



HAL
open science

Will the skill-premium in the Netherlands rise in the next decades

Arnaud Dupuy

► **To cite this version:**

Arnaud Dupuy. Will the skill-premium in the Netherlands rise in the next decades. *Applied Economics*, 2008, 39 (21), pp.2723-2731. 10.1080/00036840600749441 . hal-00581987

HAL Id: hal-00581987

<https://hal.science/hal-00581987>

Submitted on 1 Apr 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Will the skill-premium in the Netherlands rise in the next decades

Journal:	<i>Applied Economics</i>
Manuscript ID:	APE-05-0492
Journal Selection:	Applied Economics
Date Submitted by the Author:	08-Sep-2005
JEL Code:	D33 - Factor Income Distribution < D3 - Distribution < D - Microeconomics, J11 - Demographic Trends and Forecasts < J1 - Demographic Economics < J - Labor and Demographic Economics, J38 - Public Policy < J3 - Wages, Compensation, and Labor Costs < J - Labor and Demographic Economics
Keywords:	Skill premium, SBTC, Capital-skill complementarity

powered by ScholarOne
Manuscript Central™

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52

Will the skill-premium in the Netherlands rise in the next decades?*

A. Dupuy[†]

September 5, 2005

Abstract

While the skill-premium has been rising sharply in the US and the UK for 20 years, the Dutch skill-premium decreased for much of that period and only started to rise in the early 90s. In this paper, we investigate whether the Dutch skill-premium will rise in the next decades. To answer this question, we forecast the skill-premium using the Katz and Murphy (1992) and the Krusell et al. (2000) models. The Katz and Murphy model (KM) explains demand shifts by skill-biased technological change in unobservable variables captured by a time trend. In contrast, the Krusell

*I would like to thank Lex Borghans, Frank Cörvers, Bart Golsteyn, Ben Kriechel, Philip Marey, Christophe Meng, Inge Sieben, Wendy Smits and Bas ter Weel for helpful comments on earlier drafts.

[†]Research Centre for Education and the Labour Market, Faculty of Economics and Business Administration, Maastricht University PO Box 616, NL-6200 MD, The Netherlands. Email: a.dupuy@roa.unimaas.nl.

1
2
3
4
5
6
7 et al. model (KORV) explains demand shifts by (observable) changes in
8
9 the capital stock under a capital-skill complementarity technology. The
10
11 results show that while the KM model predicts that the skill-premium will
12
13 have increased by 30% in 2020, based on realistic predictions of the stock
14
15 of capital, the KORV model predicts that the skill-premium will remain
16
17 between -5% and $+5\%$ of its 1996 level.
18
19

20
21
22
23 *JEL Classification:* D33, J11 and J38.
24

25
26
27 *Keywords:* Skill-premium, skill-biased technical change and capital-skill
28
29 complementarity.
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1 Introduction

In recent decades, the skill-premium has been rising sharply in the US and the UK. In contrast, in most continental European countries the skill-premium has been decreasing or stagnating (see Freeman and Katz (1994), and Nickell and Bell (1996)) until recent years. However, in the 90s, the skill-premium started rising in Germany and the Netherlands for instance (see Acemoglu (2003), Leuven and Oosterbeek (2000) and Jacobs (2004)). At the same time, all developed countries have experienced a steadily increasing relative supply of skilled workers. There is a fairly documented literature that explains the rise in the US skill-premium by continuous shifts in the relative demand for skilled workers of a magnitude off-setting the increase in the relative supply, see Katz and Murphy (1992).

In the literature related to the rising skill-premium, two main explanations¹ are often put forward. The skill-biased technological change (SBTC) explanation, led by Katz and Murphy (1992), Bound and Johnson (1992), Berman et al. (1994) and Autor et al. (1998) and Acemoglu (2002) is the most dominant in the literature. The argument reads as follows. New technologies are relatively more complementary with skilled workers than with unskilled workers. These

¹A third explanation put forward in the literature is the increasing international trade. However, several arguments (e.g. same timing in the trade and nontrade sectors) against this explanation are raised, see Johnson (1997) and Acemoglu (2002). A fourth explanation put forward is the institutional change (DiNardo et al. (1996) and Lee (1999)). Acemoglu (2002) raises serious arguments against this explanation. Regarding the minimum wage: the decrease of the minimum wage cannot explain the rise in wage dispersion observed above the median of the wage distribution. Regarding the unions: wrong timing of deunionization and wage inequality, and inconsistency between the unionization and rising wage inequality in Canada through the 70s and 80s.

1
2
3
4
5
6
7 new technologies when used in the production process therefore shift the relative
8
9 demand for skilled workers upward. The SBTC effects on the skill-premium are
10
11 captured in the Katz and Murphy (1992) model (KM model from now on) by
12
13 regressing the log skill-premium on a time trend. The second explanation has
14
15 it roots in the capital-skill complementarity in production.² Skilled workers are
16
17 more complementary to capital than unskilled workers so that, a decrease in the
18
19 price of capital shifts the relative demand of skilled workers upward, see Krusell
20
21 et al. (2000) and Beaudry and Green (2003). The capital-skill complementarity
22
23 effects on the skill-premium are captured in the Krusell et al. (2000) model
24
25 (KORV model from now on) by regressing the log skill-premium on the log capital
26
27 stock.³
28
29
30
31
32

33
34 Although the Netherlands experienced a decrease in the skill-premium through
35
36 the 70s and 80s, the skill-premium increased notably since the mid 90s (see Leu-
37
38 ven and Oosterbeek (2000) and Jacobs (2004)). The major reason for this is the
39
40 slower growth of the skill supply observed since the beginning of 90s. This rises
41
42 the question whether the Dutch skill-premium will continue to increase in the
43
44
45

46 ²See e.g. Rosen (1968) , Griliches (1969), Grant and Hamermesh (1979) and Hamermesh
47 (1993).

