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Accounting for the use of financial capital as an input in production

Steven J. Keuning and Ted Reininga

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with an application to multi-factor productivity change estimation

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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

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Explanation of symbols

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*	= 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

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Abstract

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 input consists of the use of liabilities and net worth, while the input of non-financial capital is limited to the value that is used up during the reference period. The paper elaborates on these ideas and their operationalization in empirical work.

Next, an application to the estimation of multi-factor productivity change is described for some industry clusters in the Netherlands. The required compilation of balance sheets by industry is concisely documented. In some cases, applying the new definition of capital input yields results that are quite different from the conventional productivity growth estimates. Anyhow, the approach set out in this paper establishes a much closer relationship of macro-economic accounting and analysis to business economics.

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1. Introduction

Modern theories of economic growth emphasise the importance of the contribution of intangible capital accumulation to output volume increase. In the 1993 System of National Accounts (SNA), which gives the most recent, internationally agreed definitions of all macro-economic concepts, this focus on intangible capital is reflected in a more extensive classification of assets than in the 1968 SNA (cf. United Nations et al, 1993 and United Nations, 1968). For instance, fixed assets now include intangible assets such as computer software, literary originals and mineral exploration. After some discussion, it was decided that expenses for research and development should not be booked as capital formation in the standard national accounts (cf. e.g. Bos, Hollanders and Keuning, 1994).

In addition, the endogenous growth theory points to the role of human capital, and the diffusion of knowledge between firms, industries and countries. However, notwithstanding the important role played by human capital and such, it should be pointed out that both conventional and modern growth theories still disregard the contribution of financial capital as a crucial, separate input into production processes.

Naturally, this denial of a separate role for financial capital inputs is in conformity with the neo-classical model of perfect financial markets (as represented in the Modigliani/Miller theorem). It is increasingly acknowledged, however, that in practice the financial structure of the firm is an important determinant of its economic activity (e.g. Gertler, 1988). In any case, transactions money is needed for working capital requirements and many producers are faced with constraints on borrowing, for instance in the absence of sufficient collateral. Moreover, on the one hand many firms do not have access to equity capital, while on the other hand bank loans are highly non-marketable, and cannot be seen as perfect substitutes for equity. Finally, various studies point to the imperfect substitutability of financial claims to productive assets in different countries (e.g. Bovenberg and Goulder, 1991).

By now, the influence of imperfect capital markets on investment decisions has been substantiated empirically in various studies (e.g. van Ees et al., 1996). However, if that is the case, the use of financial assets should also be seen as a separate input in the production function. This is elaborated in the next section of this paper, according to the ideas that have already been set out earlier by Keuning (1995a). Section 3 then applies this idea to the estimation of multi-factor productivity change in various Dutch industries. The results are compared with the conventional multi-factor productivity change estimates. It is demonstrated that the incorporation of financial inputs in productivity calculations indeed throws a new light on inter-industry variations in productivity growth. This may pave the way for similar studies on international or inter-firm differences in productivity change. The final section summarises our results and draws some conclusions for further work.

2. A new operationalization of capital input in production

Traditionally, capital input has been equated with the use of *tangible* assets, such as land, machinery and buildings. Concomitantly, the physical contribution of capital to output has been emphasised. This study takes the economic *cost* of capital inputs as a point of departure. Cost is what matters in the real world, both to the users of capital services and to the suppliers, as it represents their remuneration. Only when it is known what kind of payments or reservations have actually been made in connection with the use of capital, the underlying volumes and prices of these transactions or reservations can be disentangled. Besides, such a procedure ensures consistency with the exchange value approach that is followed in every economy-wide analysis.

Ex post, the cost of capital inputs at the industry level is embodied in the gross operating surplus/mixed income generated by the industries concerned. In fact, if the (imputed) cost of self-employed labour input is isolated from this balancing item, an estimate for the 'pure' capital input cost by industry remains. The next question is: what kind of capital inputs have been remunerated from this 'residual'?

Three main categories of capital can be distinguished (cf. Annex V.D of the 1993 SNA):

1. produced assets, consisting of fixed assets (e.g. buildings, machinery and software), inventories and valuables;
2. non-produced, non-financial assets, such as land, subsoil assets, patented entities and purchased goodwill; and
3. financial assets/liabilities, such as currency, deposits, securities and loans.[1]

At present, mainstream economic theory and empirical research do not distinguish financial capital as a separate factor of production. Instead, productivity analyses and production functions define the capital input volume as the constant price value of the stock of, or services from, non-financial (fixed) assets.[2] It is then implicitly assumed:

1. that the funds used in production are fully embodied in (fixed) non-financial assets, and
2. that the price change for the use of these funds depends on the price change of the non-financial (fixed) assets utilised in production, and *not* on the price change for the use of the liabilities (and net worth) of which these funds consist.

