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Distribution and growth in France and Germany – single equation estimations and model simulations based on the Bhaduri/Marglin-model

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Distribution and growth in France and Germany – single equation estimations and model simulations based on the Bhaduri/Marglin-model*

Eckhard Hein and Lena Vogel

Abstract

We analyse the relationship between functional income distribution and economic growth in France and Germany from 1960 until 2005. The analysis is based on a demand-driven distribution and growth model for an open economy inspired by Bhaduri/Marglin (1990), which allows for profit- or wage-led growth. First, we apply a single equation approach, estimating the effects of redistribution on the demand aggregates and summing up these effects in order to obtain the total effect of redistribution on GDP growth. Since interactions between the demand aggregates are omitted from this approach, we also apply a simulation approach taking into account these interactions. In the single equations approach we find that growth in France and in Germany was wage-led. This qualitative result is confirmed by the simulation approach, but the quantitative effects differ somewhat. Whereas in the single equation approach the wage-led nature of the demand regime in Germany seems to be more pronounced than in France, in the simulation approach the effects in the two countries seem to converge.

JEL code: E12, E21, E22, E23, E25

Key words: Distribution, growth, demand-led accumulation regimes

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1. Introduction

In a seminal paper, Bhaduri/Marglin (1990) have argued that Kaleckian models of distribution and growth may allow for wage- or profit-led growth.[1] Generally, Kaleckian models are characterised by a variable rate of capacity utilisation in the long run. Income distribution is determined by firms' mark-up pricing in incompletely competitive goods markets and is hence mainly affected by the degree of competition in the goods market and by relative powers of firms and workers in the labour market. Firms' investment decisions, determined by expected sales and internal profits, determine capacity utilisation, capital accumulation and growth. In the older 'stagnationist' variant of the Kaleckian model, pioneered by Rowthorn (1981), Dutt (1984, 1987, 1990) and Amadeo (1986a, 1986b, 1987), changes in distribution have unique effects on long-run growth equilibrium: Rising wage shares cause higher capacity utilisation, capital accumulation, growth and also a higher profit rate, because a strong accelerator effect in the investment function is assumed. However, Bhaduri/Marglin (1990) have shown that in a growth model driven by effective demand, long-run growth may be either 'wage-led' or 'profit-led', if the effects of redistribution between wages and profits on consumption, on the one hand, and on firms' investment, directly via unit profits and indirectly via capacity utilisation, on the other hand, are fully taken into account. Therefore, the identification of an accumulation regime in a certain country during a certain period of time becomes a question of concrete historical and empirical analysis, and the Bhaduri/Marglin approach has increasingly inspired empirical work.

To our knowledge, Bowles/Boyer (1995) have presented the first attempt to determine growth regimes in the Bhaduri/Marglin-model empirically, applying a single-equation approach. In this approach the effects of redistribution on the demand aggregates (consumption, investment, net exports) are separately estimated and then summed up in order to obtain the total effect of redistribution on GDP growth. This method has been followed by other authors.[2] However, the results with respect to France and Germany, but also concerning other countries, are not conclusive. Bowles/Boyer (1990) find that the domestic sectors in France and Germany are wage-led, but including the effects of distribution on net exports turns the two economies profit-led. Ederer/Stockhammer (2007) confirm this result for France. These studies, therefore, seem to support Bhaduri/Marglin's (1990) theoretical conclusion that wage-led growth becomes less feasible when the effects of redistribution on foreign trade are

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[1] See Kalecki (1954, 1971) and Steindl (1952) as well as the surveys in Lavoie (1992: 297-347), Blecker (2002) and Hein (2004: 177-219).

[2] See Hein/Vogel (2007) for a survey of empirical studies based on the Bhaduri/Marglin-model and a discussion of potential reasons for different results.

taken into account. Naastepad/Storm (2007) and Hein/Vogel (2007), however, find the two economies to remain wage-led when the effects of distribution on external trade are included. The differences between these studies are mainly due to differences in the estimation results for the effects of redistribution on investment and on net exports, as has been discussed in detail in Hein/Vogel (2007). In that paper we have also argued that the single equation approach suffers from a major drawback: estimating single equations for the components of aggregate demand (consumption, investment, net exports) and summing up the partial effects of redistribution on these components does not take into account interactions between the demand aggregates. For example, in a single equation approach the effect of redistribution on the contribution of consumption demand to GDP growth is estimated, but the indirect effects of the associated change in GDP on the growth contributions of investment and net exports are not taken into account. In the present paper we attempt to remedy this deficiency by means of a simulation approach which takes into account interactions between the components of aggregate demand.

The paper is organised as follows. In the second section we present an open economy model without economic activity by the state which is based on Bhaduri/Marglin (1990) as the theoretical starting point of our analysis. The results of a single equation estimations approach to the effects of redistribution on growth in France and Germany are described in section 3. The estimated equations are then used in a simulation approach in section 4 and the results are compared to the single equations estimation method. Section 5 concludes and sums up.

2. The theoretical model

The theoretical model is based on the open economy analysis in Bhaduri/Marglin (1990) and in Blecker (1989). We assume an open economy without economic activity of the state, which depends on imported inputs for production purposes and the output of which competes in international markets. We take the prices of imported inputs and of the competing foreign final output to be exogenously given and to be moving in step. The nominal exchange rate, the price of a unit of domestic currency in foreign currency, is determined by monetary policies and international financial markets and is also considered to be exogenous for our purposes.

In order to analyse the effects of changes in distribution on economic activity and capital accumulation, we start with the goods market equilibrium condition for an open economy without economic activity of the state in real terms: Planned saving (S) has to be equal to net investment (I) and net exports (NX), the difference between exports (X) and imports (M) of goods and services:

$$S = I + X - M = I + NX. \tag{1}$$

For convenience, equation (1) is normalised by the real capital stock (K). Therefore, we get the following goods market equilibrium relationship between the saving rate (σ = S/K), the accumulation rate (g = I/K) and the net export rate (b = NX/K):

$$\sigma = g + b. \tag{2}$$

Saving consists of saving out of profits (S_Π) and saving out of wages (S_W). The propensity to save out of wages (s_W) is assumed to fall short of the propensity to save out of profits (s_Π), in particular because the latter includes retained earnings of firms. The profit share relates profits to domestic income consisting of wages and profits (h = Π/(W+Π) = Π/Y), the rate of capacity utilisation is the relation of output to potential output ($u = Y/Y^p$) and the capital-potential output ratio relates the capital stock to potential output ($v = K/Y^p$). Thus, we obtain for the saving rate:

$$\sigma = \frac{S_\Pi + S_W}{K} = \frac{s_\Pi \Pi + s_W (Y - \Pi)}{K} = \left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{u}{v}, \qquad 0 \leq s_W < s_\Pi \leq 1. \tag{3}$$

Investment is modelled according to Bhaduri/Marglin (1990): Capital accumulation is a positive function of the profit rate, which can be decomposed into the profit share, the rate of capacity utilisation and the capital-potential output ratio (r = hu/v). With a constant coefficient technology, investment is therefore positively affected by the profit share and by capacity utilisation. Increasing unit profits and hence a rising profit share have a positive effect on investment because internal funds for investment finance improve, ceteris paribus. Increasing capacity utilisation has a positive effect on investment because the relation between (expected) sales and productive capacity improves. In order for domestic capital accumulation to be positive, the expected rate of profit has to exceed a minimum rate (r_{min}), given by the foreign rate of profit or by the rate of interest in financial markets. Both possible minimum rates are considered to be exogenous in the present model.

$$g = \alpha + \beta u + \tau h, \qquad \alpha, \beta, \tau > 0, \qquad g > 0 \ \text{ only if } \ r > r_{min}. \tag{4}$$

The net export rate is positively affected by international competitiveness, provided that the Marshall-Lerner condition can be assumed to hold and the sum of the price elasticities of exports and imports exceeds unity. Under this condition, the real exchange rate (e_r) will have a positive effect on net exports. But net exports also depend on the relative developments of foreign and domestic demand. If domestic demand grows at a faster rate than foreign demand, net exports will decline, ceteris paribus. Therefore, the domestic rate of capacity utilisation will have a negative impact on net exports.

