heating
- WATER CONTROL SYSTEMS
 - * water quantity control
 - * water quality control
- INFORMATION CONTROL AND KNOWLEDGE DEVELOPMENT
 - * general information networks
 - * specific information networks
 - * knowledge development
- CITY STRUCTURE
 - * sewage treatment plants
 - * industrial sites
 - * waste disposal
 - * urban lay-out
- LAND (RE)STRUCTURING PROJECTS
 - * new land reclamation
 - * land restructuring

Economic infrastructure will evidently lead to various economic effects in terms of value added, productivity and employment. Clearly, infrastructure may also incorporate embodied

technological progress and contribute to productivity increase via a rise in capital productivity. It may also be a substitute or a complement to various production factors. In this paper we will mainly focus on the employment impacts of infrastructure.

Infrastructure impact analysis for assessing the effects on employment can be undertaken in two complementary ways: direct effects related to design, construction and building aspects of infrastructure provisions and indirect effects related to the derived (second order) consequences of the creation of infrastructure. The first category may be seen as the conventional (Keynesian) expenditure effects, whereas the second category refers to all effects generated by intermediate deliveries (as multiplier effects). In both cases, the pay-back effects of infrastructure investments in the framework of employment policy may play an important role (see also Kuik and Nijkamp, 1987). Furthermore, we may distinguish programme effects (or 'structuring' effects) associated with the supply of infrastructure. One group of programme effects consists of long-term structural employment effects based on maintenance and management. Another group of programme effects consists of spin-off effects caused by changes in the relative locational attractiveness of places or regions for new enterprises.

It is plausible that direct and indirect employment effects differ from programme effects in terms of character and time perspective. Direct and indirect effects result in years of labour (i.e.,

Figure 1: Employment effects of new infrastructure

versch programme $\rightarrow$ dir + indir eff

6 | many years). Programme effects are structural and hence result in jobs. Direct and indirect effects are measured during the years of construction, while programme effects are measurable after the construction period (see Figure 1).

A third difference between direct and indirect employment effects on the one hand and programme effects on the other hand is the spatial level on which the effects can be traced. The construction of main infrastructure is normally in the hands of national or international construction companies and nationally operating material contractors, so that employment effects then can be measured anywhere within the country, without a regional discrimination. Those effects must be measured for the whole of the country. On the other hand, programme effects will usually occur in the neighbourhood of the new infrastructure, because the effects are caused by changes in the relative locational attractiveness of places or regions for new enterprises.

7 | Programme effects can thus be measured at the level of the region in which the infrastructure is constructed.

3. Infrastructure Impact Analysis

Infrastructure impact analysis is a specific form of spatial impact analysis (cf. Nijkamp en van Pelt, 1987) and serves to assess the foreseeable effects (in the ex-ante case) of the realized effects (in the ex-post case) of investments in infrastructure. Various methods have been designed and used in the context of infrastructure impact analysis.

Input-output analysis is one of the conventional techniques used to estimate the direct and indirect employment effects of infrastructure investments. It turns out that especially the assessment of programme effects is usually problematic.

The estimation of the size of spill-over effects of infrastructure investments has always been a focal point of attention in regional, development and transportation economics. Especially in regional economic development theories, transport infrastructure has always played a prominent role, mainly because of the potential of such infrastructure for generating new growth impulses.

Beside input-output analysis and regional development theory, also locational theories have often focused attention on the role of infrastructure, by providing a micro-economic foundation

for the behaviour of firms in view of accessibility conditions. These theories were normally based on the view that accessible location brought about cost advantages to individual firms (mainly savings in transport costs), so that infrastructure is one of the decision parameters of the firm.

Some of these micro-based considerations have also been translated into a macro-based framework, for instance, by Tinbergen (1957) who tried to investigate the programme effects of infrastructural investments. In the model developed by Tinbergen a major role is played by the improvement of infrastructure as a key factor for the improvement of market positions of firms. This model can briefly be described as follows. The demand for goods is depending on the income generated by its production. It is evident, that improvements in infrastructure lead to a reduction in transport costs of the commodities produced by the firms concerned. This leads to a rise in discretionary income. This extra spending capacity will then lead to a rise in demand for new goods, which generates in turn additional employment, etc. According to Tinbergen, the multiplier effects of such programmes are higher than the direct and indirect employment effects of infrastructure. Clearly, some remarks concerning this model are in order. For instance, the model neglects the fact that consumers might save their extra discretionary income (rather than spending it), while also the possibility that firms (especially in a non-competitive market) might take a higher profit margin (rather than reducing the commodity prices) is assumed away. Furthermore, the favourable results may be reduced by the phenomenon of leakage effects in international (or interregional) trade. Nevertheless, this approach is interesting and valuable, as it calls attention for higher-order effects that may emerge in other sectors than the transport sector and its directly related sectors.