The former assumption disregards the important role played by working capital, notably in trade and other services production. However, before someone can start producing, a fund must be available to pay for the intermediate inputs, the cost-of-living of the producer, etc. The use of this fund, which amounts to abstaining from consumption, obviously fetches a price. The latter assumption overlooks the fact that the owners of the liabilities and net worth are paid, not the assets. These payments for the use of liabilities and net worth make up the bulk of the firm's capital costs and thus it is the price (change) of this use that really matters. This is easily demonstrated for the case of a loan, which is basically an asset that is hired at a predetermined price. If a large proportion of the liabilities-side of a firm's balance sheet consists of short-term loans, an increase in the

[1] Below, this third category will also be called financial capital.

[2] Refer to e.g. Baumol et al. [1989], Englander and Mittelstädt [1988], Hulten [1990], Jorgenson [1990], Maddison [1987], Rymes [1983] and Scott [1993]. Examples of attempts to distinguish financial capital as a separate factor of production can be found in Hasan and Mahmud [1993], Stiglitz [1992] and Yeager [1979].

(short-term) interest rate implies a significant rise in production costs, regardless of the types of non-financial (fixed) assets used in the production process. This rise in costs is *not* faced by a firm with the *same* kind of non-financial assets in the *same* industry which is financed by e.g. long-term loans that do not expire in the immediate future.

In addition, even though the price for the use of share capital and the like is not fixed *ex ante,* these funds are continuously seeking for a use with the highest expected remuneration. Take a situation where profits are expected to rise while the interest rate does not change. If under these circumstances two firms are equal except for the composition of their balance sheet, the firm that is financed to a larger extent by equity capital must realise a higher rise in operating surplus in order to offer the same rate of return growth to the investor. Again, it is the difference in the composition of the balance sheet that determines the relative rise in production costs of either firm.

On the other hand, suppose that over the year the replacement value of a fixed asset owned by the producer changes. This price change is only relevant to the difference in market value of that asset at the beginning and at the end of the year. That is the only real cost to the producer during the reference year. For, at any time, almost every fixed asset can be sold, and leased back if so required. In other words, the capital fund is not sunk in the fixed assets, but in the underlying liabilities and net worth.[3]

The first conclusion is that *for financial capital it is economically more relevant under which conditions it is used (as shown on the liabilities side of the balance sheet; cf. loans versus shares) than how it is used (e.g. for purchasing intermediate inputs or for fixed capital formation).*

The second conclusion is that *not the worth of non-financial assets, but only their (gradual) consumption is an input in the production process*. For a further operationalization of this input, a distinction should be made between fixed assets, inventories, and non-produced, non-financial assets.[4]

The input cost of using up fixed assets equals the gross reduction (i.e. excluding gross capital formation) in the *actual* market value of the stock of these assets during the reference year, except for catastrophic losses (cf. section XII.A.6 of the 1993 SNA).[5] This is not very different from the concept of fixed capital consumption in the 1993 SNA.[6] This also applies to the decomposition of value changes into price and volume changes.

The *input cost of using up inventories* equals the reduction in the market value of the stock during the reference year. For *materials and supplies* the gross reduction in inventories is incorporated in intermediate input costs in the national accounts. The change in the stock value of *work in progress*, of *finished goods*, or of *goods for resale* is already accounted for in the output value of the product group concerned; that is why the output and not the sales value is taken as the production value. Summarising, the input cost of a change in all kinds of inventories has already been included elsewhere in the system. This also means that, when it comes to a decomposition of the value change into a price and volume change, the intermediate input or output price change of the product group concerned also applies to the change in inventories.
Concerning *the input cost of using up non-financial, non-produced assets*, first a distinction must be made between the use of *hired* assets and the use of *own* assets. The cost of rental services associated with hiring non-financial assets (land, subsoil assets, etc.) equals the actual rents paid, except in the case of

[3] In particular, this applies to economies with a well-developed lease-industry and with mainly limited liability companies operating in the (fixed) capital intensive industries. For that reason, this statement may have been less valid several decades ago.

