NA-089

Data constructors and data users can co-operate: an illustrative case study

Jan Jacobs, Jan-Egbert Sturm and Peter Groote

The authors:
Jan Jacobs and Jan-Egbert Sturm, CCSO and Department of Economics, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands; Peter Groote, Department of Spatial Sciences, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands.

Earlier versions of this paper were presented at the IARIW 24th General Conference, 18-24 August 1996, Lillehammer, Norway and the ANU 1998 Economic History Series of the Australian National University, 13 November 1998, Canberra, Australia. The authors thank Theo Dijkstra, Simon Kuipers, Ludger Lindlar and Fieke van der Lecq for helpful discussions and comments, and Richard Paping and Vincent Tassenaar for assistance in putting the lists of prejudices together.

Division Presentation and Integration
Sector National Accounts

Statistics Netherlands

Voorburg/Heerlen, 1999

NA-089

Data constructors and data users can co-operate: an illustrative case study

Jan Jacobs, Jan-Egbert Sturm and Peter Groote

Kengetal: P-30/1999-1

ISSN: 1385-1845

Statistics Netherlands

Division Presentation and Integration
Sector National Accounts

Voorburg/Heerlen, 1999

Statistics Netherlands

Voorburg

Address:
Prinses Beatrixlaan 428

Postal address:
PO Box 4000
2270 JM Voorburg

Telephone 31 (0)70 337 38 00
Fax 31 (0)70 387 74 29

Heerlen

Address:
Kloosterweg 1

Postal address:
PO Box 4481
6401 CZ Heerlen

Telephone 31 (0)45 570 60 00
Fax 31 (0)45 572 74 40

Internet
http://www.cbs.nl

Information desks	*Telephone*	*Fax*	*E-mail*
Central information service	(045) 570 70 70	(045) 570 62 68	infoserv@cbs.nl
Special topics			
Labour and wages	(070) 337 58 50	(070) 337 59 94	infosec@cbs.nl
Population	(070) 337 58 30	(070) 337 59 87	infosbv@cbs.nl
Construction	(070) 337 42 41	(070) 337 59 75	infolbn@cbs.nl
Consumer price index (inflation)	(070) 337 58 09	(070) 337 59 94	infosec@cbs.nl
Culture, tourism and recreation	(070) 337 58 67	(070) 337 59 96	infokcr@cbs.nl
Manufacturing	(045) 570 76 17	(045) 570 62 77	infolin@cbs.nl
International Trade	(045) 570 79 17	(045) 570 66 75	infohih@cbs.nl
Agriculture	(070) 337 58 03	(070) 337 59 51	infollb@cbs.nl
Environment	(070) 337 58 96	(070) 337 59 76	infolmi@cbs.nl
Education	(070) 337 53 45	(070) 337 59 78	infosoz@cbs.nl
Government	(070) 337 58 99	(070) 337 59 80	infokov@cbs.nl
National Accounts	(070) 337 58 76	(070) 337 59 81	infopni@cbs.nl

Verklaring der tekens

.	= gegevens ontbreken
*	= voorlopig cijfer
x	= geheim
-	= nihil
-	= (indien voorkomend tussen twee getallen) tot en met
0 (00)	= het getal is minder dan de helft van de gekozen eenheid
niets (blank)	= een cijfer kan op logische gronden niet voorkomen
1996-1997	= 1996 tot en met 1997
1996/1997	= het gemiddelde over de jaren 1996 tot en met 1997
1996/'97	= oogstjaar boekjaar schooljaar enz. beginnend in 1996 en eindigend in 1997
1986/'87-1996/'97	= boekjaar enz. 1986/'87 tot en met 1996/'97

In geval van afronding kan het voorkomen dat de totalen niet geheel overeenstemmen met de som der opgetelde getallen.
Verbeterde cijfers in staten en tabellen zijn niet als zodanig gekenmerkt.

Explanation of symbols

	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
-	= nil
-	= (between two figures) inclusive
0 (00)	= less than half of unit employed
a blank	= category not applicable
1996-1997	= 1996 to 1997 inclusive
1996/1997	= average for the years 1996 up to and including 1997
1996/'97	= crop year financial year school year etc. beginning in 1996 and terminating in 1997
1986/'87-1996/'97	= book year etc. 1986/'87 up to and including 1996/'97

Detailed items in tables do not necessarily add to totals because of rounding.
Revised figures are not marked as such.