Although infrastructure investments are of critical importance for regional development, they are by no means sufficient conditions for generating regional development effects. In this context various caveats (see Van Gent and Nijkamp, 1987) have to be mentioned:

- Regional development is a latent concept, which cannot be unambiguously measured. Observable indicators such as gross regional product or income per capita do not capture all elements of economic development. A similar problem applies to infrastructure: this is not an unambiguous concept either.
- The contribution of infrastructure to regional development depends also on its

uniqueness. An increase in an ubiquitous infrastructure category does not exert a significant progress on a region. For instance, road expansion in an industrial area with

härin ! a highly developed infrastructure network will have lower effects than that in an underdeveloped area (decreasing marginal benefits).

- Infrastructure is a conditio sine qua non, but certainly not a sufficient condition for growth. First, infrastructure policy requires a comprehensive and tailor-made supply of all relevant infrastructure categories (due to synergetic effects). Second, infrastructure will only have a positive impact if the region at hand has already a favourable existing potential for new development. The implementation of new infrastructure in an economically weak region may even run the risk that the region at hand suffers from strong competition of enterprises in more distant regions. Thus infrastructure has to be considered in relation to the whole locational profile of an area. Third, infrastructure investments will only have a discriminating effect on regional development, if the competitive position of a region is enhanced. Thus a simultaneous improvement of infrastructure in both central and peripheral regions is not necessarily beneficial - in a relative sense - for peripheral regions. Fourth, the impacts of infrastructure are also codetermined by the general economic situation: in case of a less favourable economic situation, the probability of surpassing a threshold level for survivorship is much lower.
- The impacts of infrastructure are also determined by technological renewal. The improvement of the regional competitive position also requires flexibility and resilience in terms of infrastructure investments.

Altogether, network infrastructure is indispensable for regional development, but the extent to which it will have a decisive influence on regional growth is not unambiguous. But in any case, it is evident that regions or countries with a poor infrastructure network (missing links) run the risk of staying behind in the national and international economic dynamics.

Furthermore, it has to be appreciated that also external conditions (such as the availability of industrial areas or the interest of development companies in investing in related capital stocks such as office buildings) may be important.

A final remark is in order here. In analysing employment effects of infrastructure invest-

ments at the regional level, the distinction between generative and distributive employment impacts has to be kept in mind, although this is often difficult to measure from available statistics.

4. A Case Study of the Netherlands

4.1 Description

We will present now in more detail results from an infrastructure impact study in the Netherlands, with a particular view on the assessment of its economic importance in terms of investment volumes and employment effects (direct, indirect and spin-offs). This study is undertaken in order to provide a more solid empirical basis for the question whether (public) infrastructure investments would significantly contribute to an improvement of the employment situation in the Netherlands; see Bruinsma (1990).

The study is interesting as we have used various straightforward methods to get all information needed. To estimate the infrastructure investments and the direct and indirect employment effects of those investments, we have used national statistics and data provided directly from the responsible companies, like, for instance, the Dutch Railway Company, the Post & Telephone & Telegraph Company, and the Electricity Producers Company. These data at a macro-economic level have also been checked against data on a micro- or meso-economic level, for instance, by using data from individual contractors.

As mentioned above, programme effects are effects caused by changes in the relative locational attractiveness of places or regions for new enterprises (or new activities for existing enterprises). The strength of these effects will largely depend on the economic potential within the region where the new infrastructure is constructed. The empirical analysis of spin-off effects of infrastructure is a difficult task. In this project the influence of infrastructural improvements on employment is measured by a case study approach. In three regions a postal questionnaire, focussing on the influence of new infrastructure on the number of employees, was sent out to relevant firms with at least 50 employees. These regions in the Netherlands were: Leiden and the Bollenstreek in the Randstad (the economic heartland of the country), Southeast North-

Figure 2: Regions under consideration in the Netherlands

Brabant in the intermediate zone, and Twente in the peripheral zone (see Figure 2). The overall response of approximately 30 % is quite acceptable for such types of postal questionnaires. In all regions mentioned above, relatively large infrastructural improvements have been carried out during the past fifteen years, so that the existence of employment effects is plausible.