[4] Valuables are neglected here.

[5] The rental of capital goods under an operating lease is recorded as an intermediate input, whereby the consumption of fixed capital and the concomitant use of financial capital inputs are recorded as input in the industry that rents out such goods.

[6] Refer also to the discussion between Scott [1990], Eisner [1990] and Bradford [1990].

'royalties' paid to the government (see below). The decomposition of input cost changes into price and volume changes should be done according to the same method as is applied for the (intermediate) input cost of renting produced assets.

Concerning the input cost of owned non-financial assets the same rule applies as for fixed assets: the input cost equals the reduction in their stock value. The input volume equals the reduction in their stock volume or the reduction in their constant price stock value, so that the input price can then be derived. This applies to land, subsoil assets and other non-produced, non-financial assets such as patented entities and purchased goodwill.[7]

Subsoil assets and other natural resources are often not explicitly recorded on the owner's balance sheet. As a consequence, the input value for using these assets must be indirectly estimated. In that case, however, the extractor's profits may be liable to a specific tax, or an extraordinary dividend payment when the extractor is a public corporation. If the rate of this specific tax or dividend payment is the result of prolonged negotiations between the government and the extractor, it can be argued that the eventual rate is such that the extractor is precisely left with a 'normal' rate of return on his investment. The implicit resource input costs can then be equated with the specific tax or dividend receipts (cf. Keuning, 1995a: 27).

Finally, the identification *of the input cost of using liabilities and net worth* proceeds in stages. As usual, the first step is a breakdown into categories; cf. Annex V, Part I.D.2 of the 1993 SNA. For instance, interest payments are costs for the use of all kinds of loans, securities other than shares, and other credits. These categories of liabilities should be subdivided, by term-structure, by type of conditionally, etc. Changes in these payments depend on changes in the principal and on changes in the interest rate (e.g. when a loan is renewed). Next, the distributed income of all corporations or parts of corporations that operate in the industry concerned should be traced. Finally, the operating surplus that remains after subtraction of the input cost of both non-financial assets and all liabilities, reflects a remuneration for the use of the firm's net worth in production.[8]

The next step is a decomposition of the input value change into a price and volume change. The general rule applies that the volume change of the use of a certain liability equals the volume change of the principal of this liability.[9] This implies that the price index for using the liabilities equals the price index of the principal times the remuneration rate index for the liability concerned. For example, in the case of a loan the remuneration rate equals the nominal interest rate.

By way of explanation, consider the case of a firm where the price of all (non-financial) inputs and output(s) rises with the overall inflation rate, while the nominal interest rate does not change. Besides, all (non-financial) input and output volumes remain the same. In that case, the value of the financial inputs into the production process must also rise with the inflation rate. Obviously, the productivity of this firm does not change, so that the financial input volume should also remain the same.

In the case of equity, an increase in the total market value of the shares that surpasses the output price change should be seen as a volume increase of the use of this equity. Again, the input price change equals the price change of the principal (as approximated by the using industry's output price change) times the

[7] This line of reasoning implies, for example, that the input cost of land which is not overexploited usually equals zero. On the other hand, the value of the land owned appears on the assets-side of the balance sheet, and is thus also reflected somewhere on the liabilities side. Consequently this value does represent an input in production, namely a financial capital input.

[8] Obviously, from this remuneration corporate taxes must still be paid. It equally applies to *all* inputs that they are valued at "purchasers' prices", that is including e.g. taxes. In addition, it is assumed here that over a range of years net non-life insurance premiums and claims per industry roughly balance out, so that there is no effect on net worth.

[9] We would like to thank André Vanoli for pointing this out.

dividend rate.

The net operating surplus that remains after subtracting the input cost of both non-financial assets and all liabilities reflects a remuneration for the use of the enterprise's net worth in production. Its volume change equals the real change in net worth, to be read from estimated balance sheets by industry, and its price change is residual by definition.[10]

When applying the above line of reasoning to an empirical analysis, it is required, that operating surplus/mixed income by industry is decomposed into the remunerations for the different types of capital inputs. Concerning actual payments for capital inputs (interest, dividends, land rents, subsoil asset rents), the main difficulty is the re-allocation of such payments by institutional (sub)sector to the industries concerned. Concerning the imputed payments for using own-account capital inputs, the construction of balance sheets by industry is indispensable. This brings us to the following observation.