How and where to order

Obtainable from Statistics Netherlands,
Sales Department
PO Box 4481
6401 CZ Heerlen, The Netherlands.
Telephone: 31 45 570 79 70
Fax: 31 45 570 62 68
E-mail: verkoop@cbs.nl
Price: dfl 20.00
VAT incl. (Postage will be charged)

Abstract

Apparently, data users and data constructors live in separate worlds. There exists a Chinese wall between the two groups that should be torn down, to the benefit of all. This paper illustrates the benefits of communication and co-operation between data using macroeconomists and data constructing historians by describing a joint research project on the effects of infrastructure investment on the economy in the Netherlands in the second half of the nineteenth century.

Keywords: data mining, infrastructure investment, vector autoregression
JEL Classification No.: C32, C82, E22, N13

Table of Contents

1. Introduction

A few years ago Angus Maddison, a distinguished economic historian, read a paper on long-run developments in productivity in different countries. One of us attended the lecture and was completely baffled when he overheard Maddison proudly referring to his own work as data mining: researchers searching through huge archives to dig "gold", to collect long time series of data. Econometricians, however, have another notion of data mining: data mining is something everyone does but no one dares to admit. Data are exposed to lots of regressions until a relation is found that does not reject the original hypothesis. This equation is then reported in the final paper, without mentioning the long struggle that was necessary to reach this outcome. One expression meaning completely different things in two branches of economics, positive for data constructors in, for example, economic history, and negative for data users in applied econometric research - henceforth also referred to as data polishers or data mincers: can the difference be larger?

Apparently, a Chinese wall exists between data constructors and data mincers. They do not read each others papers. They attend different conferences. They practically do not mix, not even socially. Lots of prejudices exist between the groups. We believe that this Chinese wall should be torn down, to the benefit of both groups. With a case study example we hope to show that co-operation can be fruitful and may lead to new insights.

Co-operation is required for several reasons, and has only become more pressing in recent times. Macroeconomics has changed in the course of years: quantitative theory has come to dominate macroeconomic theory. Whereas in an old-fashioned theoretical macroeconomic paper properties of economic models are derived without studying data, the typical quantitative paper nowadays includes a comparison of model predictions with data properties.

A new dataset triggers a flood of papers that make contrary claims about economic theories employing slightly different specifications, leaving out some crucial data points, or exploiting yet another sophisticated econometric technique. "Give us some time series and a conclusion: we'll do the rest" appears a highly exaggerated summary of this practise, but not far beyond the truth (cf. Dijkstra, 1995). This is not our idea of scientific progress, though.

Blaug (1992, p245-246) repeats a few suggestions of Mayer (1980) on how to make economics a hard science. Two of the suggestions support our main point. First, data mincers should seek to replicate previous results using a different data set. Confidence in relations increases when reproduced with other data sets, for different countries, or for different periods. Secondly, other ways of testing and explanation, such as appeal to economic history, should not be treated as archaic. In our illustrative example below we do both. We try to reproduce Aschauer's (1989a) strong claims on the post-World War II productivity effects of infrastructure investment in the US for the Netherlands in the second half of the nineteenth century. And we employ David's (1985, 1990) ideas on large technical systems to explain the behaviour of our three-equation vector autoregressive system.

When historical data are used to study relations between variables, co-operation between data constructors and data mincers is indispensable. Knowledge on the institutional background must supplement technical data analysis skills. Data mincers are not aware of the details of the historical period under review and the precise content of the variables. Outliers can be identified with statistical methods, but cannot be linked to events. Data constructors gained profound historical knowledge in collecting their data, and know all ins and outs of the variables. In general, however, they are not equipped with the technical background to perform data-oriented analyses.

Taking the data constructor on board enables data users to perform operations that would otherwise not be possible. Normally, applied econometricians have to take data as given, and cannot disaggregate data in a sensible way. A data constructor, however, can dive in his data spreadsheets to reorganise his raw data. Below we will use this feature and decompose infrastructure in basic and complementary components, which will lead to increased insight and more robust conclusions.

The rest of the paper is organised as follows. Section 2 summarises some popular and persistent myths - or truths? - that exemplify the gap between data constructors and data mincers. Section 3 spells out our ideas on co-operation between data constructors and mincers. Section 4 illustrates our claim by recapitulating our analysis into the effects of infrastructure investment on production in the Netherlands in the second half of the nineteenth century. Section 5 concludes.

2. Common prejudices

For the sake of clarity we bring, without comments, some popular prejudices of economists about historians and *vice versa*, in a rather simplified manner. As such, "economists" are portrayed as typical data mincers and "historians" as typical data collectors. Of course, the critiques apply to other categories of data mincers and data collectors as well.