48 ³The explanation of increasing skill premium by the capital-skill complementarity has of-
49 ten been rejected because of its apparent inconsistency with a constant share of capital in
50 the economy. However, though an aggregate production function with a unitary elasticity of
51 substitution between capital and labour (aggregate of skilled and unskilled labour) ensures the
52 constancy of the share of capital, there are more flexible forms of aggregate production function
53 satisfying the postulate of the constant share of capital. Indeed, a production function with a
54 greater-than-unity elasticity of substitution accompanied by a labour augmenting technological
55 change would be consistent with constant shares of labour and capital, see e.g. Brown and
56 De Cani (1963), Kennedy (1964), David and van de Klundert (1965), Sato (1970) and Yuhn
57 (1990).
58
59
60

1
2
3
4
5
6
7 years to come like it did in the US for the last 20 years and whether the race
8
9 between schooling and technology is lost by schooling (Tinbergen (1975))?
10

11 To investigate this question we forecast the skill-premium to 2020 using the
12 KM model, where skill-biased technological change is captured by a time trend
13 and the KORV model, where SBTC are brought about by (observable) changes
14 in the capital stock under a capital-skill complementarity technology. We first
15 estimate parameters of the two models on the span 1969 to 1996 for the Nether-
16 lands. Using predictions for the relative skill supply, a first set of forecasts is
17 derived from the Katz and Murphy (1992) model. These forecasts are similar
18 to those derived by Jacobs (2004). A second set of forecasts is generated from
19 the Krusell et al. (2000) model. Four scenarios of the change in the stock of
20 capital are considered. In the first scenario, the stock of capital will increase at
21 an annual rate of 10% (equivalent to the highest growth rate in five successive
22 years (1982-1986) observed during the last decades), in the second scenario, the
23 stock of capital equipment will increase at an annual rate of 6% (equivalent to
24 the growth rate observed between 1969 and 1996), in a third scenario, it grows
25 at 3 percent per year (its growth rate in the last five years observed, 1992-1996).
26 In the fourth scenario, we use recent forecasts made by the CPB Netherlands
27 Bureau for Economic Policy Analysis indicating that the stock of capital will rise
28 at an annual rate of 1.6% through 2010.⁴
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54

55 The paper is organized as follows. In section 2 we present the KM and KORV
56
57

58 ⁴See CPB (2004).
59
60

1
2
3
4
5
6
7 model. In section 3 we discuss the data used for empirical analysis. In section 4
8
9 we present the empirical results. Section 5 concludes.

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

In this paper we analyze the schedule of the skill-premium in the Netherlands. The analysis rests on a general aggregate production function that nests the two sources of changes in the skill-premium: the substitution effect that arises from shifts in the relative supply of skilled labor and the demand shift effect due to skill-biased technological change. We distinguish SBTC brought about by unobservable variables and captured by a time trend, the KM model, from SBTC brought about by (observable) changes in the price of capital when the production technology is characterized by capital-skill complementarity, the KORV model.

Let the aggregate production function be $Y_t = F(\theta_{st}L_{st}, \theta_{ut}L_{ut}, K_t)$, where L_{st} and L_{ut} represent respectively the supply of skilled and unskilled labor, θ_{st} and θ_{ut} represent respectively the possibility of skilled and unskilled labor augmenting factors, i.e. skill-biased technological change brought about by unobservable variables, and K_t is the stock of capital at time t .

The equation on which we base our empirical investigation is derived from the marginal product conditions for wages, the assumption of competitive input markets, $\partial F/\partial L_j = w_j$ and $\partial F/\partial K = r$, that is

$$w_{st} = \theta_{st} \partial F / \partial L_{st} \quad (1)$$

$$w_{ut} = \theta_{ut} \partial F / \partial L_{ut} \quad (2)$$

where w_j is the wage rate of labor j , $j = \{u, s\}$.

The log-linear approximation of equations (1) and (2) can be written as:

$$\ln w_{st} = \alpha_0 + \alpha_s \ln(\theta_{st} L_{st}) + \alpha_u \ln(\theta_{ut} L_{ut}) + \alpha_K \ln K_t + \ln \theta_{st} \quad (3)$$

$$\ln w_{ut} = \beta_0 + \beta_s \ln(\theta_{st} L_{st}) + \beta_u \ln(\theta_{ut} L_{ut}) + \beta_K \ln K_t + \ln \theta_{ut} \quad (4)$$

Using equations (3) and (4), the log skill-premium $\pi_t \equiv \ln w_{st} - \ln w_{ut}$ can then be written as:

$$\pi_t = \alpha_0 - \beta_0 + \quad (5)$$

$$(1 + \alpha_s - \beta_s) \ln \theta_{st} + (\alpha_u - \beta_u - 1) \ln \theta_{ut} +$$

$$(\alpha_s - \beta_s) \ln L_{st} + (\alpha_u - \beta_u) \ln L_{ut} +$$

$$(\alpha_K - \beta_K) \ln K_t$$

Note that for $\alpha_s - \beta_s = \beta_u - \alpha_u$ we have:

$$\pi_t = \alpha_0 - \beta_0 + (1 + \alpha_s - \beta_s) \ln \frac{\theta_{st}}{\theta_{ut}} + (\alpha_s - \beta_s) \ln \frac{L_{st}}{L_{ut}} + (\alpha_K - \beta_K) \ln K_t \quad (6)$$

The term in second row of equation (5) captures the effect of skilled-biased technological change brought about by unobservable variables. The term in the third row captures the substitution effect induced by shifts in the relative skill supply and the term in the last row captures observable SBTC via the capital-skill complementarity.

The capital-skill complementarity effect on the skill-premium can further be decomposed into an impulse due to changes in the stock of capital, i.e. $d \ln K_t$ and a multiplicative effect depending on the technological parameters of substitution between capital and skilled and unskilled labor. Since capital and unskilled workers are usually strong substitutes, we expect $\beta_K < 0$. In contrast, we expect capital and skilled labor to be complementary and therefore $\alpha_K > 0$.

Imposing $(\alpha_K - \beta_K) = 0$ in equation 6 we obtain the KM model.