In the production accounts, the institutional units (enterprises) should be classified into more homogeneous categories than the present SNA-subsectors. For instance, non-financial corporations should be cross-classified by ownership (national private, public or foreign) and by principal production activity. For those categories it should then be possible to decompose changes in *all* input costs into price and volume changes. In fact, in modern economies the production function may be more homogeneous among firms with a similar institutional structure (e.g. multinationals versus the self-employed) and a roughly equal type of market (e.g. fast moving consumer goods like food, detergents and cosmetics) than among all establishments in a 2- or 3-digit ISIC-category. This notion, however, leads to a radically different way of classifying production processes in the national accounts.

It should not come as a surprise that presently available data by industry in the national accounts do not yet allow a rigorous empirical analysis of the above ideas. Yet, a first attempt to incorporate this new view on capital inputs into productivity analysis is reported next.

[10] Note that a real holding gain on an asset used in production commonly leads to a higher real net worth of the enterprise and thus to a *volume* increase of the use of net worth in production. This is a correct interpretation because in that case relatively more funds are tied up in the production process and this greater use of inputs implies a productivity loss, ceteris paribus.

3. *New and conventional estimates of multi-factor productivity change*

3.1 The concept of multi-factor productivity change

Solow's (1957) paper on technical change provided an economic rationale for the so-called multi-factor productivity change approach. As demonstrated by Solow, the output volume growth rate that cannot be attributed to the share-weighted input volume growth rates - under the assumption of a Hicks neutral aggregate production function - is "..equivalent to the growth rate of the Hicksian efficiency parameter.." (Hulten, 1979, p. 126). This parameter, in turn, is equivalent to the rate at which the aggregate production function shifts over time. Under these conditions, the residual reveals the quantitative contribution of technological change to economic growth. As pointed out by Hulten: "An important implication of this result is that, under the appropriate assumptions, the shift in the production function can be measured using price and quantity data alone, without the need of estimating or assuming the values of such parameters as the elasticity of substitution between capital and labour." This concept has been applied to a traditional and new estimation of multi-factor productivity change in various Dutch industries in the period 1988-1992.

3.2 Outline of the estimation methods

As said above, multi-factor productivity change equals the difference between (i) output volume growth, and (ii) the share-weighted volume growth rates of the inputs. In conformity with e.g. Keuning (1995b), the rates of change are calculated as the difference from one period to the next in the natural logarithms of the variables, while the weights equal the ordinary average of the respective shares at the beginning (1988) and end (1992) of the reference period.

In our approach, output refers to gross output, so that the inputs include intermediate inputs. Labour input includes an imputed remuneration for the self-employed. The imputed wage rate per full-time equivalent (fte) equals the actual fte wage rate of employees of the same sex and educational level in the same industry. This kind of information is available from the annual Social Accounting Matrices for the Netherlands. In the traditional estimation method, the capital input volume growth equals the growth rate of the consumption of fixed capital at constant prices. The capital input weight agrees with the average share of gross operating surplus/mixed income, excluding imputed labour income, in total output.

Our new method of estimating multi-factor productivity change differs from the traditional method by the recognition of financial capital use as a separate input. This requires the compilation of balance sheets by industry. For the time being, the necessary data could only be compiled for four broad industry clusters:

1. fixed capital intensive manufacturing (petroleum, other chemicals and transport equipment);
2. less fixed capital intensive manufacturing (all other manufacturing);
3. trade, hotels, restaurants and consumer goods repair services; and
4. transport, storage and communication services. The appendix to this paper explains how these balance sheets have been compiled.

The estimation of capital input price and volume changes in these industries has been operationalized as follows:

I. Annual gross operating surplus/mixed income by industry has been split into:[11]
   A. consumption of fixed capital[12]
   B. short-term interest payments,
   C. long-term interest payments, and
   D. dividends and retained earnings.[13]
   Comparing these categories in successive years, yields the value change of the four types of capital input concerned.

II. The volume growth of the fixed assets input equals the growth rate of the consumption of fixed capital at constant prices. The fixed assets capital input weight agrees with the average share of fixed capital consumption in total output.

III. Annual opening and closing balance sheets by industry have been compiled, subdividing the liabilities/net worth side into:
   A. short-term deposits, securities other than shares, loans and other accounts payable (also called: short-term loans, etc.),
   B. long-term deposits, securities other than shares, loans and other accounts payable (also called: long-term loans, etc.)
   C. shares and other equity, and net worth.
   The balance sheet for each year has been estimated as the average of the opening and closing balance sheet. The remuneration for using each of these categories of liabilities/net worth equals the categories B., C. and D. that were distinguished in step I.