Data collectors' critique on data users:

- Economists are not interested in data, but in degrees of freedom.
- Economists are mainly interested in their own and each other's models, less in the world as it is, and not at all in the world as it once was.
- Economists are interested in building models, not in using them.
- Economists use data for purposes that the data were not constructed for in the first place; economists compare and combine data series that are based on different source material.
- Whereas historians emphasise caesurae in the time series, economists assume equilibrium.
- Economists presuppose that if a specific phenomenon cannot be shown by the data, it is not of interest; historians take it that the data are incorrect if they do not show a phenomenon that is assumed to have been of interest.
- Historians are searching for the world as it has been in reality, economists are interested in the world as it might have been.
- Historical data are used by economists to answer questions that historians are not interested in anyway.
- The margins of error that data mincers give, are based on the ridiculous assumption that the underlying data series is 100% errorfree.

Data polishers' critique on data constructors:

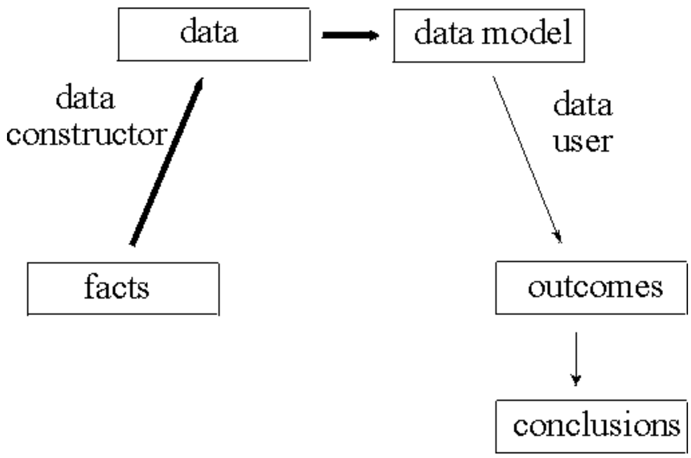
- Data constructors stop when things get interesting.
- Data constructors know their data too well; they do not trust data mincers to draw any conclusions from them.
- Data constructors never succeed in producing definite data; either disputes abound, or data constructors only provide provisional data.
- Data constructors are not interested in the data themselves, but in the stories surrounding them; ever seen a booklet on economic history?
- Data constructors spoil their degrees of freedom in obtaining reliable data.
- Data constructors are not interested in backward consistency, at least not far enough for time series analysis proper.
- Reliable data never come in time; as Charles Feinstein[1] once put it: reliable data are not new, and new data are not reliable.
- Data constructors believe in reality and in historical facts; data polishers accept that reality does not exist.
- To summarise: ever tried to obtain the simple series you want from a statistical agency?

[1] In a presentation at the University of Groningen, March 15, 1996.

3. Co-operation

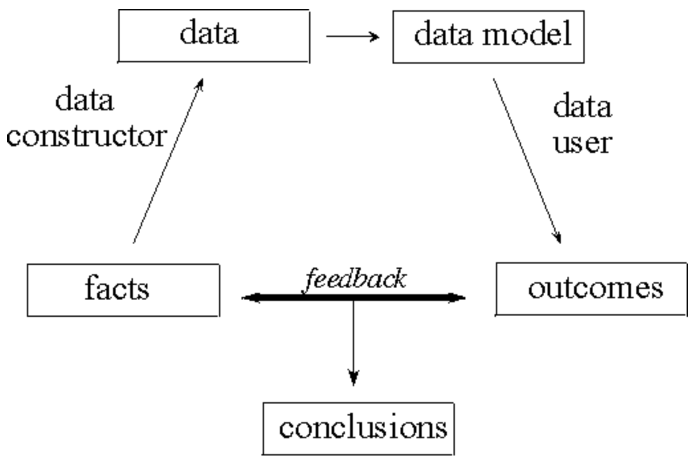
A second way to demonstrate that there exists a wall between data users and data constructors is by elaborating on Figure 1. The figure illustrates our views on current econometric practice in general, and applied time series analysis in particular.

Figure 1 *The way it is*



On the left side the work of the data constructor is depicted. He translates real world economic events into data. Then the data polisher takes over. He puts the data in a data model and generates outcomes on the basis of which final conclusions are reached. The existence of a Chinese wall will be clear now: after having constructed the data, the data constructor throws his data over the wall and the data user starts to work without communicating ever again with the data constructor.

Figure 2 *The way it should be*



It is evident that there should be feedback between data constructors and data polishers. Figure 2 gives an illustration. The outcomes of the econometrical analysis are confronted with the real world, that is with the facts that lie behind the data. After all, the data only summarise the real world and by definition cannot capture everything. For instance, sometimes outcomes seem weird in the eyes of the data user, whereas the data constructor can easily explain where the differences with the theoretical model the data user has in mind come from. Therefore, to be sure that correct conclusions are drawn from the analysis this confrontation or feedback is necessary. It prevents us from drawing wrong conclusions, based on biased economic ideas of the data user.