KM model

$$\pi_t = \gamma_0 + \gamma_1 \ln \frac{L_{st}}{L_{ut}} + \gamma_2 t + \varepsilon_t \quad (7)$$

where $(1 + \alpha_s - \beta_s) \ln \frac{\theta_{st}}{\theta_{ut}} = \gamma_2 t$, $(\alpha_s - \beta_s) = \gamma_1$ and $\alpha_0 - \beta_0 = \gamma_0$, and the

elasticity of substitution between skilled and unskilled labor is $\sigma = 1/\gamma_1$.

Imposing $\ln \frac{\theta_{st}}{\theta_{ut}} = \delta$ to be constant through time in equation 6, we obtain the KORV model.

KORV model

$$\pi_t = \gamma'_0 + \gamma'_1 \ln \frac{L_{st}}{L_{ut}} + \gamma_3 \ln K_t + \varepsilon'_t \quad (8)$$

where $(\alpha_K - \beta_K) = \gamma_3$, $(\alpha_s - \beta_s) = \gamma'_1$ and $\alpha_0 - \beta_0 = \gamma'_0$.

3 The data

The data we use consists of annual time-series of capital and labor for the Dutch economy between 1969 and 1996.⁵ We use the National accounts time-series collected by Statistics Netherlands, CBS (1999). The data consists of capital and labor accounts. The capital accounts data contains five investment series. Investment in machines, transports, computers, materials and the aggregate of these four investments that form investments in equipment are available in current prices. We make use of the respective price-index for the period 1969-1996 to deflate the five series of investment and obtain measures of investments in 1969 prices. The stock of capital for the five series is then calculated using the perpetual inventory method. The capital stock in 1969 is set to the investment

⁵The data can be obtained from the author's website, <http://www.fdewb.unimaas.nl/roa>. More recent data was not available at the time the analyses were done.

1
2
3
4
5
6
7 level in 1969. We recursively construct the stock of capital the next period using
8
9 investment and a depreciation ratio of 0.05 for equipment, machines and trans-
10
11 ports and 0.10 for materials and 0.15 for computers.⁶ In the remaining part of
12
13 this study we use the series on the stock of capital equipment. The series of
14
15 capital equipment are normalized to 1 in 1969. As illustrated in Figure 1 the
16
17 stock of capital equipment increases almost steadily throughout the period at a
18
19 yearly rate of 6%.
20
21
22
23

24 Since we are interested in developments in the skill-premium we distinguish
25
26 between skilled and unskilled labor. We use the time-series collected by Statistics
27
28 Netherlands (CBS).⁷ We define low skilled workers by workers with primary or
29
30 secondary education and skilled workers by higher educated workers. The relative
31
32 supply of skilled workers is the ratio of the number of skilled workers, expressed
33
34 in man-years, to the number of unskilled workers, also expressed in man-years.
35
36 Wages are based on gross hourly wages and we define the skill-premium as the
37
38 ratio of the wages of skilled workers and unskilled workers. The supply of both
39
40 skilled and unskilled workers is normalized to 1 in 1969.
41
42
43
44
45

46 The data indicates that the supply of skilled workers has been multiplied by
47
48 a factor 3.5 in the period of observation while the supply of unskilled workers
49
50 remained fairly stable, as shown in Figure 1.
51
52
53

54 ⁶Other plausible rates of depreciation did not alter the results significantly.

55 ⁷The labour series and wage series we use are simply obtained by aggregating $l_u = l_{pr} + l_{se}$
56 for unskilled labour (where l_{pr} and l_{se} are respectively the number of man-year with primary
57 and secondary education and weighting $w_u = (l_{pr}w_{pr} + l_{se}w_{se})/l_u$ for the unskilled wage.
58
59
60

1
2
3
4
5
6
7 <Figure 1>
8

9 As indicated in Figure 2, the skill-premium decreases, first moderately through
10 1979 at an annual rate of 0.6%, then sharply between 1979 and 1985 at an annual
11 rate of 2.8%, and remains fairly stable to 1992. From 1992 to 1996, the skill-
12 premium slightly increases at an annual rate of 0.4%.
13
14
15
16
17
18
19

20 21 **4 Empirical results**

22 23 **4.1 Estimation of the KM and KORV models**

24
25
26 Our empirical objective is to get estimates of the parameters of the KM and
27 KORV models to make forecasts of the skill-premium in the Netherlands. This
28 could be done by OLS estimations of equation 7 and 8. However, when esti-
29 mating both parameters γ_1 and γ_2 in equation 7 or γ'_1 and γ_3 in equation 8
30 simultaneously, the parameters have the wrong sign due to strong multicollinear-
31 ity in the series. We therefore regress the skill-premium series on the relative
32 supply of skilled labor at given plausible time trend parameters (KM model) or
33 capital-skill complementarity parameters (KORV model) as suggested by Katz
34 and Murphy (1992) and Jacobs (2004).
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50

51 <Table 1>
52

53 The estimation results reported in Table 1 indicate that at comparable elas-
54 ticities of substitution, both the model with time trend and the model with
55
56
57
58
59
60

1
2
3
4
5
6
7 capital equipment explain roughly the same percentage of the variance in the
8
9 skill-premium schedule. The fit of both models is globally equivalent as indicated
10
11 by the adjusted R^2 statistics and illustrated in Figure 2. Both models seem to
12
13 be equally suited to forecast ex-post the skill-premium in the Netherlands. It
14
15 is empirically impossible to decide which model should be preferred, choosing in
16
17 favor of the KM or the KORV model therefore depends merely on one's economic
18
19 belief on whether capital and skilled labor are complementary in production or
20
21 not.
22
23
24
25

26
27 To compare the magnitude of the capital-skill complementarity effect to that
28
29 of the time trend, we decompose the change in the skill-premium into two effects.
30
31 The substitution effect is induced by the increased relative supply of skilled work-
32
33 ers. The demand effect is either due to SBTC in unobservable variables in the
34
35 KM model or to SBTC via the capital-skill complementarity in production in the
36
37 KORV model. We split the period into two sub-periods. The period 1969-1981 is
38
39 characterized by an annual growth in capital equipment of 6.7% and the period
40
41 1981-1996 is characterized by a slower growth of capital equipment, annual rate of
42
43 5.7%. The demand and substitution contributions, expressed in annual percent-
44
45 age rates, are reported in Table 2. In the KM model, demand shifts contribute to
46
47 increase the skill-premium by 2% per year. In the KORV model, demand shifts
48
49 contribute to increase the skill-premium by 1.83% per year. Since in the KM
50
51 model, the time trend captures the effect of all variables that are highly linearly
52
53 correlated with time and omitted in the KM model, it also includes the effects
54
55
56
57
58
59
60

of capital equipment. Therefore, we can conclude that between 1969 and 1996, 92% of the demand shifts, $1.83/2 = 0.915$ in Table 2, are induced by the growth of equipment stock, although the importance of unobserved sources tend to be larger in the last period, 15% between 1981 and 1996 ($1.69/2 = 0.845$), than in the beginning period, 0.5% between 1969 and 1981 ($1.99/2 = 0.995$).