$$b = \psi e_r(h) - \phi u, \qquad \psi, \phi > 0. \tag{5}$$

The real exchange rate which is determined by the nominal exchange rate (e) and by the relationship between foreign prices (p_f) and domestic prices (p): $e_r = ep_f/p$, is affected by changes in the profit share, but in an ambiguous way, as has been shown in detail in Hein/Vogel (2007).

$$e_r = e_r(h), \qquad \begin{array}{l} \dfrac{\partial e_r}{\partial h} > 0, \text{ if } \Delta z > 0 \text{ and } \Delta m = 0, \\ \dfrac{\partial e_r}{\partial h} < 0, \text{ if } \Delta z = 0 \text{ and } \Delta m > 0. \end{array} \tag{6}$$

Assuming that firms set prices according to a mark-up on unit variable costs, consisting of imported material costs and labour costs, a change in the profit share can either be caused by a change in the mark-up or by a change in the ratio of unit costs of imported materials to unit labour costs (z). If an increase in the profit share is caused by a rising mark-up, ceteris paribus, domestic prices will rise and the real exchange rate and hence international competitiveness will decline. But if an increasing profit share is triggered by a rising ratio of unit imported material costs to unit labour costs, ceteris paribus, the real exchange rate will increase and international competitiveness will improve. Nominal depreciation of the domestic currency, that is an increase in the nominal exchange rate, or falling nominal wages will increase the ratio of unit material costs to unit labour costs, and will therefore make an increasing profit share go along with improved competitiveness.

Stability of the goods market equilibrium requires that saving responds more elastically towards a change in the endogenous variable, the rate of capacity utilisation, than investment and net exports do together:

$$\frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u} - \frac{\partial b}{\partial u} > 0 \qquad \Rightarrow \qquad \left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{1}{v} - \beta + \phi > 0. \tag{7}$$

We shall only consider stable goods market equilibria and the effects of changes in distribution on these equilibria. The equilibrium rates (*) of capacity utilisation and capital accumulation are given by:

$$u^* = \frac{\alpha + \tau h + \psi e_r(h)}{\left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{1}{v} - \beta + \phi}, \tag{8}$$

$$g^* = \alpha + \frac{\beta\left[\alpha + \tau h + \psi e_r(h)\right]}{\left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{1}{v} - \beta + \phi} + \tau h \ . \tag{9}$$

Whereas equilibrium capacity utilisation indicates equilibrium activity with given productive capacities, equilibrium capital accumulation determines the development of productive capacities or potential output. The effect of a change in the profit share on the rates of capacity utilisation and capital accumulation can be calculated from equations (8) and (9):

$$\frac{\partial u}{\partial h} = \frac{\tau - \left(s_\Pi - s_W\right)\frac{u}{v} + \psi\frac{\partial e_r}{\partial h}}{\left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{1}{v} - \beta + \phi}, \tag{8a}$$

$$\frac{\partial g}{\partial h} = \frac{\tau\left(\frac{s_W}{v} + \phi\right) + \left(s_\Pi - s_W\right)\left(\tau\frac{h}{v} - \beta\frac{u}{v}\right) + \beta\psi\frac{\partial e_r}{\partial h}}{\left[s_W + \left(s_\Pi - s_W\right)h\right]\frac{1}{v} - \beta + \phi}. \tag{9a}$$

Equation (8a) shows that an increasing profit share will have no unique effect on equilibrium capacity utilisation. From the numerator it can be seen that the total effect of redistribution in favour of profits is composed of three effects: First, there is a positive effect via investment demand (τ), second, a negative effect via consumption demand [$-\left(s_\Pi - s_W\right)\frac{u}{v}$] and third, an undetermined effect via net exports ($\psi\frac{\partial e_r}{\partial h}$). The direction of the latter depends on the source of redistribution and can be either negative or positive.

For equilibrium capital accumulation a similar result is obtained, as can be seen in equation (9a). The total effect of an increasing profit share on equilibrium accumulation is not unique and depends on the direction and the magnitude of three effects again. In the numerator we have first the positive effect originating from an increase in unit profits [$\tau\left(\frac{s_w}{v}+\phi\right)$]. Then we have the indirect effect via consumption demand and capacity utilisation [$(s_\Pi - s_W)\left(\tau\frac{h}{v}-\beta\frac{u}{v}\right)$], which can be positive or negative. And finally there is the indirect effect via net exports ($\beta\psi\frac{\partial e_r}{\partial h}$) which may also be positive or negative.

So far equilibrium analysis takes us. In what follows we shall confine the empirical study to the analysis of the effects of a change in distribution on the components of aggregate demand and hence on GDP growth.

3. Single-equation estimations of the effect of a change in the profit share on real GDP growth

Taking the growth of real GDP as a proxy for capacity utilisation and following Bowles/Boyer (1995), we first estimated the overall effect of a change in the profit share on real GDP growth applying a single-equation approach. In this way we obtained a first approximation of the nature of the growth regime in the respective countries, France and Germany, disregarding the effects of interdependencies between the demand components. We estimated three separate equations determining the partial effects of a change in the profit share (h) on the GDP growth contributions of consumption (C), investment (I) and net exports (NX). The partial effects were then added up to obtain the total effect of a percentage change in the profit share on the percentage change of GDP (Y):

$$\frac{\frac{\partial Y}{Y}}{\partial h} = \frac{\frac{\partial C}{Y}}{\partial h} + \frac{\frac{\partial I}{Y}}{\partial h} + \frac{\frac{\partial NX}{Y}}{\partial h} \tag{10}$$

For the reasons outlined in the theoretical model we expected the following signs of the derivatives:

$$\frac{\frac{\partial C}{Y}}{\partial h} < 0,\ \frac{\frac{\partial I}{Y}}{\partial h} > 0,\ \frac{\frac{\partial NX}{Y}}{\partial h} = ?, \qquad \Rightarrow \quad \frac{\frac{\partial Y}{Y}}{\partial h} = ?. \tag{10a}$$

Estimations for France and Germany were carried out for the period 1960 to 2005. All data was obtained from the AMECO database of the European Commission (2006).[3] Variables are generally in real terms. Profits and the profit share were not adjusted for changes in the share of employees in total employment. The results reported below therefore slightly differ from those derived for France and Germany in Hein/Vogel (2007).

Generally, the time series contained in the different equations were first tested for unit roots applying an Augmented Dickey-Fuller Test (ADF). Since not all the variables contained in the equations were I(1), we tested for the possibility to estimate an error-correction model applying the bounds testing approach developed by Pesaran et al. (2001) which tests for the existence of a long-run relationship between the variables regardless of their order of integration. Bounds of critical values were developed for an F-test testing for the significance of all long-term equilibrium coefficients and for a t-test for the error correction term. If the test values are outside these bounds, the null hypothesis of no significance can be rejected regardless of the order of integration or the mutual cointegration of the variables. For the specification of the lag-structure of the error-correction models, the 'general to specific' approach by Granger (1997) was adopted, starting with a relatively high number of lags and successively eliminating insignificant coefficients. If the estimation of an error-correction model according to this approach was not possible, the equation was estimated using first differences of the variables in order to avoid the problem of spurious regressions. All regressions were estimated with the method of ordinary least squares.

Assuming away interactions between the demand aggregates and hence assuming that the profit share has no effect on the GDP variable as a determinant in the estimated equations, the effects of a change in the profit share on the GDP growth contributions of the demand aggregates can be estimated either directly, regressing the profit share on the share of the respective demand aggregate in GDP. Alternatively, level variables in logs for profits (and wages in the consumption function) or the profit share itself can be regressed on the demand aggregates in logs, and then the estimated coefficients have to be corrected in order to obtain the effect of a change in the profit share on the GDP-growth contribution of the demand aggregate.[4]

For both countries under investigation we estimated the same equations for consumption and net exports. In the case of the investment function, however, this was not possible due to significance problems. Therefore, we had to try different estimations, as will be seen below.

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[3] See 'Data definitions and data source' in the appendix.

[4] See 'Estimation strategy in the single equation approach' in the appendix.