There are two ways to achieve this feedback. The hard way is for one person to carry out the whole analysis, *i.e.*, to construct and analyse his own data. In our opinion this has become an almost impossible task. The disciplines of *e.g.*, econometrics and economic history are very specialised nowadays. To be an expert in both fields is virtually impossible. This is exemplified in the still elitist character of *e.g.*, cliometrics. The easy way is to combine the strengths of both parties and conduct joint research projects. That is what we have done. We will try to show its merits in the next section.

4. Illustration: effects of infrastructure investment on production in the Netherlands (1850-1913)

By exploring a case study example we will elaborate on our belief that data constructors and data mincers should more often combine their strengths. In this research project, we investigate the output effects of infrastructure investment in the Netherlands during the second half of the 19th century. This section draws heavily upon Sturm *et al.* (1999) and Groote *et al.* (1995, 1998).

Recent years have witnessed a remarkable swell of interest in infrastructure spending as a strategy to promote economic development. Whereas specialists in regional and local economic development have long recognised infrastructure spending as a possible vehicle of growth, the genesis of this renewed attention is David Aschauer's (1989a) research on the impact of public investment on private sector productivity. His empirical findings are strong: over the 1949 to 1985 period, a 1 percent increase in the public capital stock raised the level of output by almost 0.4 percent. Unlike previous regional/metropolitan studies, Aschauer's results imply that public capital is productive and not just a possible inducement to business location. However, his results are not without criticism. For a review of the issues that are at stake, see *e.g.*, Gramlich (1994) and Sturm (1998). Here we use a completely new dataset on another era and apply a more data-oriented research methodology to shed light on these issues.

Implicit in Aschauer's study is that public investment concerns mainly infrastructure. In the studies on the post-World War II period enormous differences exist in the definition of infrastructure. For example, most economists recognise that the private sector might also invest in infrastructure. However, data limitations impose researchers to continue their attention to public investment spending, or parts of it, depending on data availability. One of the benefits of joining hands with a data constructor makes this problem disappear. Groote's (1995) database is built up from the micro level, starting from individual companies' accounts, government reports and archival records, enabling us to use whatever definition of infrastructure that is theoretically justifiable. We have chosen to define infrastructure as equivalent to the categories "other construction" and "land improvement" in the *System of National Accounts* (1968, p.114). It consists of 18 sectors in the fields of transport, telecommunications, utilities, and water management. Only the truly infrastructural aspects of these sectors are included. Thus, the permanent way and works of railways are included, but rolling stock is not.

In order to test whether or not certain elements of infrastructure have larger effects on output than other, we will split up our infrastructure variable into two parts. The first part, which we will call *basic* infrastructure, consists of those sectors that exhibit (nearly) all of the elementary characteristics of infrastructure (public character and fundamental importance for other economic sectors; non-tradable and lumpy character of investments; technical and spatial indivisibilities). These sectors are: main railways, roads, canals, harbours and docks, the electromagnetic telegraph, drainage, dikes, and land reclamation. The second part, which we labelled *complementary* infrastructure, has enough of these characteristics to label it as infrastructure, but not all, or not as intense as basic infrastructural sectors: light railways, (urban) tramways, gas, electricity, and water supply, (local) telephone networks. Of course this division in basic and complementary infrastructure is time-dependent and somewhat arbitrarily. For example, whereas we regard electricity as complementary infrastructure in our sample, this became of fundamental importance to the economy in the twentieth century, and must be labelled basic infrastructure nowadays. However, historians, *i.e.* experts on the institutional and historical setting, will not deny that mainly railways and shipping canals (including harbours) belong to the basic infrastructure in the period under study.

Apart from infrastructure and gross domestic output we include machinery investment in our investigation. For the series on output we refer to Buyst *et al.* (1995), for the series on investment in machinery and equipment to Clemens *et al.* (1996). All series are outcomes of joint research efforts of participants in a project on *The Reconstruction of Dutch National Accounts 1800-1940*, which has been under way since 1989 at the universities of Utrecht, Groningen, and Amsterdam (see Van Ark, 1995).