<Table 2>

4.2 Robustness checks

Is capital irrelevant?

The capital-skill complementarity explanation is often rejected in the literature (see Acemoglu (2002)) because of its apparent lower explanatory power. Acemoglu (2002) for instance, regresses the US log skill-premium with on the one hand a time trend and on the other hand the log price of capital equipment. The R^2_{adj} associated to the time trend model is 0.90 and larger than that of the regression with the price of capital, i.e. 0.86. Based on the R^2 adjusted statistics, the KM model should be preferred to the KORV model. However, we argue that this way of testing hypotheses is biased against the capital-skill complementarity hypothesis since the time variable picks up the effects of *all* unobserved variables linearly correlated with time (capital included). To show this, we generated a skill-premium series (28 observations) by $\tilde{\pi}_t = 1 + 2 \ln \frac{L_{st}}{L_{ut}} + 3 \ln K_t + \varepsilon_t$ where $\varepsilon_t \rightarrow NID(0, 1)$ and regressed this skill-premium series once with capital (the

1
2
3
4
5
6
7 true model) and once with time trend instead. We then calculated the *Error*
8
9 *Sum of Squares* of both regressions and compared the results. We found that
10
11 for 2995 out of 10000 replications the *ESS* of the capital model exceeds that of
12
13 the time trend model. This means that, with a probability of 30%, we reject the
14
15 capital-skill complementarity hypothesis in favor of the alternative hypothesis of
16
17 unobserved SBTC when the true hypothesis is capital-skill complementarity. We
18
19 also ran 10000 replications of the reverse test (true hypothesis is time trend: the
20
21 skill-premium is generated with time trend) and in none of these replications were
22
23 the *ESS* associated with the capital regression lower than the *ESS* associated
24
25 with the time trend.
26
27
28
29
30
31

32 *Robustness of the parameters*

34
35
36 The Durbin-Watson statistics, reported in Table 1, indicate a possible spurious
37
38 relationship in the equations of the model. The Augmented Dickey-Fuller statis-
39
40 tics indicate that the log skill-premium series and log equipment stock are not
41
42 stationary, integrated of order 1 ($ADF(\pi_t) = -0.57$ and $ADF(\ln K_t) = -1.65$)
43
44 whereas the possibility that the log skill supply series are stationary can not
45
46 be rejected at 5% ($ADF(\ln \frac{L_{st}}{L_{ut}}) = -3.41$). We therefore regressed equation (7)
47
48 and (8) in first differences to investigate the sensitivity of the long run model
49
50 estimates. The estimates of the skill-premium equation are reported in Table
51
52 3. The estimated parameters are of relatively similar magnitude in levels and
53
54 first differences and the parameters remain significant when estimated with first
55
56
57
58
59
60

1
2
3
4
5
6
7 differences. The results are reassuring regarding the findings presented in this
8
9 paper.

10
11 <Table 3>

12
13
14
15 *Different capital series*

16
17
18 We check the robustness of our results with respect to the choice of the capital
19 variable by replacing the equipment capital by two other measures of capital,
20 namely the stock of computers and the stock of machines. These two measures of
21 capital grow at very different rates during the period 1969-1996, as can be seen
22 from Figure 3. The computers stock series increases sharply in the period 1969-
23 1979, annual rate of nearly 26% per year and slows down through 1996 to a yearly
24 rate of 8.9%. In contrast, the machines stock increases relatively constantly in
25 the period 1969-1996 at a moderate annual rate of 5.2%.

26
27
28
29
30
31
32
33
34
35
36
37
38 <Table 4>

39
40
41 We replicate the analysis ran for capital equipment but for computers and
42 machines stock instead. The results of the levels and first-differences estimations
43 of equation (8) with computers and machines instead of capital equipment are re-
44 ported in Table 4. The percentage explained of the variance in the skill-premium
45 is insensitive to the type of capital considered as indicated by the various R_{adj}^2
46 statistics (i.e. 0.96 for equipment, 0.95 for machines and 0.94 for computers).
47
48
49
50
51
52
53
54
55
56
57
58
59
60

4.3 Forecasts of the Dutch skill-premium in 2020

We make use of the supply forecasts for skilled and unskilled workers provided by CBS and CPB. The data provides an estimation of the number of persons employable in the labor force from 2000 to 2020. The forecasts for the period 1997 to 2000 are obtained by linear extrapolation of the series.

We make predictions of the relative wage of skilled workers using deterministic scenarios of the stock of capital. The four deterministic scenarios considered are:

- i) The stock of capital grows at an annual rate of 10 percent during the period 1997-2020, corresponding to the highest historical growth rate in five consecutive years (1982-1986) between 1969 and 1996.
- ii) The stock of capital grows at 6 percent per year, corresponding to the average rate during the period 1969-1996.
- iii) The stock of capital grows at 3 percent per year, corresponding to the growth rate observed in the last five years, 1992-1996.
- iv) As predicted by the CPB Netherlands Bureau for Economic Policy Analysis, the stock of capital rises at an annual rate of 1.6% through 2020.⁸

The decomposition of the skill-premium forecasts under the different models and scenarios is reported in Table 5.

⁸The CPB (2004) forecasts a moderate growth in the stock of capital of 1.6% per year through 2010. In this paper, we extrapolate this forecasts to 2020. Note that this scenario is realistic at sight of the recent decrease in firms' investments, observed in the Netherlands, -12% between 2000 and 2004.