IV. The liabilities and net worth of year t+1 at prices of year t have been estimated by deflating with the industry output price index.[14] This yields the annual volume growth of the principal of each category of liabilities/net worth.

V. The volume growth of the input of the three categories of liabilities/net worth equals the volume growth of the principal. The price changes follow from these volume changes and the value changes estimated in step 1. The input weight of the three categories of liabilities/net worth equals the average share of the remuneration categories B., C. and D. in step I in total output.

The main difference between both methods is thus that in the new method the capital input weight is split into four categories of capital inputs, among which three categories of financial capital inputs (see the tables in the Annex to this section). Of course, the decomposition of the value change into price and volume changes for each of the categories may diverge.

[11] The input cost of using up non-produced, non-financial assets ('rents') in the industries concerned has been considered negligible.

[12] In a more detailed approach, a subdivision by type of fixed asset would be possible.

[13] Distinguishing between dividends and retained earnings has been abandoned, because, for fiscal reasons, a large but fluctuating part of the shareholders' remuneration consists of an increase in the market value of their shares as a consequence of high retained earnings.

[14] It has been assumed that the terms of trade between output and financial capital input does not change as long as the remuneration rate for the liabilities/net worth is constant. This leads to selecting the output price index to deflate the changes in balance sheet value of the liabilities and net worth.

3.3 A comparison of the results according to both methods

Table 3.1 summarises multi-factor productivity growth rates for the four above-mentioned industry clusters. More detailed results are shown in the four tables annexed to this section.

Table 3.1: Multi-factor productivity change (1988-1992) in the Netherlands

logarithmic growth rates (%)

Chemical Industry, Petroleum Industry, and Transport Equipment Industry

years	1989	1990	1991	1992	1988-1992[1)]
traditional method	0.88	0.32	-0.58	-0.09	0.53
new method	1.36	0.55	-0.74	-0.42	0.75

Other Manufacturing Industry

years	1989	1990	1991	1992	1988-1992[10]
traditional method	0.80	0.45	0.13	-0.45	0.94
new method	1.22	0.43	0.23	-0.60	1.29

Trade, Hotels, Cafés, Restaurants, and Repair of Consumer Goods

years	1989	1990	1991	1992	1988-1992[1)]
traditional method	0.48	0.42	0.02	-1.27	-0.35
new method	1.84	1.76	1.57	-2.47	2.75

Transport, Storage and Communication

years	1989	1990	1991	1992	1988-1992[1)]
traditional method	2.04	1.83	2.09	0.92	7.11
new method	-1.26	2.17	2.79	1.41	5.25

1) Cumulative growth rate when considering the period 1988-1992 as a whole.

For both clusters of manufacturing industries, the results of the new approach resemble those of the traditional method. The productivity growth pattern is the same, by and large: a continuous decrease of productivity change over the period 1988-1992. The productivity change estimates for the period as a whole do not differ very much either. However, the traditional method somewhat underestimates the actual productivity changes, both the positive and the negative ones.

In the trade and related services industry, the new method yields quite different insights. In fact, during the period concerned a substantial productivity growth occurred, while the conventional method estimates a small decline. Notably, a relatively large volume decrease of the input of both long-term loans, etc. and shares plus net worth contributed to the high productivity growth in 1989-1991. The reverse holds for 1992. Both methods yield a declining pattern of multi-factor productivity change over the period 1989-1992.

Finally, in the transport, storage and communication industry the new approach results in a slightly lower productivity growth estimate for the period as a whole. For each of the years 1990, 1991 and 1992, the outcomes of both methods are similar, albeit that the new method yields slightly higher growth rates. In 1989, however, a very high volume growth of the input of both long-term loans, etc. and shares plus net worth caused a productivity decline in this industry, which was not picked up by the traditional method.

Summarising, the results of both estimation methods are rather similar, except for trade and related services. In that industry, where working capital plays a relatively important role, the traditional method yields a productivity decline for the period 1988-1992 as a whole, while the new method results in a positive figure.

As a consequence, the range of productivity change estimates by industry for the period as a whole was smaller according to the new method (between 0.75% and 5.25%) than according to the traditional method (between -0.35% and 7.11%).