3.1 Consumption

The effect of a change in distribution on aggregate consumption was estimated according to the assumptions contained in the saving function (3) of the theoretical model:

$$C = f(\Pi, W)\,. \tag{11}$$

Compensation of employees represents wages (W) and gross operating surplus represents profits (Π) in the empirical analysis. We used gross instead of net profits to ensure that the partial effects can be added up to the total effect on the percentage change of real GDP. Both wages and profits were deflated by the price deflator of GDP in order to obtain the real values. All variables were then converted into logarithms, so that elasticities instead of direct partial effects were estimated. Following our theoretical model, we generally expected the elasticity of consumption with respect to wages to be significantly higher than the elasticity with respect to profits.

The time series of real consumption, real profits and real wages were found to be almost completely I(1) at the 1 percent significance level (Table A1 in the appendix). Since the critical values by Pesaran et al. (2001) rejected the existence of a long-run level relationship between the variables, the consumption function was estimated employing first differences:

$$d[\log(C_t)] = c + a_1 d[\log(\Pi_t)] + a_2 d[\log(W_t)]. \tag{12}$$

Equation (12) thus estimates the elasticities $a_1 = (\partial C/C)/(\partial \Pi/\Pi)$ and $a_2 = (\partial C/C)/(\partial W/W)$, respectively. Table 1 presents the results. Generally, coefficients were found to be highly significant at the 1 percent level, suggesting the equation to be robust and well specified. This was confirmed by relatively high values of R-squared and the rejection of general misspecification, autocorrelation or heteroskedasticity of the residuals by various test statistics. When necessary, estimations were corrected for outliers to prevent heteroskedasticity of the residuals.

Table 1: Estimation results for the consumption function

equation (12) $d[\log(C_t)] = c + a_1 d[\log(\Pi_t)] + a_2 d[\log(W_t)]$

Country	c	a_1	a_2	Adj. R^2	DW-Statistics	Ramsey RESET Test (prob.)	Q-Statistics (prob. for lag = 1)	White Test (prob.)
France[1]	0.006** (0.002)	0.136*** (0.030)	0.589*** (0.056)	0.765	1.864	0.380	0.664	0.666
Germany[2]	0.006** (0.002)	0.137*** (0.042)	0.660*** (0.050)	0.923	1.767	0.592	0.451	0.168

Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors are in parentheses.
[1] Estimated correcting for an outlier in 1974.
[2] Estimated correcting for outliers in 1975 and 1991.

Table 2: Partial effect of a change in the profit share on the growth contribution of consumption

equation (13) $$\frac{\partial \frac{C}{Y}}{\partial h} = a_1 \frac{C}{\Pi} - a_2 \frac{C}{W}$$

Country	C/Π	C/W	a_1(C/Π)	a_2(C/W)	(∂C/Y)/∂h
France	2.338	1.112	0.318	0.655	**-0.337**
Germany	2.075	1.062	0.284	0.701	**-0.417**

As expected, the long-run elasticities of consumption with respect to wages were significantly higher than those with respect to profits. In order to calculate the partial effect of a change in the profit share on the GDP growth contribution of consumption, we converted the elasticities according to equation (13):

$$\frac{\partial \frac{C}{Y}}{\partial h} = a_1 \frac{C}{\Pi} - a_2 \frac{C}{W} \tag{13}$$

In both countries, the partial effect of the profit share on consumption was significantly negative: A one-percentage-point increase of the profit share according to our results reduces private consumption by 0.337 and 0.417 percentage-points of GDP, respectively.

3.2 Investment

Capital accumulation in our theoretical model was determined by capacity utilisation and the profit share. In the estimations we used the log of real GDP as a proxy for capacity utilisation and tried the following investment function:

$$I = f(Y, h)\,. \tag{14a}$$

Alternatively, the log of real gross profits was included instead of the profit share to represent the profitability effect on investment:

$$I = f(Y, \Pi)\,. \tag{14b}$$

For the reasons given in the theoretical model, we generally expected a positive influence of both an increase in profitability and in real GDP on investment. As mentioned above, we estimated various specifications for the investment function and report those with the most significant and plausible results for the two countries. The variables were tested for stationarity and we found that they were generally I(1) (Table A2 in the appendix). Again, we tested for the existence of a long-run level relationship between the variables with the bounds testing approach by Pesaran et al. (2001) and estimated error correction models, when possible.

For France, the following error correction model could be estimated:

$$\begin{aligned} d[\log(I_t)] = {} & c + a_1 \log(I_{t-1}) + a_2 \log(Y_{t-1}) + a_3 \log(\Pi_{t-1}) \\ & + a_4 d[\log(Y_t - I_t)] + a_5 d[\log(I_{t-1})] + a_6 d[\log(\Pi_{t-2})] \end{aligned} \tag{15a}$$

Both the critical bounds values for the t-Statistic for the error correction term and those for the F-Statistic for the three long-term coefficients rejected the null hypothesis of no significance at the 1 percent level (Table 3a). Additionally, a high value of R-squared and the value of the Durbin-Watson Statistic indicated a good specification of the model. We restricted the short-run dynamics between GDP and investment, thus assuming the share of investment in GDP to be constant at least in the short run. In order to obtain the long-run effect of a change in the profit share on the GDP growth contribution of investment, the long-run coefficient of profits was converted according to equation (16a):

$$\frac{\partial \frac{I}{Y}}{\partial h} = \frac{a_3}{-a_1}\frac{I}{\Pi}. \tag{16a}$$

In the case of Germany, we were not able to estimate any error correction model and thus directly estimated the effect of the profit share on the investment share. Both shares were included as level variables, but a lagged endogenous variable was included to avoid autocorrelation and spurious results. In order to account for the non-stationarity of the profit share and possible long-run dynamics in its relationship to the investment share, we additionally included both the actual and the lagged value of the profit share in the investment function:

$$\frac{I_t}{Y_t} = c + b_1 d\left[\log(Y_t)\right] + b_2 h_t + b_3 \frac{I_{t-1}}{Y_{t-1}} + b_4 h_{t-1}. \tag{15b}$$

Again, the equation seems to be well specified, as there was no indication of misspecification, heteroskedasticity or autocorrelation after the equation had been corrected for an outlier in 1974 (Table 3b). The effect of the profit share on the growth contribution of investment in GDP could be obtained directly from the long-run coefficient of the profit share:

$$\frac{\partial \frac{I}{Y}}{\partial h} = \frac{b_2 + b_4}{1 - b_3}. \tag{16b}$$

Table 3a: Estimation results for the investment function, effect of profits on investment in ECM

equation (15a) $d[\log(I_t)] = c + a_1 \log(I_{t-1}) + a_2 \log(Y_{t-1}) + a_3 \log(\Pi_{t-1}) + a_4 d[\log(Y_t - I_t)] + a_5 d[\log(I_{t-1})] + a_6 d[\log(\Pi_{t-2})]$

Country	a_1	a_2	a_3	Adj. R^2	DW-Statistics	Wald Test[1] (F-Stat.)	Ramsey RESET Test (prob.)	Q-Statistics (prob. for lag = 1)	White Test (prob.)
France	-0.329*** (0.072) [-4.605***]	0.211** (0.083)	0.117** (0.057)	0.639	2.036	7.887***	0.589	0.757	0.121

Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors are in parentheses, t-Statistics in square brackets.
[1] Bounds testing for H_0: $a_1=a_2=a_3=0$ to test for the existence of a long-run relationship between the variables. We assume an unrestricted constant and use special critical values from Pesaran et al. (2000).

Table 3b: Estimation results for the investment function, effect of profits on the investment share in GDP

equation (15b) $\frac{I_t}{Y_t} = c + b_1 d[\log(Y_t)] + b_2 h_t + b_3 \frac{I_{t-1}}{Y_{t-1}} + b_4 h_{t-1}$

Country	b_1	b_2	b_3	b_4	Adj. R^2	DW-Statistics	Ramsey RESET Test (prob.)	Q-Statistics (prob. for lag = 1)	White Test (prob.)
Germany[1]	0.142*** (0.028)	-0.206* (0.110)	0.923*** (0.037)	0.221** (0.104)	0.963	1.857	0.824	0.643	0.447

Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors are in parentheses.
[1] Estimated correcting for an outlier in 1974.
[2] Estimated correcting for outliers in 1969 and 1976.