<Table 5>

Using the KM model, we predict that the skill-premium will rise at an annual rate of 1.3% so that by 2020, the skill-premium will be 30% above its 1996 level. (See Jacobs 2004) To meet this result with the KORV model, that is accounting for the capital-skill complementarity in production, the stock of capital would have to rise continuously until 2020 at an annual rate of 6.8%. This implied annual growth rate in the stock of capital is twice the annual rate observed in the last five years of our sample 1992-1996 and lies 0.8 percentage points above the average rate in the span 1969-1996.

The increase in the skill-premium, as predicted by the KORV model, varies from 50% when capital stock rises 10 percent per year to -5% when the stock of capital grows at 1.6% per year through 2020.

5 Conclusion

The answer to the question: is the race between schooling and technology, e.g. Tinbergen (1975) lost by schooling? is empirically blur. Economists that support the idea that shifts in the demand for skilled labor result from skill-biased technological change in unobservable variables would answer positively (30% increase in the skill-premium by 2020). In contrast, the answer of economists in favor of the capital-skill complementarity in production will depend on their expectations regarding the evolution of the price of capital. If the price of capital keeps falling

1
2
3
4
5
6
7 at a pace comparable to that of the last decades, by 2020 the race would be lost
8
9 by schooling. However, if the price of capital decreases at the same pace it did
10
11 in the 90s, the skill premium will stabilize.
12
13
14
15
16

17 References

- 18
19
20 ACEMOGLU, D. (2002): “Technical Change, Inequality and the Labor Market,”
21
22 *Journal of Economic Literature*, 40(1), 7–72.
23
24
25
26 ——— (2003): “Cross-Country Inequality Trends,” *Economic Journal*, 113,
27
28 121–49.
29
30
31
32 AUTOR, D., F. KATZ, AND A. KRUEGER (1998): “Computing Inequality: Have
33
34 Computers Changed the Labor Market?,” *Quarterly Journal of Economics*,
35
36 113(4), 1169–213.
37
38
39
40 BEAUDRY, P., AND D. GREEN (2003): “Wages and Employment in the United
41
42 States and Germany: What Explains the Differences?,” *American Economic*
43
44 *Review*, 93(3), 573–602.
45
46
47
48
49 BERMAN, E., J. BOUND, AND Z. GRILICHES (1994): “Changes in the Demand
50
51 for Skilled Labor Within US Manufacturing: Evidence from Annual Survey of
52
53 Manufactures,” *Quarterly Journal of Economics*, 109(1), 367–97.
54
55
56
57
58
59
60

- 1
2
3
4
5
6
7 BOUND, J., AND G. JOHNSON (1992): "Changes in the Structure of Wages
8
9 During the 1980's: An Evaluation of Alternative Explanations," *American*
10
11 *Economic Review*, 82(3), 371–92.
12
13
14
15 BROWN, M., AND J. DE CANI (1963): "Technological Change and the Distrib-
16
17 ution of Income," *International Economic Review*, 4, 289–309.
18
19
20
21 CPB (2004): "Macro Economische Verkenning," *CPB reports*.
22
23
24 DAVID, P., AND T. VAN DE KLUNDERT (1965): "Biased Efficiency Growth
25
26 and Capital-Labor Substitution in the US, 1899-1960," *American Economic*
27
28 *Review*, 55, 357–93.
29
30
31
32 DINARDO, J., N. FORTIN, AND T. LEMIEUX (1996): "Labor Market Institutions
33
34 and the Distribution of Wages, 1979-1992: A Semi-Parametric Approach,"
35
36 *Econometrica*, 64(5), 1001–44.
37
38
39
40 FREEMAN, R., AND L. KATZ (1994): "Rising Wage Inequality: The United
41
42 States Vs. Other Advanced Countries," *NBER*.
43
44
45
46 GRANT, J. (1979): "Labor Substitution in U.S. Manufacturing," Ph.D. thesis,
47
48 Michigan State University.
49
50
51
52 GRILICHES, Z. (1969): "Capital-Skill Complementarity," *Review of Economics*
53
54 *and Statistics*, 51(4), 465–8.
55
56
57
58
59
60

- 1
2
3
4
5
6
7 HAMERMESH, D. (1993): *Labor Demand*. Princeton, New Jersey: Princeton Uni-
8
9 versity Press.
10
11
12 JACOBS, B. (2004): “The Lost Race Between Schooling and Technology,” *De*
13
14 *Economist*, *Forthcoming*.
15
16
17
18 JOHNSON, G. (1997): “Changes in Earnings Inequality: The Role of Demand
19
20 Shifts,” *Journal of Economic Perspectives*, 11(2), 41–54.
21
22
23
24 KATZ, L., AND K. MURPHY (1992): “Changes in Relative Wages, 1963-1987:
25
26 Supply and Demand Factors,” *Quarterly Journal of Economics*, 107(1), 35–78.
27
28
29
30 KENNEDY, C. (1964): “Induced Bias in Innovation and the Theory of Distribu-
31
32 tion,” *Economic Journal*, 74, 541–47.
33
34
35
36 KRUSELL, P., L. OHANIAN, V. RÍOS-RULL, AND G. VIOLANTE (2000):
37
38 “Capital-Skill Complementarity and Inequality: A Macroeconomic Analysis,”
39
40 *Econometrica*, 68(5), 1029–53.
41
42
43
44 LEE, D. (1999): “Wage Inequality in the US During the 1980s: Rising Dispersion
45
46 or Falling Minimum Wage?,” *Quarterly Journal of Economics*, 114(3), 941–
47
48 1024.
49
50
51
52 LEUVEN, E., AND H. OOSTERBEEK (2000): “Rendement Van Onderwijs Stijgt,”
53
54 *Economisch Statistische Berichten*, 4262, 523–4.
55
56
57
58
59
60

1
2
3
4
5
6
7 NICKELL, S., AND B. BELL (1996): "Changes in the Distribution of Wages and
8
9 Unemployment in OECD Countries," *American Economic Review, Papers and*
10
11 *Proceedings*, 86(2), 302–8.
12