We adopt the "a-theoretical" VAR approach advocated by Sims (1980) to perform Granger-causality tests. To make our main hypothesis testable, we restate it as follows: infrastructural capital formation is said to "Granger-cause" output, if the time series prediction of output from its own past improves when lags of infrastructural capital formation are added to the equation. The VAR analysis reveals that this is definitely the case, and this causality is unidirectional, meaning that past output does not improve the infrastructure investment equation. Furthermore, splitting up infrastructure in *basic* and *complementary* infrastructure allows us to conclude that - as expected - mainly basic infrastructure is responsible for this effect. A striking observation from the machinery equation is that no relationship seems to exist between machinery investment and (basic) infrastructural investment[2]. This finding contradicts the conclusion that infrastructure positively influences output indirectly through machinery outlays, a conclusion often stated and empirically verified in the literature on the post-World War II period (see *e.g.*, Aschauer, 1989b, and Erenburg, 1993).

The econometric techniques we apply rely heavily upon the time series properties of our data. For example, the asymptotic distributions of causality tests which can be implemented in a VAR analysis are sensitive to unit roots and time trends in the data series. To determine whether our series are stationary, we use the Augmented Dickey Fuller test. We find that all series of interest are trend stationary, implying that we can build our model in levels by including a trend.

In basic VAR analysis it is not possible to use the estimated coefficients to make direct statements about the size of the estimated effects. Sims (1980) proposed to work around this problem, and to analyse a VAR model by observing the reactions over time of different shocks on the estimated system. To that purpose the autoregressive process has to be rewritten in its moving average representation to obtain the impulse response functions.[3] As depicted in the upper part of Figure 3, the response of output to a shock in infrastructure investment peaks after six years. However, the time pattern of the response of output to a shock in infrastructure does not gradually build up to this peak. At first the response is positive, although not very substantial. Then it gradually diminishes to come close to zero after the second year. Next it regains momentum again, to peak after six years. Thereafter the response dies out gradually. Unfortunately, we can only speculate on the plausibility and underlying reasons of this peculiar time pattern and make our hypothesis as convincing as possible by transparent reasoning and comparison with stylised facts from the historical literature. This is where the expertise of the data constructor is of eminent importance again. He is not only familiar with the data series, but also with the period at stake and with the techniques of historical analysis.

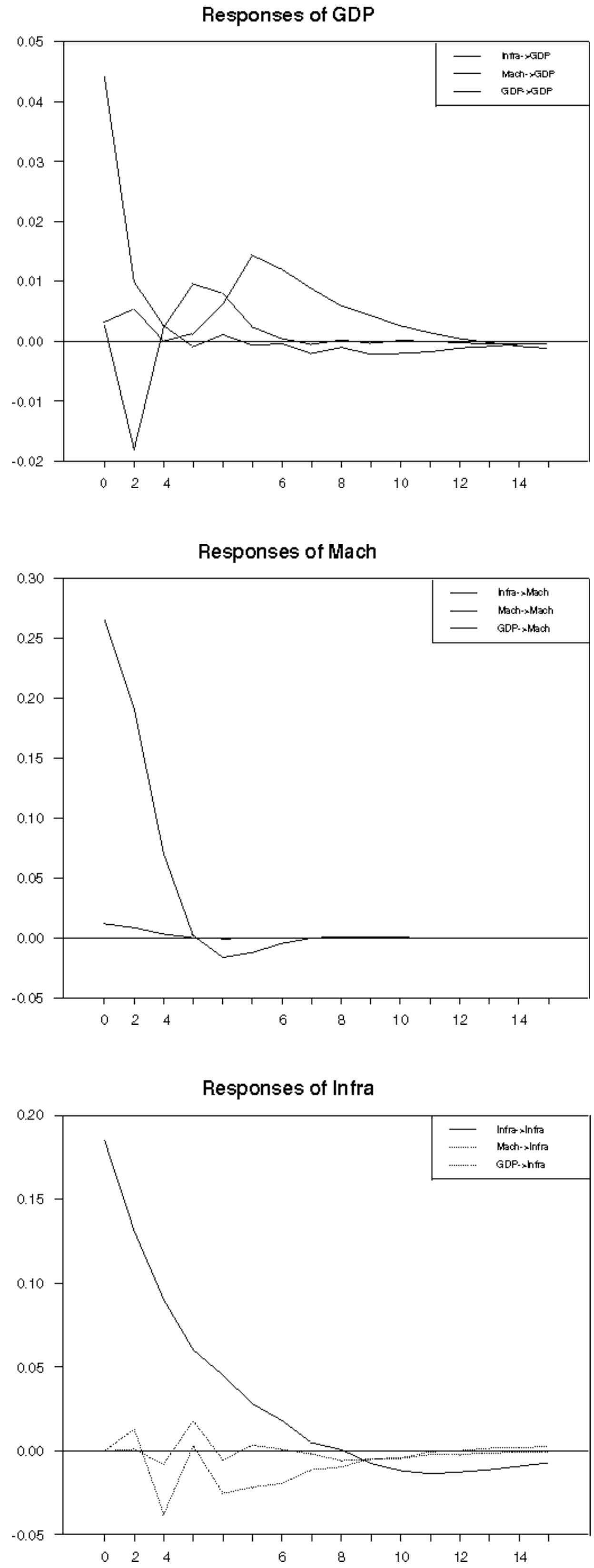
Our supposition is that the time pattern of the response curve may be seen as the resultant of three underlying processes, which are all known from the literature and which we will subsequently shortly elaborate on, namely: positive forward linkages, positive backward linkages and negative transitional dynamics.