For the two countries, the partial effects of the profit share on investment are summarised in Table 4. In addition to analysing the significance of the single coefficients in equations (15a) and (15b), we tested for the significance of the long-run coefficients with a Wald Test. For France, we found a significant positive effect of the profit share on the growth contribution of investment: A one-percentage-point increase in the profit share increases investment by 0.269 percentage-points of GDP. In Germany, the long-run coefficient of the profit share was also found to be positive. However, the Wald Test for overall significance did not reject the null hypothesis of no significance, so that we have no long-run effect of the profit share on the growth contribution of investment. Since the positive effect on investment in France was less pronounced than the negative effect on consumption, both countries display a wage-led regime when disregarding the effects of redistribution on net exports.

3.3 Net exports

Based on the arguments in our theoretical model, we assumed net exports and thus also the share of net exports in GDP to be affected by domestic and foreign demand on the one hand, and by the profit share, through its effect on the real exchange rate, on the other hand:

$$\frac{NX}{Y} = f(h, Y, Y^f). \tag{17}$$

We expected domestic demand, represented by domestic GDP, to have a negative influence on the share of net exports, and consequently foreign demand, represented by GDP of the main trading partners (Y^f), to have a positive influence on net exports. According to the theoretical model, the sign of the effect of the profit share on the share of net exports is not clear in advance, but depends on the source of the change in the profit share and the concomitant effect on the real exchange rate.

In order to assure the comparability with the simulation results from the next section, the share of net exports was calculated from real variables. We converted domestic and foreign GDP into logarithms and for simplicity reasons generally assumed the Euro area and/or the USA to be the main trading partner of our two countries. We tested both possibilities for each country and eliminated the coefficient that was not significant. Thus, for Germany we assumed the Euro area to be the main trading partner. In the estimation for France, neither the GDP of the Euro area, nor that of the USA was found to be significant, so that the variable was omitted from the equation.

Table 4: Partial effect of the profit share on the growth contribution of investment

equation (16a) $\frac{\partial \frac{I}{Y}}{\partial h} = \frac{a_3}{-a_1}\frac{I}{\Pi}$ or (16b) $\frac{\partial \frac{I}{Y}}{\partial h} = \frac{b_2 + b_4}{1 - b_3}$

Country	$a_3/-a_1$ or $(b_2+b_3)/(1-b_4)$	I/Π	$(\partial I/Y)/\partial h$
France (16.a)	0.356**	0.757	**0.269**
Germany (16.b)	0.195	/	/

Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Results of a Wald Test for overall significance of the effect.

Table 5: Estimation results for the net exports function

equation (18) $\frac{NX_t}{Y_t} = c + a_1 d[\log(Y_t)] + a_2 d[\log(Y_t^f)] + a_3 h_t + a_4 \frac{NX_{t-1}}{Y_{t-1}} + a_5 h_{t-1}$

Country	a_1	a_2	a_3	a_4	a_5	Adj. R^2	DW-Statistics	Ramsey RESET Test (prob.)	Q-Statistics (prob. for lag = 1)	White Test (prob.)
France[1]	-0.301*** (0.056)	/	-0.017 (0.031)	0.788*** (0.079)	/	0.860	1.807	0.788	0.533	0.318
Germany[2]	-0.405*** (0.082)	0.376*** (0.123)	0.469** (0.184)	0.861*** (0.076)	-0.438** (0.188)	0.794	1.680	0.549	0.283	0.246

Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Standard errors are in parentheses.
[1] Estimated correcting for outliers in 1997 and 2005. Since neither the GDP of the Euro area, nor that of the US was found significant, the variable was omitted from the equation. An additional lagged variable $a_6 d[\log(Y_{t-1})]$ (coefficient: 0.155** (0.063)) was included in the equation to correct for autocorrelation.
[2] The growth of GDP of the Euro area is taken as $Y^{foreign}$.

Stationarity for the time series contained in equation (19) was rejected by the ADF Test (Table A3 in the appendix). Still, estimation in an error-correction model was not possible according to the special critical values by Pesaran et al. (2001). Although the share of net exports in GDP as well as the profit share was not found to be stationary, we did not estimate them in first differences, but instead included lagged variables to account for first order autocorrelation:

$$\frac{NX_t}{Y_t} = c + a_1 d\left[\log(Y_t)\right] + a_2 d\left[\log(Y_t^f)\right] + a_3 h_t + a_4 \frac{NX_{t-1}}{Y_{t-1}} + a_5 h_{t-1}. \tag{18}$$

With the exception of the coefficient of the profit share in the estimation for France which was insignificant and estimated to be zero, coefficients were significant at least at the 10 percent level (Table 5). In the estimation for France a lagged variable $a_6 d[\log(Y_{t-1})]$ was included in the estimation to correct for first order autocorrelation. When necessary, we corrected for outliers to avoid heteroskedasticity. Overall, estimations for France and Germany had relatively high values of R-squared and showed no indication of misspecification.

The partial effect of the profit share on the GDP growth contribution of net exports could be calculated directly from the long-run coefficient of the profit share:

$$\frac{\partial \frac{NX}{Y}}{\partial h} = \frac{a_3 + a_5}{1 - a_4}. \tag{19}$$

Again we tested for the overall significance of the long-run effect of the profit share on the share of net exports with a Wald Test. In the case of France, this was not necessary since we found no significant effect of the profit share on net exports. For Germany, we estimated a positive effect on the growth contribution of net exports of 0.195 percentage-points, but the Wald Test could not be rejected. Thus, we were unable to find any significant effects of the profit share on the growth contribution of net exports in either country.

3.4 Total effect

The total effect of a change in the profit share on the percentage change of GDP was calculated by adding up the three partial effects on the GDP growth contributions of the demand aggregates consumption, investment and net exports, according to equation (10).

Table 6: Partial effect of a change in the profit share on the share of net exports equation (19) $\frac{\partial \frac{NX}{Y}}{\partial h} = \frac{a_3 + a_5}{1 - a_4}$		
Country	**$(a_3+a_5)/(1-a_4)$**	**$(\partial NX/Y)/\partial h$**
France	/	/
Germany	**0.223**	/
Notes: *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level. Results of a Wald Test for overall significance of the effect.		

Table 7: Total effect of a change in the profit share on the percentage change of real GDP equation (10) $\frac{\partial \frac{Y}{Y}}{\partial h} = \frac{\partial \frac{C}{Y}}{\partial h} + \frac{\partial \frac{I}{Y}}{\partial h} + \frac{\partial \frac{NX}{Y}}{\partial h}$		
	France	**Germany**
$(\partial C/Y)/\partial h$	-0.337	-0.417
$(\partial I/Y)/\partial h$	0.269	/
$(\partial NX/Y)/\partial h$	/	/
$(\partial Y/Y)/\partial h$	**-0.068**	**-0.417**

Without consideration of foreign trade, both France and Germany show a wage-led growth regime over the period covered in the analysis (Table 7). Since we found no significant effects of the profit share on net exports, the two countries remain wage-led when taking into account foreign trade: A one-percentage-point increase in the profit share results in a decrease of GDP by 0.068 and 0.417 percent, respectively. These results suggest that the wage-led nature of the growth regime is much more pronounced in Germany, which is due to a stronger negative effect on consumption and a non-significant effect on investment.

4. Model simulations of the effect of a change in the profit share on real GDP growth

Estimating single equations for the components of aggregate demand and summing up the partial effects of redistribution on these components does not take into account interactions between the demand aggregates. In this section we attempt to remedy this deficiency by means of applying a simulation approach which takes into account interactions between the components of aggregate demand. This means, for example, that the effect of redistribution on the growth contribution of consumption and hence on GDP growth is also included as an indirect effect in the influence of redistribution on investment and net exports, respectively.