13
14
15 ROSEN, S. (1968): "Short-Run Employment Variation on Class-I Railroads in
16
17 the United States, 1947-1963," *Econometrica*, 36, 511–29.
18

19
20
21 SATO, R. (1970): "The Estimation of Biased Technical Progress and the Pro-
22
23 duction Function," *International Economic Review*, 11, 179–208.
24

25
26
27 TINBERGEN, J. (1975): *Income Distribution: Analysis and Policies*. Amsterdam:
28
29 North-Holland.
30

31
32
33 YUHN, K. (1991): "Economic Growth, Technological Change Biases, and the
34
35 Elasticity of Substitution: A Test of the de la Granville Hypothesis," *Review*
36
37 *of Economics and Statistics*, pp. 340–6.
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

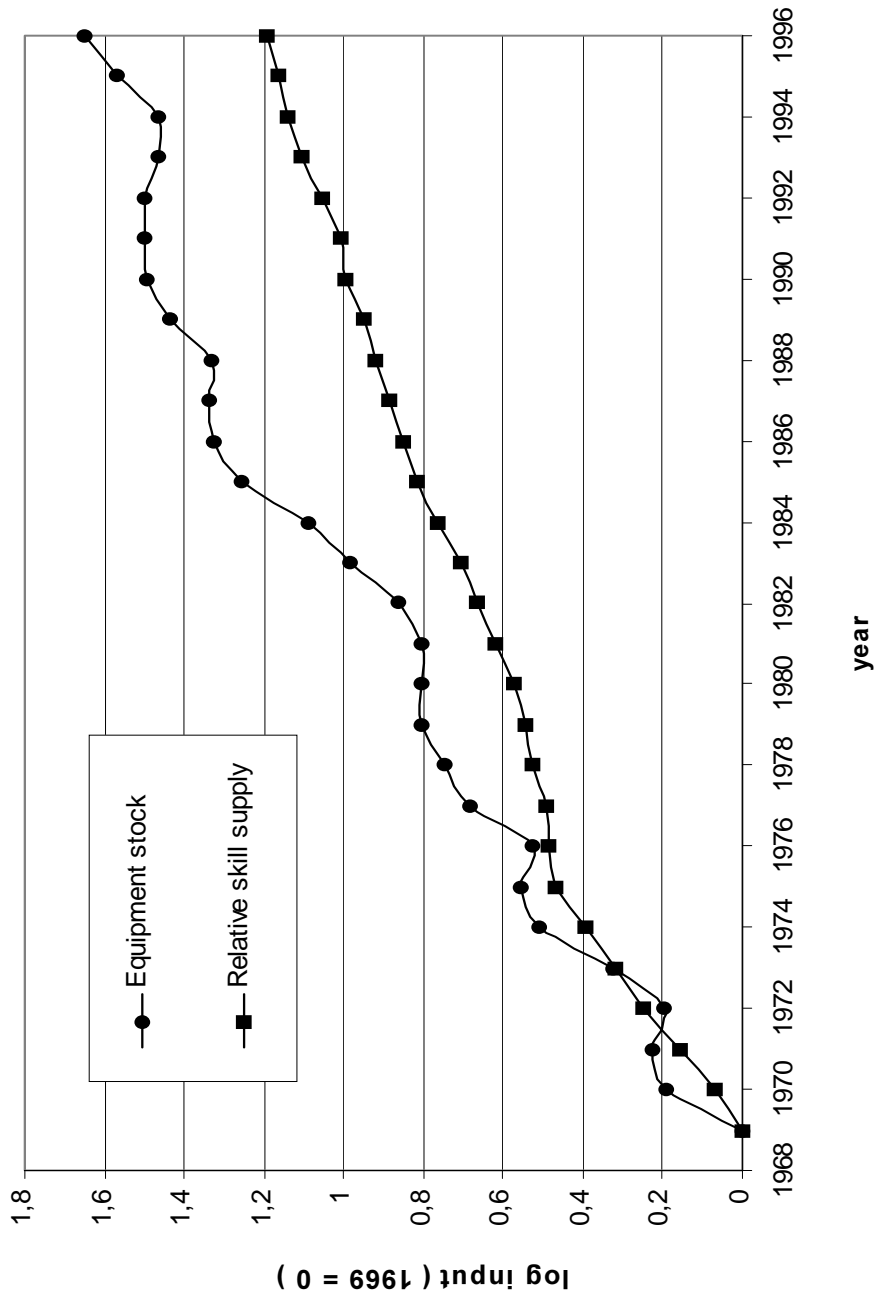


Figure 1: Time-series of equipment stock and relative supply of skilled labor in the Netherlands 1969-1996.