---

2 There exists a small *negative* relationship from complementary infrastructure towards machinery investment.

3 We assume a causal ordening with output and infrastructure as most endogenous and most exogenous respectively. See Sturm, Jacobs and Groote (1995) for details.

Figure 3 *Responses of various shocks on the model with total infrastructure investments*



With positive forward linkages we refer to the cost reductions in the sectors using the infrastructural services as an input in their production process. It is mainly these long-run effects that are the subject of most post-World War II research, see *e.g.*, Aschauer (1989a). Our research project shows that these forward linkages can be attributed to only a few types of infrastructure. By splitting up infrastructure into - what we called - basic infrastructure and complementary infrastructure we are able to demonstrate that hardly any long-run effects on output existed when a shock is conducted on complementary infrastructure, whereas a shock on basic infrastructure had a long-lasting effect on output in the previous century. Again, the expertise of the data collector is a necessary input in the process of econometric analysis.

Positive backward linkages, which are surprisingly hardly broached in the above-mentioned studies, cover the short-run expenditure effects. Since the construction of infrastructure itself is an economic activity, it stimulates the demand for *e.g.*, labour, raw materials, other capital goods, entrepreneurship, technology, and institutions. This will generate additional income that circulates through the economy for some time. In particular complementary infrastructure engenders these short-run effects.

Finally, the third underlying process contains the costs of adapting the economic system to changes in its fundamental characteristics. Infrastructure is by definition of fundamental importance to the rest of the economy. Therefore, infrastructural investments cause changes in the basic economic system that economic agents need time and money to adapt to. On several occasions Paul David has elaborated on this (see e.g., David, 1985, 1990). For the period under consideration a good example might be the transformation of an economy mainly based on waterways shipping towards on economy in which traffic by rail takes a dominant place. It is the young, relatively small sectors that most easily overcome transitional problems. Older industries, which are firmly rooted in the preceding "large technical system", will need more time. As these more inert industries normally have a larger share in output, this will further delay the showing up of any productivity effects in aggregate economic indicators.

Before ending this section we will elaborate on one issue we boldly omitted in the description of our joint research project: our finding that the time series under consideration are trend-stationary.[4] This is in itself a remarkable result. Post-World War II economic time series are almost without exception nonstationary (integrated mostly of order one), and necessitate first-differencing or the use of complex cointegration techniques. Nelson and Plosser (1982) conclude that most post-World War II macroeconomic variables are difference-stationary, implying that a temporary shock has permanent effects. It is generally held that longer time series, *i.e.* covering a longer span, do not affect this conclusion, see for example De Haan and Zelhorst (1995).

Our results for the second half of the nineteenth century, however, clearly indicate that gross domestic product is trend-stationary. At first sight, the trend stationarity character of our series facilitates the mathematics. Unfortunately, trend stationarity also implies that changes in one variable cannot have a permanent effect on the other variables, because by definition all series ultimately return to their long-run trend paths. Therefore the fact that our series are trend-stationarity is not only rather puzzling but also frustrates long-run effects of infrastructure investment, *i.e.* shocks on a trend-stationary variable cannot have permanent effects. For this reason we limit our attention to modelling the medium- and short-run effects.

[4] Time series over the nineteenth century for the United Kingdom prove to be trend stationary as well (see *e.g.*, Feinstein, 1972, 1988).

5. Concluding remarks

Data constructors and data users should co-operate. The previous section illustrated that both parties benefit from working together. A novel historical data set was subjected to sophisticated econometric techniques to conclude that infrastructure investment positively influenced production in the Netherlands in the second half of the nineteenth century. At least three positive externalities resulted from the feedback between data constructors and data users in our illustrative example. Firstly, outcomes of impulse responses could be interpreted by means of sound economic-historical reasoning. Secondly, the possibility of disaggregating infrastructure investment data allows the data mincers to double-check the outcomes of the Granger-causality tests, which led to more robust conclusions. Thirdly, employing knowledge acquired in the construction of his data set, the data constructor could easily label the typical trend-stationary character of the time series a general property of economic time series in the second half of the nineteenth century.