The simulation models for France and Germany were build as follows: The three single equations explaining consumption, investment and net exports in the single-equation approach were included in the model, which was then closed by the accounting equations: $Y = C + I + NX + \varepsilon_1$ and $Y = W + \Pi + \varepsilon_2$, and by the definition $\Pi = hY$. ε_1 includes those components of aggregate demand not explicitly analysed in the estimations and in the model, that is public consumption and public investment. ε_2 includes those components of gross domestic product at market prices which is not distributed as domestic private factor income (profits and wages), that is the difference between value added taxes and subsidies as well as net factor income flows between the domestic economy and foreign countries.

First we compared the model solutions for the endogenous variables to the time series in order to check for the fit of the model with historical data. The model specifications for both countries fit the data quite well, especially when considering the simple nature of the model. We then simulated a permanent one-percentage-point shock to the profit share and tracked its impact on the endogenous variables of the model. The reactions of the variables for France are presented in Figure 1a:

Figure 1a: Effect of a one-percentage-point increase in the profit share on profits, wages and the demand aggregates in France: percentage deviation from baseline

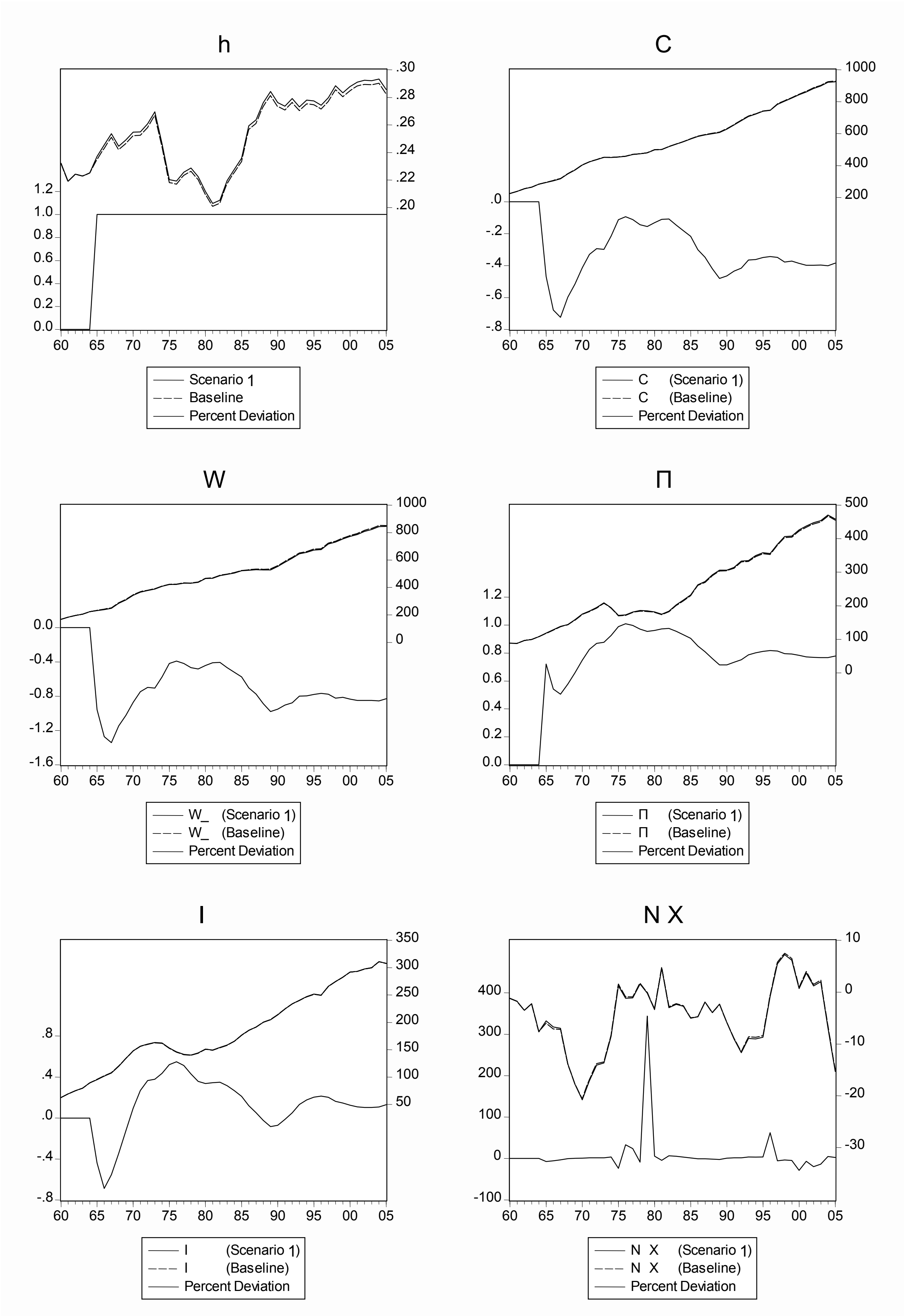
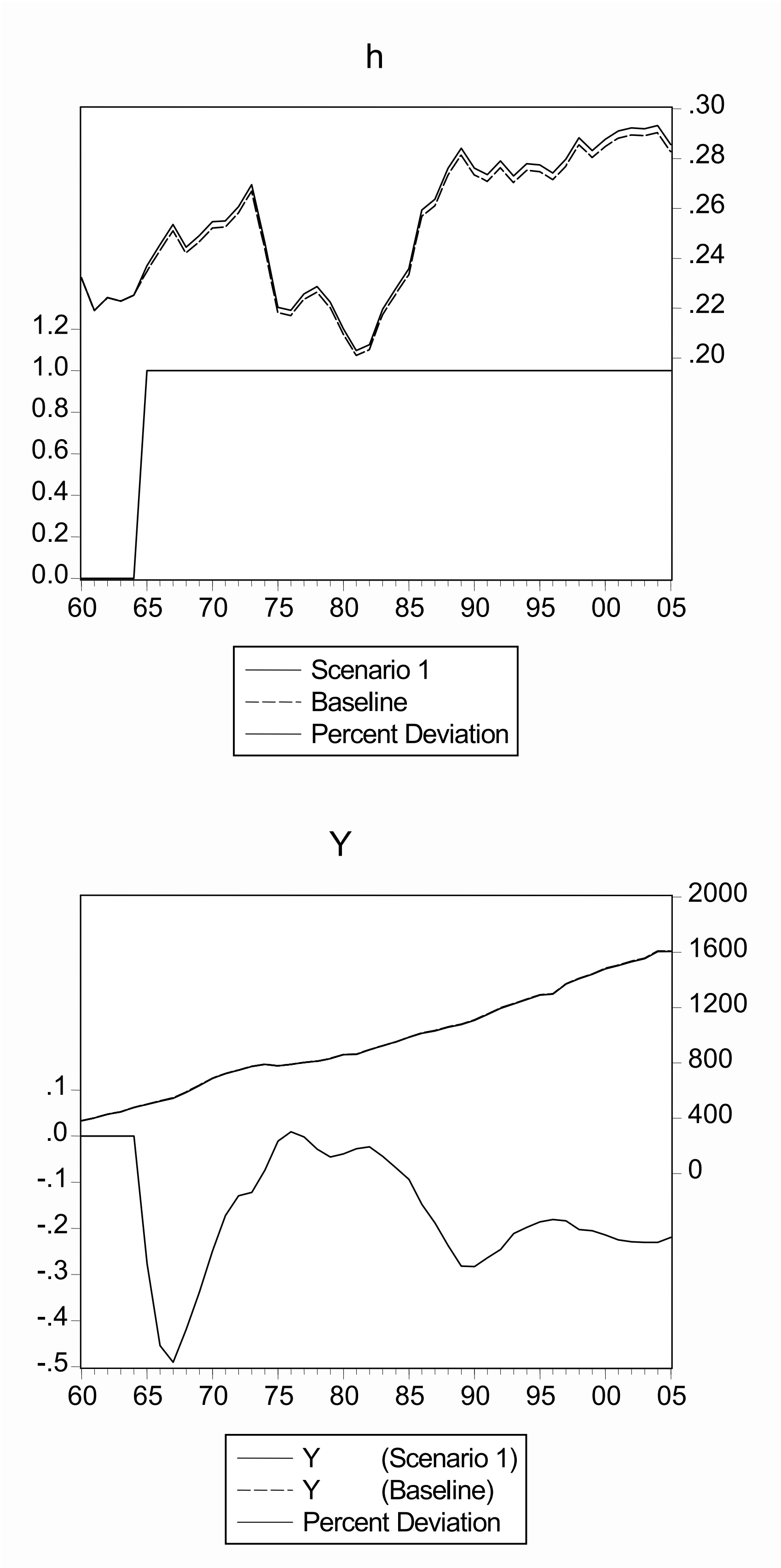


