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Technology, demand and distribution: a cumulative growth model with an application to the Dutch productivity growth slowdown

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This paper argues that the case for real wage growth restraint, and the consequent restoration of profitability, which the mainstream consensus regards as a necessary condition for sustained output and productivity growth, is based on weak foundations, because it neglects the negative impact of wage moderation on productivity growth. Using a general Keynesian growth model, which integrates a (wage-led or profit-led) demand regime and a productivity regime (incorporating the productivity-growth enhancing effects of higher demand and higher real wages), the conditions are identified under which real wage restraint fails to raise output and productivity growth. The model is applied empirically to the Netherlands (1960–2000).

Key words: Demand-led growth, Endogenous technological change, Wage-led and profit-led demand regimes, Productivity regime, Cumulative causation
JEL classifications: O4, O3, E3

1. Introduction

Following the demise of Keynesianism and the rise of supply-side economics with its emphasis on (international) cost competitiveness, a near consensus has emerged that real wage restraint—in conjunction with a more general 'flexibilisation' of labour markets—is a necessary condition for adequate long-run macroeconomic performance of the OECD countries. In this view, there exists a macroeconomic trade-off between the growth of output and of productivity, which supposedly requires 'supply-side' stimulus through high profitability and a low real wage, and more egalitarian distributional outcomes, which, in contrast, require real wage increases. Implicit in this trade-off between growth and equity is the assumption that, to use the felicitous terminology of Bhaduri and Marglin (1990), the aggregate demand regimes of the OECD economies are exhilarationist (or profit-led) in nature. This means that profits, investment and exports play a dominant role in expanding aggregate demand in so far as any reduction in consumption due to a lower real wage is

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more than compensated for by the positive response in (private) investment and exports to that lower real wage. However, despite the fact that in almost all OECD countries real wage growth was significantly restrained, allowing profit rates to recover to their 'Golden Age' levels, OECD macroeconomic performance during 1980–2000 is in general characterised by lower output and labour productivity growth, lower rates of investment and higher rates of unemployment than witnessed during the period 1960–80. This disappointing performance, the long-term slowdown of productivity growth and the continuously high rate of unemployment, in particular, raise the crucial question of why the redistribution of income from wages to profits, in a supposedly profit-led demand regime, has so far failed to bring about 'adequate long-run economic performance'.

This paper argues that the answer to this question must be sought in the (possible) interactions between demand, productivity and the real wage. Our central claim is that labour productivity is not exogenous and constant, but, harking back to Kaldor's technical progress function, is affected by changes in the size of the market and in the real wage rate (Taylor, 1991). Any change in productivity (at a given real wage), in turn, has a feedback effect on aggregate demand—because, through its impact on unit labour cost, it affects income distribution, consumption, investment and exports. We analyse such productivity–demand interactions within the framework of a general Keynesian growth model, which integrates—a reformulated version of—the wage-led or profit-led aggregate demand system proposed by Bhaduri and Marglin (1990), Taylor (1991) and others, and a neo-Kaldorian supply system incorporating the productivity-growth enhancing effects of higher demand and higher real wages. This unifying framework is used to explore systematically why the restraint of real wage growth may fail to lead to higher output and productivity growth. In order to focus sharply on the interrelationships between demand growth and productivity growth, our model takes distributional relations (i.e., real wage growth) as exogenously given. We find that the introduction of endogenous technological change and productivity growth fundamentally changes the nature of the growth process, and may—under certain restrictions on the productivity and demand regimes—even force a profit-led system to behave in a wage-led manner, and vice versa.