In the Tinbergen debate following the publication of Tinbergen (1939a, 1939b) Keynes (1939) asked whether relations between macroeconomic variables could be treated as stable in time. In our analysis of the effects of infrastructure investment in the Netherlands we ran into a related problem. Most post-World War II macroeconomic variables are difference-stationary, implying that a temporary shock has permanent effects. Our results for the second half of the nineteenth century, however, clearly indicate that gross domestic product in the Netherlands is trend-stationary. This result is puzzling and frustrates long-run effects of infrastructure investment, because shocks on a trend-stationary variable cannot have permanent effects. We conjecture that the character of output has changed over the last one and a half century, possibly caused by infrastructure investment. Further research is necessary to support our claim.

In the publish-or-perish struggle of our days construction and exploitation of new data sets is very important, but not very rewarding due to its time consuming character. Co-operation between data constructors and applied econometricians is essential in this respect, and can lead to interesting results and important new insights. A removal of the Chinese wall between them enables data constructors and data mincers to further and more fruitfully harvest their own lands, while at the same time manuring the other's lands.

References

Ark, B. van (1995), "Towards European historical national accounts", *Scandinavian Economic History Review*, **XLIII**(1), 3-16.

Aschauer, D.A. (1989a), "Is public expenditure productive?", *Journal of Monetary Economics*, **23**, 177-200.

Aschauer, D.A. (1989b), "Does public capital crowd out private capital?", *Journal of Monetary Economics*, **24**, 171-188.

Blaug, M. (1992), *The methodology of economics; or how economists explain*, Cambridge surveys of economic literature, 2nd edition, Cambridge University Press, Cambridge.

Buyst, E., J.P.H. Smits and J.L. van Zanden (1995), "National accounts for the Low Countries, 1800-1990", *Scandinavian Economic History Review*, **43**(1), 53-76.

Clemens, A., P.D. Groote, and R. Albers (1996), "The contribution of physical and human capital to economic growth in the Netherlands, 1850-1913", *Economic and Social History in the Netherlands*, **7**, 181-198.

David, P.A. (1985), "Clio and the economics of QWERTY", *American Economic Review*, **75**, 332-337.

David, P.A. (1990), "The dynamo and the computer: an historical perspective on the modern productivity paradox", *American Economic Review*, **80**, 355-361.

Dijkstra, T.K. (1995), "Pyrrho's lemma, or have it your way", *Metrica*, **42**, 119-225.

Erenburg, S.J. (1993), "The real effects of public investment on private investment", *Applied Economics*, **25**, 831-837.

Feinstein, C.H. (1972), *National income, expenditure, and output of the United Kingdom, 1855-1965*, Cambridge University Press, Cambridge.

Feinstein, C.H. (1988), "National statistics, 1760-1920, sources and methods of estimation for domestic reproducible fixed assets and work in progress, overseas assets, and land", in C.H. Feinstein and S. Pollard, editors, *Studies in capital formation in the United Kingdom, 1750-1920*, Clarendon Press, Oxford, 258-471.

Gramlich, E.M. (1994), "Infrastructure investment: a review essay", *Journal of Economic Literature*, **32**, 1176-1196.

Groote, Peter, Jan Jacobs and Jan-Egbert Sturm (1995), "Output responses to infrastructure investment in The Netherlands 1853-1913", *Research Memorandum* GD-24, Groningen Growth and Development Centre, Groningen.

Groote, Peter, Jan Jacobs and Jan-Egbert Sturm (1999), "Output effects of Dutch transport infrastructure", *Journal of Economic and Social Geography* [forthcoming].

Groote, P.D. (1995), *Kapitaalvorming in infrastructuur in Nederland, 1800-1913*, PhD thesis, Rijksuniversiteit Groningen, Groningen.

Keynes, J.M. (1939), "Professor Tinbergen's method", *Economic Journal*, **49**, 558-568.

Mayer, T. (1980), "Economics as a hard science: realistic goal or wishful thinking", *Economic Inquiry*, **XVIII**, 165-178.

Nelson, C.R. and C.I. Plosser (1982), "Trends and random walks in macroeconomic time series: Some evidence and implications", *Journal of Monetary Economics*, **10**, 139-167.

Sims, C.A. (1980), "Macroeconomics and reality", *Econometrica*, **48**(1), 1-48.

Sturm, Jan-Egbert (1998), *Public capital expenditure in OECD countries: the causes and impact of the decline in public capital spending*, Edward Elgar Publishing, Cheltenham.

Sturm, Jan-Egbert, Jan Jacobs and Peter Groote (1999), "Output effects of infrastructure investment in the Netherlands 1853-1913", *Journal of Macroeconomics*, **22**(2) [forthcoming].