Annex to Section 3

Table A.3.1: Traditional and new estimates of multi-factor productivity change in the chemical, petroleum and transport equipment industry

share-weighted volume growth rates (logarithmic)

years	1989	1990	1991	1992
traditional method				
output	5.65	2.13	0.21	0.50
intermediate consumption	4.21	1.15	0.56	0.37
labour input	0.26	0.41	-0.04	-0.03
capital input	0.29	0.25	0.28	0.25
multi-factor productivity change	0.88	0.32	-0.58	-0.09
new method				
output	5.65	2.13	0.21	0.50
intermediate consumption	4.21	1.15	0.56	0.37
labour input	0.26	0.41	-0.04	-0.03
long-term loans, etc. Input	-0.16	-0.09	0.02	0.17
short-term loans, etc. Input	-0.02	0.07	0.05	0.13
shares plus net worth input	-0.13	-0.06	0.25	0.18
fixed assets input	0.12	0.10	0.11	0.10
multi-factor productivity change	1.36	0.55	-0.74	-0.42

Table A.3.2: Traditional and new estimates of multi-factor productivity change in the other manufacturing industry

share-weighted volume growth rates (logarithmic)

years	1989	1990	1991	1992
traditional method				
output	3.88	4.21	1.96	0.27
intermediate consumption	2.56	3.20	1.61	0.59
labour input	0.23	0.28	-0.08	-0.13
capital input	0.28	0.28	0.31	0.26

multi-factor productivity change	0.80	0.45	0.13	-0.45
new method				
output	3.88	4.21	1.96	
0.27				
intermediate consumption	2.56	3.20	1.61	
0.59				
labour input	0.23	0.28	-0.08	-0.13
long-term loans, etc. Input	-0.01	0.17	0.11	
0.06				
short-term loans, etc. Input	0.04	0.05	-0.02	
0.04				
shares plus net worth input	-0.20	0.06	0.07	
0.28				
fixed assets input	0.04	0.04	0.04	
0.04				
multi-factor productivity change	1.22	0.43	0.23	-0.60

Table A.3.3: Traditional and new estimates of multi-factor productivity change in trade, hotels, restaurants and consumer goods repair services

share-weighted volume growth rates (logarithmic)

years	1989	1990	1991	
1992				
traditional method				
output	5.75	5.10	5.22	
1.60				
intermediate consumption	2.75	2.12	2.58	
0.58				
labour input	1.17	1.24	1.14	0.76
capital input	1.35	1.32	1.47	
1.54				
multi-factor productivity change	0.48	0.42	0.02	-1.27
new method				
output	5.75	5.10	5.22	
1.60				
intermediate consumption	2.75	2.12	2.58	
0.58				
labour input	1.17	1.24	1.14	0.76
long-term loans, etc. Input	-0.14	-0.28	-0.27	0.86
short-term loans, etc. Input	0.14	0.12	-0.09	
0.15				
shares plus net worth input	-0.25	-0.10	-0.15	
1.46				
fixed assets input	0.24	0.23	0.26	
0.27				
multi-factor productivity change	1.84	1.76	1.57	-2.47

Table A.3.4: Traditional and new estimates of multi-factor productivity change in transport, storage and communications services

share-weighted volume growth rates (logarithmic)

years	1989	1990	1991	1992
traditional method				
output	5.25	4.58	5.48	4.64
intermediate consumption	1.90	0.92	1.31	2.00
labour input	0.45	0.80	1.07	0.77
capital input	0.87	1.03	1.01	0.95
multi-factor productivity change	2.04	1.83	2.09	0.92
new method				
output	5.25	4.58	5.48	4.64
intermediate consumption	1.90	0.92	1.31	2.00
labour input	0.45	0.80	1.07	0.77
long-term loans, etc. Input	1.42	0.30	-0.03	-0.10
short-term loans, etc. Input	0.07	0.00	0.00	-0.01
shares plus net worth input	2.21	-0.17	-0.20	0.04
fixed assets input	0.47	0.56	0.55	0.51
multi-factor productivity change	-1.26	2.17	2.79	1.41

4. Summary and conclusions

The growing awareness that the financial structure of a firm also determines its activity should also be reflected in production functions, productivity calculations and so on. This paper has attempted to operationalize a meso-economic measurement of financial capital inputs in production and to show the consequences for the estimation of multi-factor productivity change.