To illustrate our argument, we apply an econometrically estimated version of our theoretical model to the Netherlands (1960–2000), which perhaps is the OECD country where, after 1982, wage restraint was most adamantly pursued at the national level, by labour unions, employers' associations and government, to combat the structural problems of high unemployment and low growth. The arguments used to justify the 'voluntary' restraint of real wage growth are, without exception, predicated on the assumptions that (i) the Dutch aggregate demand regime, in which exports play a major role, is profit-led, and (ii) the inegalitarian distributional changes do not have any impact whatsoever on Dutch productivity growth. The response to the, by international standards exceptionally high, reduction in real wage growth, that was achieved after 1982, has been disappointing: Dutch GDP growth and productivity growth were lower during 1984–2000 than in the period 1960–80; and while post–1984 GDP growth has been desultory, labour productivity growth has exhibited a clear downward trend, that was much stronger than the OECD average. The only claim to success lies in the sharp increase in the rate of Dutch employment growth (and the concomitant decline in unemployment). However, until now, the causes of the, in overall terms, disappointing performance remain a puzzle, mainly because available analyses, by focusing exclusively on *supply-side* factors, fail to provide a satisfactory explanation of the Dutch productivity crisis. Instead, our analysis provides a synthetic treatment that unifies demand and supply factors in explaining post–1984

Dutch economic performance, thus not only explaining the productivity growth slowdown *per se*, but also showing that it is the main cause of the increased labour intensity of recent Dutch GDP growth. The Dutch 'employment miracle' is, in other words, found to be just the flip-side of the Dutch productivity growth crisis.[1]

The paper is organised as follows. Section 2 presents an overview of recent Dutch macroeconomic performance (1960–2000). Section 3 outlines the theoretical cumulative causation model, which integrates a neo-Kaleckian demand regime and a neo-Kaldorian productivity regime. The interactions between demand growth and productivity growth, set in motion by a policy of real wage restraint, are discussed under various demand-side and supply-side assumptions; the analytical results lead to a typology of demand–productivity growth trajectories, and we investigate the response to a reduction in real wage growth for each trajectory. In Section 4, we apply the model to the Dutch case to explain the long-run change in GDP, productivity and employment between 1960–80 and 1984–2000. Section 5 concludes.

2. Dutch macroeconomic performance (1960–2000)

To draw out major empirical generalisations or 'stylised facts', characterising economic growth in the Netherlands during the last four decades, we make a distinction between two periods:

- the high-wage period 1960–80, which in turn is sub-divided into (a) the 'Golden Age' 1960–73, and (b) the 'stagflationary' years 1973–80; and
- the real-wage-restraint period 1984–2000, within which we single out the speculative ('new economy') demand boom of 1996–2000.[2]

Tables 1 and 2 present key indicators of Dutch macro-economic performance for each (sub-) period. Table 3 compares Dutch performance with average OECD performance.

As for all the industrialised countries, the period 1960–73 represents the 'Golden Age' of cooperative capitalism: Dutch GDP growth was high (almost 5% per annum); labour productivity growth was high (4.5% per year); and there was near full employment. This superior performance depended upon there being no constraint on aggregate demand, which grew without serious interruption over the period (Marglin and Schor, 1990, Cornwall and Cornwall, 2001). Export growth and investment growth were strong components of the aggregate demand growth. Dutch exports increased by more than 9% on average per year, in line with the rapid expansion of world trade. Dutch investment rose at a historically high pace (4.8% per year), helped by the stability of aggregate demand growth. The rapid investment growth led to a historically unprecedented increase in capital intensity ($\hat{\kappa}$) and, by embodying technological progress in physical capital, to a sharp rise in the average quality of the capital stock (as reflected in a declining average age of capital, Δage); in addition, continued high demand for investment goods induced the capital goods industry to incorporate the latest technologies in its product (Cornwall and Cornwall, 2001). The rapid investment growth, therefore, generated historically very high rates of

[1] This suggests clear parallels with 'the great American jobs machine' (at least prior to the late 1990s); see Palley (1998).

[2] For a critical evaluation of Dutch economic performance during 1982–2002, see Storm and Naastepad (2003), who argue that the high GDP growth during the 1990s was largely the result of increased consumption spending, financed out of the gains in household wealth flowing from the stock market and real estate boom.