Figure 1b: Effect of a one-percentage-point increase in the profit share on real GDP in France: percentage deviation from baseline



In the simulation, a one-percentage-point increase in the profit share in France immediately increases profits by about 0.7 percent and reduces wages by about 1 percent. Although the change in distribution has favourable effects on profits, both consumption and investment decrease after the shock which then negatively feeds back on both wages and profits. However, soon after the shock, the positive effect of the increase in the profit share on investment sets in, resulting in a positive deviation of investment from its baseline after five years. Profits further increase, and to a lesser degree, also wages and consumption improve but remain considerably below baseline. The increases in consumption and investment reach their peak after about ten years, then turning into a downward trend and finally converging to their seemingly stable long-run values. The effect of changes in the profit share on net exports seems to be small. Taking a closer look at the absolute deviations from baseline in Figure A1 in the appendix, our simulation finds a small negative effect of the increase in the profit share on net exports in the long run in France.

The same pattern as for consumption and investment, with cyclical short-run dynamics and convergence to a relatively stable value, at least during the time span of the simulation, can be observed for real GDP in France in Figure 1b. The permanent negative effects on wages and consumption, and also on net exports, in the simulation for France are stronger than the positive effects on profits and investment, resulting in an overall negative effect of a one-percentage-point increase in the profit share on GDP of about -0.2 percent, and hence a wage-led growth regime. Thus, while the simulation does not change the overall qualitative result of the single-equation approach for France, it suggests the wage-led nature of the growth regime to be considerably stronger when taking into account the interdependencies between the demand aggregates.

In the model simulation for Germany, shown in Figure 2a, a one-percentage-point increase in the profit share immediately increases profits by nearly 0.9 percent and reduces wages by about 0.7 percent. Thus, in contrast to the results for France, the positive effect on profits is found to be stronger than the negative effect on wages. However, this does not prevent consumption and investment from reacting negatively immediately after the shock. After about four years, the negative effect on investment is lessened and after about 15 years the deviation from baseline becomes positive. Although the increase in profits roughly remains at its high initial level, investment finally converges to baseline and there is hence no permanent positive effect on investment, confirming our single equation estimation for investment. Similar but less pronounced than the simulation results for France, wages and consumption experience an upturn a few years after the shock, but remain below baseline also in Germany.

About fifteen years after the shock, however, both wages and consumption then show a slightly downward trend. It thus seems that despite the lasting positive effect of the increase in the profit share on profits in Germany, there is no considerable positive effect on investment in the long run, while wages and consumption experience lasting negative effects which even show a downward trend towards the end of the simulation period. In contrast to the findings for France, the cyclical short-run dynamics are less pronounced and it seems that there is no stable long-run equilibrium, at least for wages and consumption. The effect of changes in the profit share on net exports seems to be small again. Taking a closer look at the absolute deviations of our simulations from baseline in Figure A2 in the appendix reveals that in Germany the increase in the profit share has a small positive effect on net exports which is increasing in the long run.

The overall effect of the increase in the profit share on GDP exhibits similar short-run dynamics as those of consumption and wages and also shows a long-run downward trend which seems to continue until the end of the simulation period, as can be seen in Figure 2b. The significantly negative effects on wages and consumption are dominating the small positive effect on net exports and cause a wage-led growth regime. At the end of the simulation period a one-percentage-point increase in the profit share reduces GDP by about 0.18 percent. Although this seems to suggest a less pronounced wage-led nature than the one found in the single-equation results for Germany, the ongoing downward trend implies an increasingly negative effect of redistribution in favour of profits on real GDP.

On the whole, the model simulations for France and Germany do not alter the qualitative overall results of the single-equation estimations outlined above. Growth in both countries is wage-led, and the simulation approach therefore confirms the single equation estimation results for the two countries by Naastepad/Storm (2007) and by Hein/Vogel (2007), and it contradicts the findings by Bowles/Boyer (1995) for the two countries and by Ederer/Stockhammer (2007) for France. Taking a look at the quantitative effect, the simulation results reveal an interesting convergence of the long-run negative impact of an increasing profit share in the two countries at around -0.2 percent of GDP each, whereas the single equation estimations indicated considerable differences between the countries, a considerably stronger effect for France than for Germany in Naastepad/Storm (2007) and vice versa in our studies.

Figure 2a: Effect of a one-percentage-point increase in the profit share on profits, wages and the demand aggregates in Germany, percentage deviation from baseline