4.2 Estimation of direct and indirect employment effects

In this section the direct and indirect employment effects of investments in the various infrastructure categories will be assessed in order to provide an overview of the total employment effects (excluding programme effects) of infrastructure investments in the Netherlands (1985). For each category of infrastructure the direct and indirect employment effects per million of investment are calculated. The direct employment effect per million of Dutch guilders of investment appeared to vary from 4.3 towards 8.0 manyears. The indirect employment effect ranged from 2.6 towards 5.0 manyear. It was almost impossible to calculate figures for the rather new infrastructure categories of 'Information control and knowledge development'. The

Table 1: Investments in economic infrastructure and the direct and indirect employment effects

Category	Investment	Employment per mil- lion investment		Total employment development	
		Direct	Indirect	Direct	Indirect
TRANSPORTATION					
roads	2.600	5.5	4.9	14.300	12.740
railways	585	6.0	3.6	3.510	2.106
waterways	130	8.0	4.8	1.040	624
airports	95	6.0	3.6	570	342
harbours	164	5.9	3.5	966	573
information transmission	978	4.3	2.6	4.172	2.503
pipelines	7	6.0	3.6	42	23
WATER AND ENERGY SUPPLY					
water supply	419	6.0	3.6	2.514	1.466
natural gas supply	429	8.0	5.0	3.432	2.145
electricity supply	1.990	5.6	2.5	11.110	5.000
district heating	290	5.6	2.5	1.619	730
WATER CONTROL SYSTEMS					
water quantity control	132	{ 5.8	{ 3.5	{ 3.590	{ 2.166
water quality control	487	{	{	{	{
CITY STRUCTURE					
sewage treatment plants	460	7.9	4.6	3.640	2.116
industrial sites	51	6.0	3.6	306	183
waste disposal	15	6.0	3.6	90	60
LAND (RE)STRUCTURING					
new land reclamations	{ 370	{ 6.7	{ 4.0	{ 2.479	{ 1.480
land restructuring	{	{	{	{	{
Total	9.202			53.380	34.257

assessment of all figures is presented in Table 1.

Obviously, the figures on indirect employment are most difficult to obtain. They can be computed in principle by means of employment multipliers generated in the context of input-output analysis. However, an input-output matrix with this degree of sectoral detail is not available in the Netherlands. Therefore the indirect employment effects had to be estimated on the basis of raw data on the input structure of various segments of the construction sector.

Altogether, with a total investment in infrastructure of roughly 9.2 billion Dutch guilders, nearly 88.000 manyears were involved. This implies roughly that an extra investment of about 105.000 guilders in infrastructure would create one manyear of labour. It has to be admitted that the volume of labour created by infrastructure is relatively small compared to the total number

of unemployed (about 500.000 persons). Nevertheless, an increase of government expenditure in this direction would mean a welcome contribution to the decrease of unemployment. Clearly, such an increase of public investment may also have negative effects on employment in the private sector, however, because crowding out on the capital market may lead to a decrease of private investments, e.g. due to higher interest rates. One should also be aware that there may be an opposite effect of public investments on private investments, however, i.e., when spin-off effects occur. Such effects will be discussed in the next section.

4.3 Estimation of programme effects

In a case study approach we have used an employers survey. Employers in the basic sectors with 50 or more employees were interviewed about the influence of recently constructed infrastructure on the number of persons employed in their firms in three regions in the Netherlands (for details, refer to Bruinsma, 1990). A few difficulties appear to arise in using such a regional survey.

First it is hard if not impossible to make a distinction between distributive and generative effects. Are the observed effects the result of the growing internal strength, brought about by infrastructural investments? Or are these effects the consequence of a shift in employment from the surrounding areas as the result of a better competitiveness? Most employers tend to be unaware of such aspects.

Second, it is for employers difficult to distinguish the influence of a change in the infrastructure from the upgrading of the total regional economic production structure and environment.

Thirdly, in addition to jobs created as a consequence of infrastructure investments, one also has to take into account jobs which would have been lost if the infrastructure investments would not have been carried out (the policy-off situation). The size of the latter category is difficult to establish.

Fourth, no attention has been paid to household effects (e.g., better access to markets or information). For instance, when new recreation or shopping trips are generated, which lead to the development of employment in those sectors, such information is not included.

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We are aware of the limitations of the method used; the results presented here are put forward after careful interpretation of the data in the context of the specific region.

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It is of utmost importance that the entire context of regional development and the role that infrastructural improvements may play within this context, is clearly indicated before the employers are able to answer questions specifically dealing with those infrastructural improvements. So in the introductory part of the questionnaire the infrastructure was placed and described in the total regional context. The results of an analysis appeared to be in conformity with most outcomes suggested in the literature. The two factors which appear to be of decisive influence on the fluctuations in the number of employees are market perspectives and internal company considerations, like for instance automation. A second group of major influencing factors concerns: labour market, availability of industrial sites, new infrastructure and investment subsidies. So the infrastructural factors are well represented in this second group. The influence of other factors like the already existing infrastructure, contacts with the government and the image of the region appear to be marginal.