In essence, our findings are the following. First, the input of non-financial assets in production does not differ fundamentally from intermediate inputs, albeit that the services from these assets are spread out over more than one year.[15] Secondly, in addition to the costs due to the gradual consumption of non-financial assets, there are costs connected with the use of the funds tied up in these assets. These funds are used for production and cannot simultaneously be used for other purposes, such as the immediate satisfaction of wants. That abstinence must of course be remunerated. The essence of the argument developed here is that this remuneration should *not* be assigned to the kinds of assets and working capital financed with these funds, but to the categories of liabilities and net worth that acquire this income. In comparison with present macro-economic theory and practice, this implies a shift in emphasis from the assets-side of the balance sheet to the liabilities/net worth-side. The total value of both sides of the balance sheet is of course the same. What differs is the classification of items and, particularly, the decomposition of value changes into volume changes and price changes when it comes to productivity analyses, production functions, etc.

It has been stated above, that a rigorous empirical application of these ideas requires a different meso- and macro-economic data base than is presently available. Yet, it has been attempted to apply the new concept of capital input in production to the estimation of productivity change for four industry clusters in the Netherlands. The results have been compared with the outcomes according to the traditional estimation method. The new method has resulted in a substantially smaller range of productivity change estimates by industry. Particularly in the trade and related services industry, the new method yielded quite different results. Whereas originally this seemed the only industry with a productivity loss over the whole period concerned, the new method yielded a productivity gain, in between the gain of the manufacturing and the transport industries.

It goes without saying that this modest experiment cannot yet substantiate the accuracy or the relevance of this new approach to measuring capital input in production. However, it may be worth while to repeat this exercise for other countries and other periods. In addition, it may be of interest to compare the productivity performance of countries, or individual firms, with this new method.

By recasting the model of economic production in the way described here, a new light may be thrown on differences in productivity growth among firms, industries or countries. In turn, that might reveal a new perspective on the determinants of economic growth. Finally, the approach in this study also establishes a much closer link of macro-economic accounting and analysis to business economics. In fact, the neglect of financial inputs in present mainstream macro-economic theory of production and growth is all the more surprising, in view of the paramount importance of these inputs in business economics.

[15] In so far as well-developed markets for second-hand capital goods do not exist, these commodities are less fungible than intermediate inputs. However, the delivery of intermediate inputs may also be fixed in long-term contracts.

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Appendix: The compilation of industry balance sheets

The estimation procedure of capital input volume changes outlined above necessitates the construction of industry balance sheets. In this appendix, various issues related to the assembly of industry balance sheets are dealt with. In particular, this concerns (i) the different statistical units that underlie industry output data on the one hand and balance sheet information on the other hand, (ii) the financial flows *not* directly linked to production activities, and (iii) valuation problems.

1 Statistical units

In line with the SNA regulations, the establishment unit is used for the compilation of output data. Balance sheet information, on the other hand, is based on data from enterprise units. In a rather detailed analysis, output data for an establishment and the concomitant balance sheet data of the owning enterprise might thus end up in different industries.

In our analysis, rather aggregated industry data are used for four clusters of activities. It has been assumed that at this quite aggregate level, the problem of different statistical units is only of minor importance and does not significantly influence our results.

Quite another problem is caused by the fact that our basic source of information on balance sheets - the so-called Statistic of Finances of Enterprises (Statistiek Financiën Ondernemingen) - only contains information on incorporated enterprises. The balance sheet data were grossed up using unpublished data on balance sheets for unincorporated enterprises.

2. Financial flows not linked to the production process

The theory in section 2 of this paper implicitly assumes that the liabilities and net worth on the balance sheet all serve to finance the production process of the enterprise's establishment(s). However, in the case of a multi-national enterprise, a financial liability may also be used to finance production activities of a foreign affiliate. For the time being, no corrections were made for this phenomenon, due to lack of data.

In addition, so-called Special Financial Institutions (SFI) are especially established to change the routing of financial flows between foreign enterprises for purely fiscal reasons. As such, they are not linked to any production process in the Netherlands. Therefore, the SFI balance sheet data have been eliminated from our data set.

3. Valuation problems

Ideally, the valuation of liabilities and net worth should be based on current market values. However, a number of enterprises in the source statistics reported its balance sheet on the basis of historic costs. Again, this could not be corrected for the moment.

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NA/82 Wim P. Leunis and Jolanda G. Timmerman, **Micro-meso-macro linkage for labour in the Netherlands**, 1996.
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