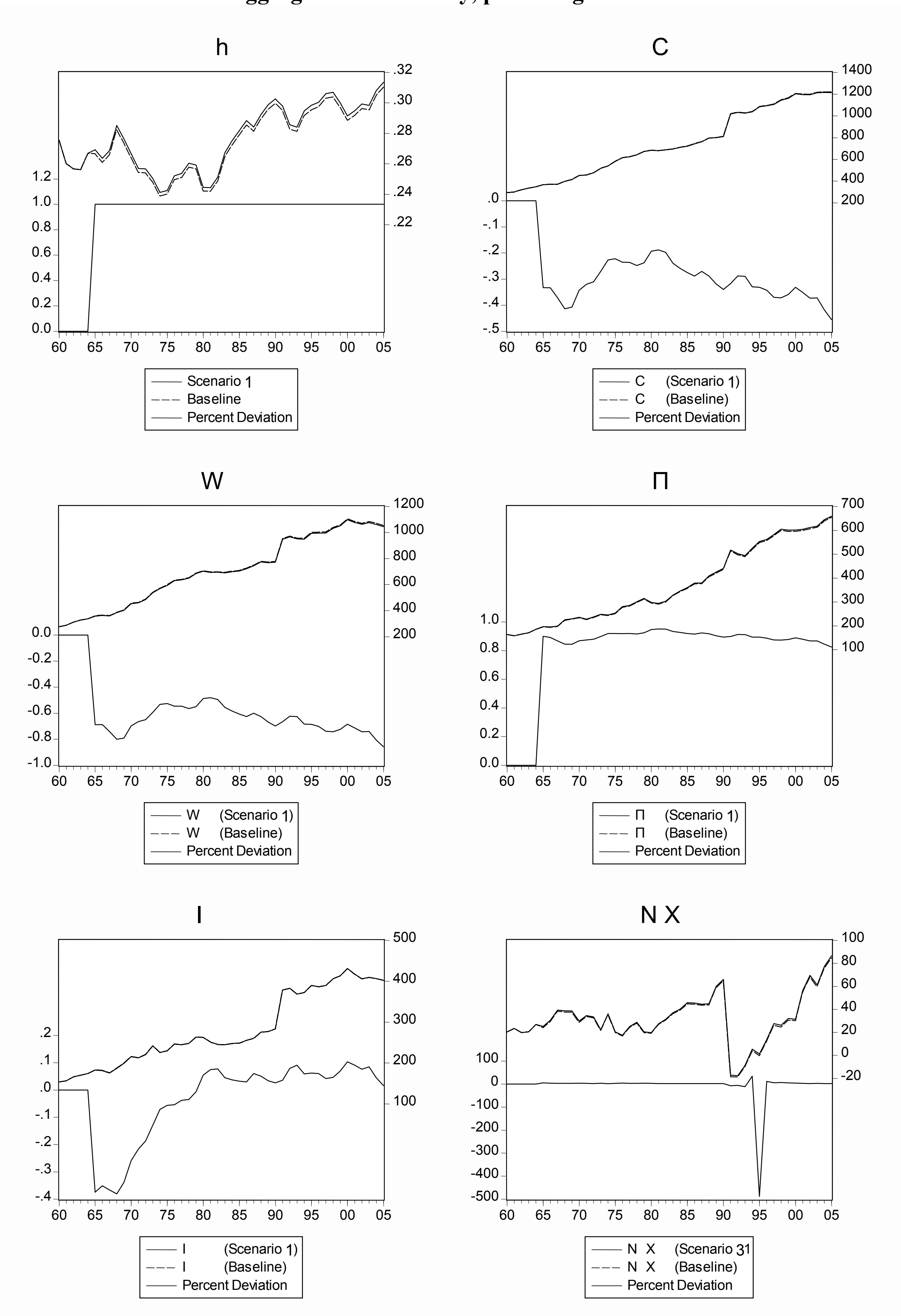
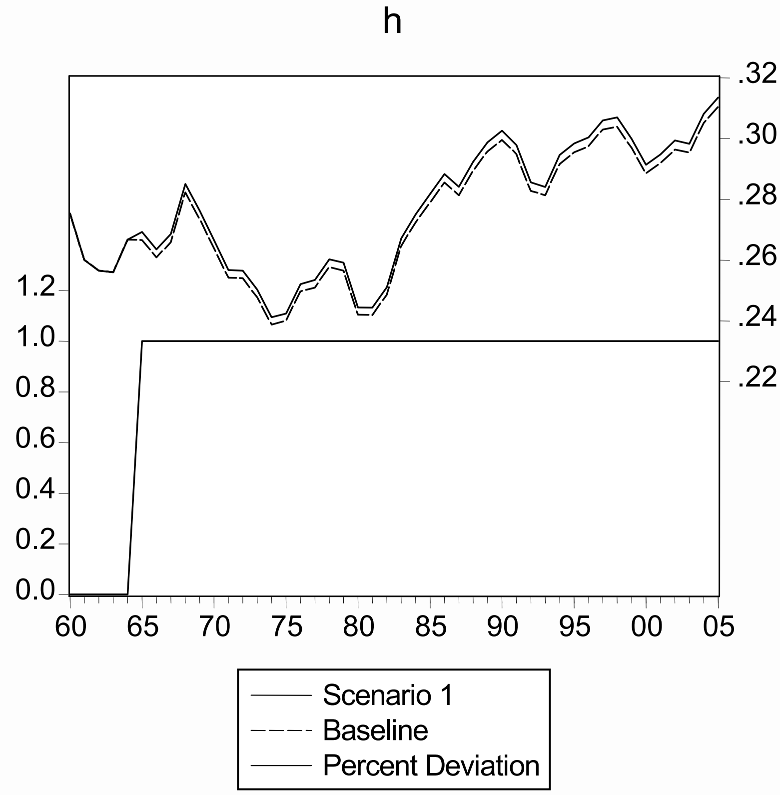
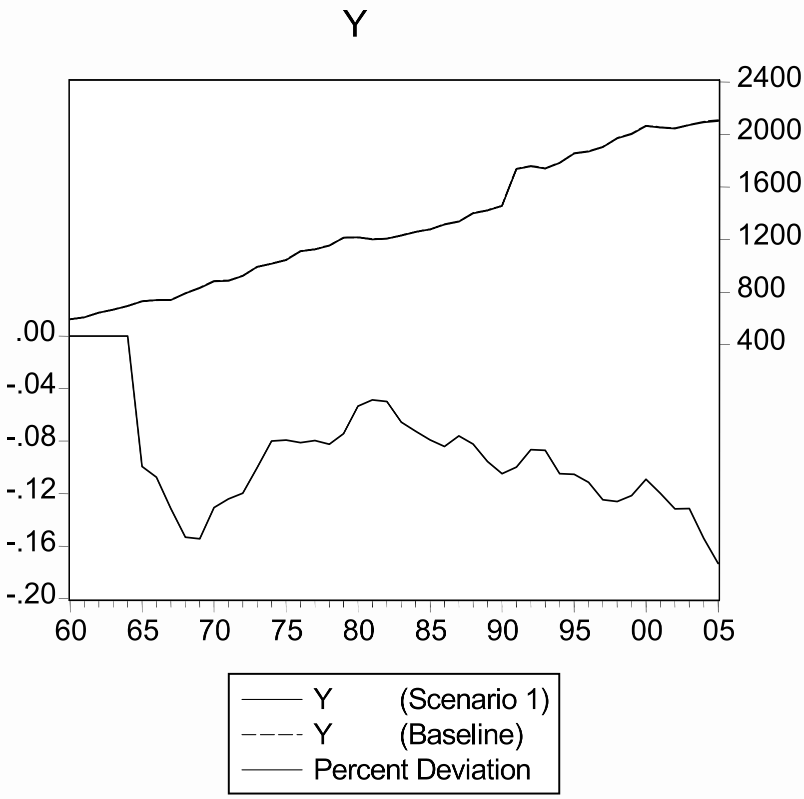


Figure 2b: Effect of a one-percentage-point increase in the profit share on real GDP: in Germany, percentage deviation from baseline





5. Conclusions

We have analysed the relationship between functional income distribution and economic growth in France and Germany from 1960 until 2005. The analysis was based on a demand-driven distribution and growth model for an open economy inspired by Bhaduri/Marglin (1990), which allows for profit- or wage-led growth. First, we applied a single equation approach, estimating the effects of redistribution on the demand aggregates and summing up these effects in order to obtain the total effect of redistribution on GDP growth. We found that GDP growth in both countries was wage-led. Since interactions between the demand aggregates were omitted from the single equation approach, we also applied a simulation approach taking into account these interdependencies. The overall result of a wage-led nature of GDP growth in France and Germany was confirmed by this approach. However, the quantitative effects differ somewhat. Whereas in the single equation approach the wage-led nature of the demand regime in Germany was more pronounced, in the simulation approach the long-run effects in the two countries seemed to converge. Bhaduri/Marglin's (1990) theoretical conclusion that wage-led growth becomes less feasible when the effects of redistribution on foreign trade are taken into account, therefore, cannot be confirmed by our empirical analysis. Medium-sized economies, as France and Germany, seem to remain wage-led even when taking into account the effects of redistribution on foreign trade and net exports.[5]

Of course, also the simulation approach presented in this paper still suffers from major shortcomings which should be overcome in future empirical research. First, we have not explicitly addressed monetary factors in the determination of the components of aggregate demand. This is a serious limitation for Post-Keynesian/Kaleckian models relying on the long-run independence of investment from saving, because these models should address the questions of investment finance, firms' debt and finance costs.[6] Second, our approach has not yet included any feedback effects of capital accumulation or growth on distribution. We have simply taken distribution as the exogenous variable determining growth as the endogenous variable.[7] Third, we have neither considered the productivity enhancing effects of investment

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[5] In the single equations approach applied to six countries in Hein/Vogel (2007), we have found that only the small open economies Austria and the Netherlands were profit-led, whereas France, Germany, the UK and the USA were wage-led.

[6] For Post-Keynesian models including monetary variables see the discussion in Lavoie (1995) and in Hein (2007, part II). For attempts to include the interest rate or other financial variables in empirical estimations of the Bhaduri/Marglin or other Kaleckian models see Hein/Ochsen (2003), van Treeck (2007) and Stockhammer (2004a, 2004b, 2005-6).

[7] See Marglin/Bhaduri (1990, 1991), Bhaduri (2006a) and Gordon (1995) for the discussion of feedback effects between economic activity and growth, on the one hand, and distribution on the other.

in capital stock or output growth through embodied technical change or increasing returns to scale, nor the effects of redistribution on productivity growth.[8] More empirical research in these areas, based on Post-Keynesian or Kaleckian distribution and growth models, seems to be required for a more complete understanding of the long-run development of the relationship between income distribution and economic growth.

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[8] See Kaldor (1957), León-Ledesma/Thirlwall (2002), Dutt (2003, 2006), Bhaduri (2006b, 2006c), Naastepad (2006), and Vogel (2006).