A slightly different pattern appears to exist when the reason to relocate the firm is brought to attention. Dominant factors are then the availability of industrial sites and market perspectives. Factors with a significant influence are the internal company factor, new infrastructure and investment subsidies. Rather striking is the fact that the main reason to relocate is for nearly 50 % of the relocated enterprises the inappropriateness of the old location; only 5 % of the enterprises had relocated mainly because of the suitability of the new location. Another rather striking result is the close connection with the former location. Over sixty percent of the enterprises relocated inside the same city boundary.

Although those figures are interesting from a general viewpoint of location theory of firms, in this case study the central focus concerns the spin-off effects ('programme effects') of specific infrastructural investments.

In general, it is plausible to assume that infrastructural improvements should result in a rather large improvement of the regional infrastructure complex (the synergy of all individual infrastructure components), before we may observe a spin-off effect that is sufficient significant to be measured. The survey therefore focussed on such infrastructural projects, like, for instance,

motorways, railways, regional airports and the replacement of old copper telecommunication networks by new optical fibre ones.

The employment spin-off effects of the railroad and regional airports appeared to be marginal due to the fact that those infrastructure elements are not in common use for any of the economic sectors.

The employment effects of highways appear to be substantial (see Figure 3). In Leiden, for instance, 27 % of the entrepreneurs indicated a positive employment development as a consequence of the improvement of the highways. In Brabant 11 % and Twente 22 % of the enterprises gained employment for this reason.

The effects of the optical fibre networks seem to be smaller (see Figure 4); however, in 1988 only 1 % of the Dutch telecommunication network was based on optical fibre.

To check whether those given figures were correct, a control question was built in. The employers were asked on their opinion about how the firm would have acted if the new infrastructure were not realized. In between other questions about firm size, the firms investments and the question whether the firm still would be relocated, the question was asked what the consequence would have been for the numbers of employees. The results of this question

Figure 3: Employment effects of new road infrastructure

Figure 4: Employment effects of new optical fibre telecommunication networks

(see Figures 5A-D) are quite consistent with the figures shown before. In this respect Leiden appears to score with 17 % a little bit lower than would be expected, and Twente somewhat higher with 26 %.

In both Leiden and Twente a relative high percentage of firms indicated that their firm size

Figure 5A-D: Effects if the infrastructure was not realized

would have been smaller without the new infrastructure. The effect on the investment level of firms appears to be substantial. Nearly 40 % of the firms in Leiden, 30 % of the firms in Twente and 20 % of the firms in Brabant expected lower company investments, if the infrastructure had not been realized. About 15 % of the relocated firms would not have been relocated.

The overall view from these figures is that the impact of new infrastructure in these regions on company behaviour is rather large, especially in the cases of Leiden and Twente.

Keeping the difficulties inherent to using a questionnaire study in mind, it is nevertheless possible to measure at least threshold or minimum effects, considering that a positive employment effect as reported by a firm means at least one new created job. For example, in Twente the construction of the highways A35 (Almelo-Hengelo) and A1 (Amsterdam-Osnabruck) had a minimum effect of 383 new jobs in the basic sector. Assuming a multiplier of 1.4 for the effect in the non-basic sector, the total minimum employment effect is then 536 jobs. The total investments in highway construction in Twente amounted to 346 million Dutch guilders. This means that an investment of 650.000 guilders generated one new job (note the difference between the temporal effect of 'one manyear of labour' and the more structural notion of 'job'). As indicated in Bruinsma (1990) the actual employment spin-off effect of the construction of those highways may actually be considerably higher, since these are only minimum estimates. Altogether the programme effects of infrastructure investments tend to be significant.

5. Conclusion

What general inferences can be drawn from this case study on the Netherlands?

The following factors were found to have a positive influence on the strength of the employment effects.

First, the region must possess a clear economic potential. On the labour market there should not only be a reserve quantity of labour, but it is also necessary that it contains a good quality of labour. There has to be also a good entrepreneurial spirit, while the political climate has to be in favour of economic development.

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Second, the new realized infrastructure has to serve the needs of all economic sectors. As a

consequence, spin-off effects can be expected by an expansion of the following infrastructure elements: road infrastructure, telecommunication networks, energy and water supply infrastructures. Energy and water supply infrastructures are basic infrastructure elements and normally already available, without any capacity constraint. It is not reasonable to assume that increasing investments in those networks will lead to substantial spin-off effects, unless these networks were absent.

The construction of highways or the replacement of the copper telecommunication cables by optical fibre networks on the other hand may result in substantial structural employment effects. Through those expansions, the whole infrastructure complex of the region may be upgraded.

Substantial employment effects were found in two situations. Employment effects appear to emerge when an essential but missing link in the infrastructure network was constructed or when the new investments led to a capacity increase in a clearly congested network. It has to be admitted, however that for the reasons mentioned in section 4.3 it is very difficult to measure the exact spin-off employment effects of the different infrastructure elements within regions.

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