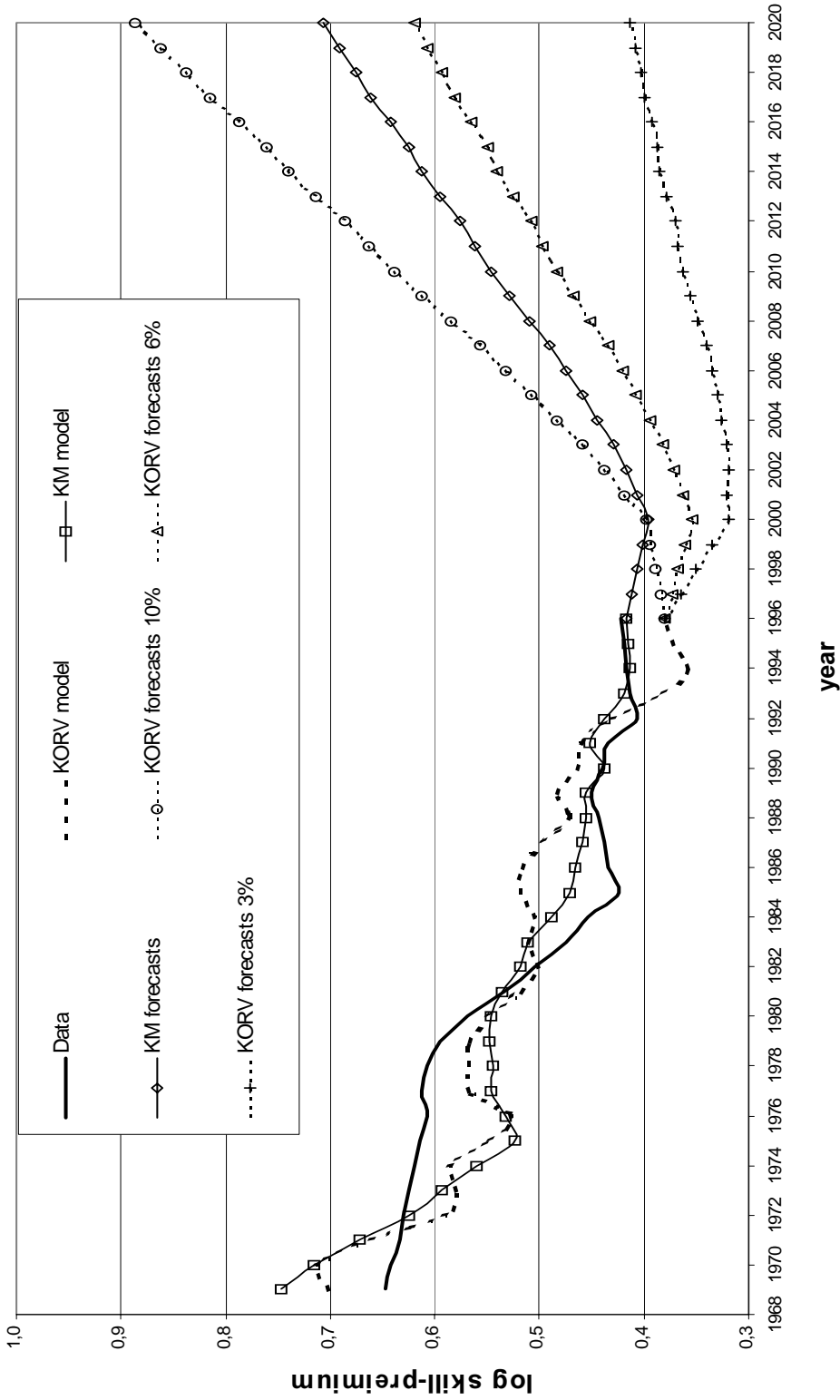


Figure 2: Ex-post (1969-1996) and ex-ante (1997-2020) predictions of the skill-premium schedule in the Netherlands using the KM and KORV models.

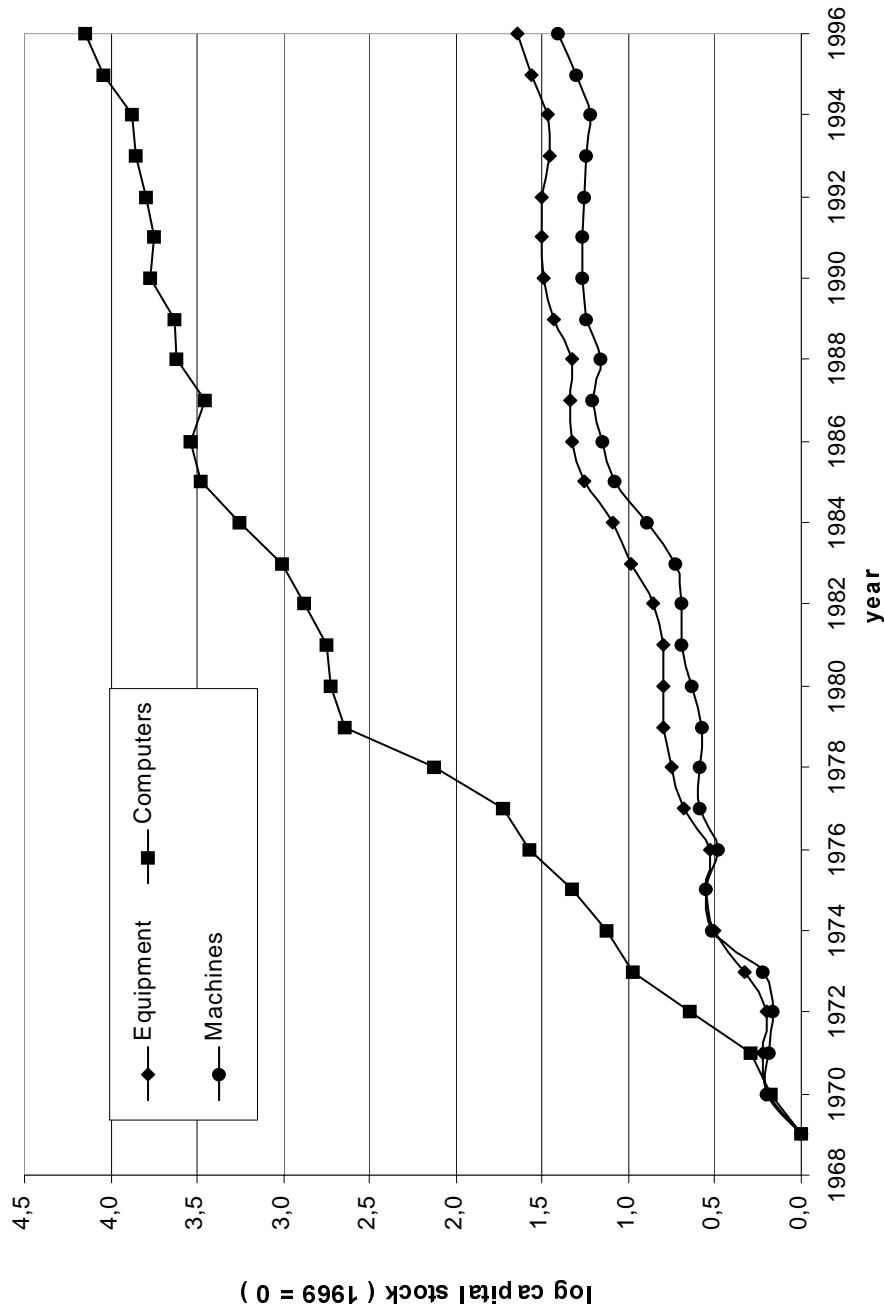


Figure 3: Time-series of equipment stock, computers stock and Machines stock in the Netherlands 1969-1996.