System of National Accounts, revision 3, United Nations, New York.

Tinbergen, J. (1939a), *Statistical testing of business cycle theories: a method and its application to investment activity*, volume I, League of Nations, Geneva.

Tinbergen, J. (1939b), *Statistical testing of business cycle theories: business cycles in the United States of America 1919-1932*, volume II, League of Nations, Geneva.

Zelhorst, D. and J. de Haan (1995), "The nonstationarity of aggregate output: some additional international evidence", *Journal of Money, Credit, and Banking*, **26**(1), 23-33.

Related publications (translated)

National accounts (incl. diskette)	P-2	ƒ 75,00
The Dutch Economy	P-19	ƒ 32,50
Social security, pension insurance, life insurance	P-6	ƒ 15,00
Quarterly accounts (subscription)	P-14	ƒ 49,50
Quarterly accounts on diskette (subscription)		ƒ150,00
Business Cycle report, monthly annex to the Statistical Bulletin Subscription Statistical Bulletin	A-1	ƒ125,00
Regional economic annual data	P-11	ƒ 67,50
Methods and research		ƒ 10,00

All these publications are in Dutch only, except for the Quarterly accounts on diskette and the National accounts

A large number of the above mentioned publications can be consulted in the libraries of Statistics Netherlands at Voorburg (direct line +31 70 337 5151) or Heerlen (direct line +31 45 570 71 87).

List of occasional papers

The list below will give an impression of the subjects covered in previously published Occasional papers. A complete list of all available Occasional papers can be obtained from the National accounts information desk (telephone 31 70 337 58 76; fax 31 70 337 59 81; e-mail infopni@cbs.nl). The price of a single issue comes to Dfl. 20.00. For an annual subscription of at least six issues the costs amount to Dfl. 100.00.

NA/82 **Micro-meso-macro linkage for labour in The Netherlands, Leunis, Wim P. and Jolanda G. Timmerman (1996).**
This paper describes recent developments in the area of labour market statistics and shows the advantages of integrating these data in the system of Labour accounts and in Social Accounting Matrices. The benefits of such integrated information surpasses the sum of the benefits of various source data. A subsequent effort to adjust the micro data and aggregate figures increases the possible uses of statistics even further.

NA/83 **The interaction between national accounts and socio-economic policy, Keuning, Steven J. (1996).**
This paper addresses the interaction between national accounts and socio-economic policy formulation. In the Netherlands, this interaction mainly occurs through the widespread application of formal economic modelling. Lately, however, the domestic use of national accounts figures swells because of their growing relevance to policy-making and because the Netherlands' national accounts incorporate all kinds of social and environmental data.

NA/84 **The future of the national accounts, Bos, Frits (1996).**
This paper investigates the consequences of globalisation, European unification, automation and more market-oriented government for the national accounts as a central international overview-statistic on national economies. The perspective on the future is a mixture of exploiting present and new potentials and coping well with dangers.

NA/85 **Accounting for the use of financial capital as an input in production; with an application to multi-factor productivity change estimation, Keuning, Steven J. and Ted Reininga (1997).**
It is increasingly acknowledged that the financial structure of a firm is an important determinant of its economic activity. Therefore, the use of financial capital should be seen as a separate input in the production process. This paper attempts to operationalise a meso-economic measurement of financial capital inputs in production and shows the consequences for the estimation of multi-factor productivity change. This approach establishes a much closer relationship of macro-economic accounting and analysis to business economics

NA/86 **Volume measurement of government output; the Dutch practice since revision 1987, Kazemier, Brugt (1997).**
In 1992, Statistics Netherlands published the first results of a major revision of national accounts statistics. Part of this revision was the introduction of an alternative method to estimate the volume change of government output. This paper briefly describes this alternative method and the results of the revision with respect to the volume change of government services.

NA/87 **Chain indices in the national accounts: the Dutch experience, Boer, Sake de, Jan van Dalen and Piet Verbiest (1997).**
In this paper we discuss the use of chain indices in the Netherlands. In Dutch practice chain indices are applied from 1980 onwards. Chain indices are a good base for the construction of economic models, since changing weights guarantee a near approximation of actual developments and the actual economic structure. However, special attention should be paid to the tuning of the model to the characteristics of the data and to the presentation of model results to the public.

NA/88 **Measurement and valuation of natural gas and oil reserves in the Netherlands, Pommée, Marcel (1998).**
This paper discusses some conceptual and methodological issues related to the estimation of reserves of natural gas and oil. The first section focuses on these subsoil assets in relation to the 1993 SNA. The second section deals with the situation and valuation of these assets in the Netherlands. The valuation method applied may be of special interest because of its simplicity and modest data requirements.