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Appendix

Data definitions and data source

C	real private final consumption expenditure, obtained directly from the AMECO database.
h	profit share, as percentage of GDP at 2000 market prices, calculated as the ratio of real profits (deflated by the GDP deflator) and real GDP from the AMECO database.
I	real gross fixed capital formation, total economy, obtained directly from the AMECO database.
NX	real net exports, calculated from the difference of real exports of goods and service and real imports of goods and services from the AMECO database.
Π	real gross operating surplus, deflated by the price deflator of GDP, both obtained from the AMECO database.
W	real compensation of employees (total economy), deflated by the price deflator of GDP, both obtained from the AMECO database.
Y	real GDP (at 2000 market prices), obtained directly from the AMECO database.

Estimation strategy in the single equation approach

In order to determine the effect of a change in the profit share on real GDP growth, we estimate the effects of a change in the profit share on the GDP growth contributions of the demand aggregates and sum up these partial effects:

$$\frac{\frac{\partial Y}{Y}}{\partial h} = \frac{\frac{\partial C}{Y}}{\partial h} + \frac{\frac{\partial I}{Y}}{\partial h} + \frac{\frac{\partial NX}{Y}}{\partial h} \tag{A1}$$

For example, in order to determine the effect of a change in the profit share on the growth distribution of consumption demand, we can start from:

$$C = C_\Pi + C_W = c_\Pi \Pi + c_W (Y - \Pi) = c_W Y + (c_\Pi - c_W)\Pi = c_W Y + (c_\Pi - c_W)hY. \tag{A2}$$

with C as total consumption, C_Π as consumption out of profits, C_W as consumption out of wages, c_Π as the propensity to consume out of profits, c_W the propensity to consume out of wages, Π as total profits, W as total wages, Y as GDP, and h as the profit share. Assuming that the effect of a change in the profit share has no further effect on GDP, hence assuming that there are no interactions between the demand aggregates, we obtain from (A2):

$$\frac{\partial C}{\partial h} = (c_{\Pi} - c_{W})Y , \tag{A3}$$

and hence:

$$\frac{\frac{\partial C}{Y}}{\partial h} = c_{\Pi} - c_{W} . \tag{A4}$$

Given the assumption for the derivation above and starting from (A2), this is equivalent to estimating:

$$\frac{C}{Y} = c_{W} + (c_{\Pi} - c_{W})h . \tag{A5}$$

Alternatively, a saving function with S as total saving, s_{Π} as the saving propensity out of profits and s_{W} as the saving propensity out of wages can be estimated:

$$\frac{S}{Y} = s_{W} + (s_{\Pi} - s_{W})h . \tag{A6}$$

From (A5) or (A6) we obtain:

$$\frac{\partial\left(\frac{C}{Y}\right)}{\partial h} = c_{\Pi} - c_{W} = (1 - s_{\Pi}) - (1 - s_{W}) = s_{w} - s_{\Pi} . \tag{A7}$$

For investment and net export a similar strategy can be applied.

Table A1: Tests for unit roots on the variables of the consumption function. Null hypothesis: The variable has a unit root.		
Country	**Variable**	**ADF (t-statistics)**
France	C	-2.378
	Δ C	-4.268***
	Π	-1.632
	Δ Π	-5.057***
	W	-2.377
	Δ W	-3.059
	Δ Δ W	-6.781***
Germany	C	-2.159
	Δ C	-4.867***
	Π	-1.703
	Δ Π	-6.048***
	W	-2.759
	Δ W	-4.566***

Table A2: Tests for unit roots on the variables of the investment function. Null hypothesis: The variable has a unit root.		
Country	**Variable**	**ADF (t-statistics)**
France	I	-3.061
	Δ I	-3.778**
	Y	-2.718
	Δ Y	-4.875***
	Π	-1.632
	Δ Π	-5.057***
Germany	I/Y	-2.654
	Δ I/Y	-4.314***
	Y	-2.180
	Δ Y	-4.960***
	h	-1.198
	Δ h	-5.140***
Notes: *** denotes statistical significance at the 1% confidence level, ** significance at the 5% level, * significance at the 10% level.		

Table A3: Tests for unit roots on the variables of the function of net exports. Null hypothesis: The variable has a unit root.

Country	Variable	ADF (t-statistics)
France	NX/Y	-1.656
	Δ NX/Y	-6.019***
	Y	-2.718
	Δ Y	-4.875***
	h	-1.672
	Δ h	-4.907***
Germany	NX/Y	-2.065
	Δ NX/Y	-5.521***
	Y	-2.180
	Δ Y	-4.960***
	$Y^{foreign}$	-2.331
	Δ $Y^{foreign}$	-4.829***
	h	-1.198
	Δ h	-5.140***

Figure A1: Effect of a one-percentage-point increase in the profit share on real net exports in France, absolute deviation from baseline

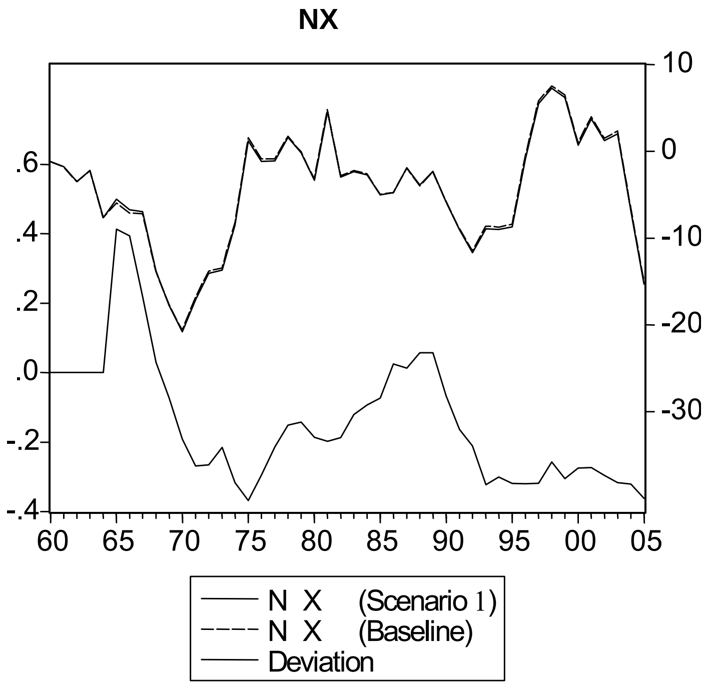
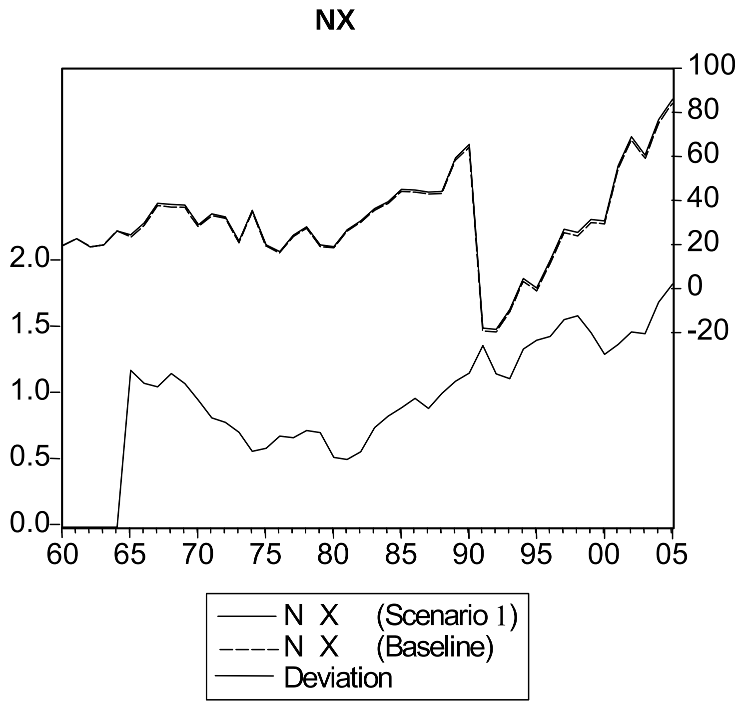


Figure A2: Effect of a one-percentage-point increase in the profit share on real net exports in Germany, absolute deviation from baseline



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