Table 1: Parameter estimates of the skill-premium in levels.

Levels				
KM model	$\log \frac{L_{st}}{L_{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2	DW
<i>time</i> : $\gamma_2 = 0.01$	-0.492^a (0.021)	2.03	0.95	0.97
<i>time</i> : $\gamma_2 = 0.02$	-0.731^a (0.025)	1.37	0.97	1.19
<i>time</i> : $\gamma_2 = 0.03$	-0.970^a (0.031)	1.03	0.97	1.32
<i>time</i> : $\gamma_2 = 0.04$	-1.120^a	0.89	0.98	1.38
KORV model	$\log \frac{L_{st}}{L_{ut}} : \gamma'_1$	$\sigma = -\frac{1}{\gamma'_1}$	R_{adj}^2	DW
$\log K_t : \gamma_3 = 0.10$	-0.397^a (0.021)	2.52	0.93	0.20
$\log K_t : \gamma_3 = 0.20$	-0.542^a (0.024)	1.85	0.95	0.24
$\log K_t : \gamma_3 = 0.30$	-0.686^a (0.028)	1.46	0.96	0.29
$\log K_t : \gamma_3 = 0.40$	-0.831^a (0.032)	1.20	0.96	0.34

^a sig at 1%

(Standard-deviation)

DW Durbin-Watson

Note: σ is the elasticity of substitution between skilled and unskilled labor.

Table 2: Comparison of changes in the skill-premium under SBTC and Capital skill complementarity.

Period	KM, contribution of:			KORV, contribution of:			Data
	<i>time</i>	$\log \frac{L_{st}}{L_{ut}}$	$\hat{\pi}_t$	$\log K_t$	$\log \frac{L_{st}}{L_{ut}}$	$\hat{\pi}_t$	π_t
69-81	2	-3.75	= -1.75	1.99	-3.52	= -1.54	-1.09
81-96	2	-2.73	= -0.73	1.69	-2.56	= -0.87	-0.59
69-96	2	-3.22	= -1.22	1.83	-3.03	= -1.19	-0.83

Note: the contributions are expressed in annual percentage rates.

Table 3: Parameter estimates of the skill-premium in first differences.

First-Differences			
KM model	$\log \frac{L_{st}}{L_{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2
<i>time</i> : $\gamma_2 = 0.01$	-0.349^a (0.058)	2.87	0.57
<i>time</i> : $\gamma_2 = 0.02$	-0.530^a (0.068)	1.89	0.69
<i>time</i> : $\gamma_2 = 0.03$	-0.711^a (0.081)	1.41	0.74
<i>time</i> : $\gamma_2 = 0.04$	-0.892^a	1.12	0.76
KORV model	$\log \frac{L_{st}}{L_{ut}} : \gamma'_1$	$\sigma = -\frac{1}{\gamma'_1}$	R_{adj}^2
$\log K_t : \gamma_3 = 0.10$	-0.284^a (0.060)	3.52	0.44
$\log K_t : \gamma_3 = 0.20$	-0.402^a (0.078)	2.49	0.49
$\log K_t : \gamma_3 = 0.30$	-0.520^a (0.100)	1.92	0.49
$\log K_t : \gamma_3 = 0.40$	-0.637^a (0.124)	1.57	0.48

^a sig at 1%

(Standard-deviation)

Note: σ is the elasticity of substitution between skilled and unskilled labor.

Table 4: Parameter estimates of the skill-premium in levels and first differences for computers and machines.

	Levels			First-Differences		
Computers	$\log \frac{L^{st}}{L^{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2	$\log \frac{L^{st}}{L^{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2
$\log K_t : \gamma_3 = 0.30$	-1.381 ^a (0.064)	0.72	0.95	-1.072 ^a (0.177)	0.93	0.57
$\log K_t : \gamma_3 = 0.20$	-1.005 ^a (0.046)	0.99	0.95	-0.770 ^a (0.126)	1.30	0.57
$\log K_t : \gamma_3 = 0.12$	-0.704 ^a (0.033)	1.42	0.94	-0.529 ^a (0.088)	1.89	0.55
$\log K_t : \gamma_3 = 0.10$	-0.629 ^a (0.030)	1.59	0.94	-0.469 ^a (0.080)	2.13	0.55
Machines	$\log \frac{L^{st}}{L^{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2	$\log \frac{L^{st}}{L^{ut}} : \gamma_1$	$\sigma = -\frac{1}{\gamma_1}$	R_{adj}^2
$\log K_t : \gamma_3 = 0.30$	-0.620 ^a (0.028)	1.61	0.95	-0.500 ^a (0.113)	2.00	0.41
$\log K_t : \gamma_3 = 0.40$	-0.742 ^a (0.032)	1.35	0.95	-0.611 ^a (0.142)	1.64	0.39
$\log K_t : \gamma_3 = 0.50$	-0.864 ^a (0.031)	1.16	0.95	-0.722 ^a (0.182)	1.39	0.38

^a sig at 1%

(Standard-deviation)

Note: σ is the elasticity of substitution between skilled and unskilled labor.

Table 5: Decomposition of the skill premium forecasts to 2020 for the KM and KORV models and realistic scenarios of the growth of capital stock.

Model: Scenario	<i>time</i>	$\log K_t$	$\log \frac{L_{st}}{L_{nt}}$	$\hat{\pi}_t$	$(\widehat{\pi}_{2020} - \widehat{\pi}_{1996}) \%$
KORV: $\dot{K} = 10\%$	—	2.86	−0.68	2.18	+50%
KORV: $\dot{K} = 6\%$	—	1.75	−0.68	1.07	+25%
KORV: $\dot{K} = 3\%$	—	0.86	−0.68	0.18	+5%
KORV: $\dot{K} = 1.6\%$	—	0.50	−0.68	−0.18	−5%
KORV: $\dot{K} = 6.75\%$ (=KM)	—	1.96	−0.68	1.28	+30%
KM	2	—	−0.72	1.28	+30%

Note: the contributions are expressed in annual percentage rates.