Table 1. *Dutch economic performance 1960–2000: key indicators I*[ab] *(average annual growth rates)*

Period	$\hat{x}$	$\hat{\lambda}$	$\hat{l}$	$\hat{w}$	$\hat{\upsilon}$	$\hat{P}$	$\hat{i}$	$\hat{\kappa}$	$\hat{e}$	$\hat{z}$
1960–80	4.07	3.88	0.19	5.17	1.29	6.19	3.52	4.30	6.96	7.35
1960–73	4.95	4.54	0.34	6.26	1.72	5.75	4.80	4.70	9.05	8.37
1973–80	2.78	3.08	−0.18	3.66	0.57	7.33	1.40	3.81	4.19	6.26
1984–96	2.81	0.59	2.03	0.05	−0.54	1.62	2.06	1.25	5.09	5.78
1996–2000	3.71	0.10	3.26	−1.02	−1.11	3.72	0.93	1.94	7.04	7.11

[a] $\hat{x}$ = the growth rate of GDP at constant 1995 market prices; $\hat{\lambda}$ = the growth rate of labour productivity (GDP at constant 1995 factor cost per hour); $\hat{l}$ = growth rate of aggregate employment (in hours); $\hat{w}$ = growth rate of the real wage rate (per hour); $\hat{\upsilon}$ = growth rate of real unit labour cost (per hour); $\hat{P}$ = the inflation rate (growth rate of the deflator of GDP at market prices); $\hat{i}$= growth rate of private (gross) fixed investment (at constant 1995 prices); $\hat{\kappa}$ = growth of the fixed capital stock (at constant 1995 prices) per hour; $\hat{e}$ = growth rate of exports (at constant 1995 prices); and $\hat{z}$ = growth rate of the volume of OECD trade (exports).
[b] Computed using data from the following sources: (a) Statistics Netherlands, *National Accounts of the Netherlands*, various issues: GDP at constant 1995 market prices; GDP at constant 1995 factor cost; deflator of GDP at market prices; wage income at constant 1995 prices; private fixed capital formation (at 1995 prices). (b) European Commission (2001), *European Economy*, No. 72: growth rates of export volume, world exports, relative real unit labour cost and Dutch and OECD labour productivity growth per person. (c) University of Groningen and the Conference Board, GGDC Total Economy Database (http://www.eco.rug.nl/ggdc): hours worked. (d) Maddison (1996): fixed capital stock at constant 1995 prices (updated, using the perpetual inventory method, to the year 2000).

Table 2. *Dutch economic performance 1960–2000: key indicators II*[a]

Period	$\bar{age}$ (1)	$\Delta\bar{age}$ (2)	(k/l) (3)	(i/x) (4)	π (5)	(e/x) (6)	$e - m/(x)$ (7)	(e/z) (8)	u (9)
1960–1980	15.3	−0.29	34.9	22.9	41.4	46.2	0.36	7.3	2.5
1960–1973	15.3	−0.29	29.2	24.4	44.4	45.1	−0.16	8.4	1.1
1973–1980	11.3	0.02	45.5	20.1	35.6	47.9	1.56	6.3	5.0
1984–1996	12.7	0.13	60.8	22.1	44.9	54.5	4.27	5.8	7.1
1996–2000	14.5	0.23	69.7	23.6	49.7	61.5	5.30	7.0	4.3

[a] Column (1): average age (in years); column (2): average annualised change; columns (3)–(9): average percentage share.
$\bar{age}$ = the average age of the fixed capital stock at the beginning of the period; $\Delta\bar{age}$ = the annualised change in average age of fixed capital stock; (k/l) = the average ratio of fixed capital stock (Euro in constant 1995 prices) per hour worked; (i/x) = the share of gross fixed investment in GDP (at market prices); π = the profit share in GDP at factor cost; (e/x) = the share of exports in GDP (at market prices); $(e - m)/x$ = the share of net exports (= exports − imports) in GDP (at market prices); (e/z) = the share of Dutch exports in exports of 22 competing OECD countries; and u = the unemployment rate, definition Eurostat (percentage of civilian labour force).

Source: Computed using data from the following sources: (a) Statistics Netherlands, *National Accounts of the Netherlands*, various issues: GDP at market prices; GDP at factor cost; fixed capital formation; profit share; and (net) export share. (b) European Commission (2001), *European Economy*, No. 72: real wage growth in the Netherlands and the OECD; Dutch world export share; unemployment rates of the Netherlands and the EU-15 countries. (c) University of Groningen and the Conference Board, GGDC Total Economy Database (http://www.eco.rug.nl/ggdc): total number of hours worked. (d) Maddison (1996): fixed capital stock at constant 1995 prices (updated, using the perpetual inventory method, to the year 2000); average age of fixed capital stock in 1960, 1973, 1979 and 1989.

Table 3. *Dutch economic performance (1960–2000): relative to OECD performance*[a]

Period	$\hat{x}_r$ (1)	$\hat{\lambda}_r$ (2)	$\hat{l}_r$ (3)	$\hat{w}_r$ (4)	$\hat{v}_r$ (5)	$\hat{\epsilon}_r$ (6)	u_r (7)
1960–80	−0.43	−0.21	−0.33	0.48	2.40	−1.71	−0.6
1960–73	−0.55	−0.40	−0.25	0.71	1.97	−0.85	−1.2
1973–80	−0.34	0.25	−0.54	0.27	3.07	−3.05	0.6
1984–96	−0.21	−0.55	0.99	−0.47	0.41	−0.32	−2.5
1996–2000	0.88	−0.66	2.06	−0.39	−0.93	1.20	−5.4

[a] Column (1)–(6): average annual growth rates; column (7): percentage of labour force.
$\hat{x}_r$ = growth rate of real GDP at constant 1995 market prices of the Netherlands *minus* the weighted average growth rate of real GDP of the EU-15, the USA and Japan; $\hat{\lambda}_r$ = growth rate of Dutch labour productivity (per person) *minus* the weighted average growth rate of labour productivity (per person) of the EU-15, the USA and Japan; $\hat{l}_r$ = growth rate of employment (hours worked) in the Netherlands *minus* the weighted average growth rate of employment (hours worked) in 22 OECD countries; $\hat{w}_r$ = growth rate of Dutch real wages *minus* the weighted average growth rate of real wages in the EU-15, the USA and Japan; $\hat{v}_r$ = growth rate of Dutch real unit labour cost *minus* the weighted average growth rate of real unit labour costs of the EU-15, the USA and Japan; $\hat{\epsilon}_r$ = rate of depreciation (+) of the Dutch Guilder relative to the weighted average exchange rate of the EU-15, the USA and Japan; and u_r = the difference between the Dutch unemployment rate (percentage of the labour force) and the average unemployment rate in the EU-15.
Computed using data from the following sources: (a) European Commission (2001), *European Economy*, No. 72: growth rates of real GDP, labour productivity (per person), real wages, and relative real unit labour cost, nominal exchange rate changes, and standardised unemployment rates. (b) University of Groningen and the Conference Board, GGDC Total Economy Database (http://www.eco.rug.nl/ggdc): hours worked in 22 OECD countries.

productivity growth and—through the multiplier process—led to high GDP growth, justifying past investment and encouraging its continuation in a positive feedback loop. At a deeper level, the high growth path of the Golden Age had important domestic and international foundations (Marglin and Schor, 1990; Cornwall and Cornwall, 2001). Domestically, it was based on a social compromise over the distribution of income and a commitment to full employment, which entailed high growth rates of real wages as well as of productivity and aggregate demand, as a result of which profit *rates* could also increase (even as the *share* of profits in GDP became lower). Internationally, the Golden Age was based on a stable international trade and payments system (the Bretton Woods system), within which controls on international capital flows were used to protect fixed exchange rates and, at the same time, liberate macroeconomic policy to pursue domestic goals (Setterfield and Cornwall, 2002).

The Golden Age came to an abrupt end by the early 1970s as a result of a breakdown of the systems of domestic and international regulation.[1] Domestically, the profit share began to decline significantly as a result of a slowdown in productivity growth, rising real input costs, tighter labour market conditions (which had led to a secular improvement of workers' bargaining position), and intensified (foreign) competition. Tensions between trade unions and employers' associations mounted and eventually led to the collapse of the 'old' social comprise. Internationally, the collapse of the Bretton Woods system and the consequent deregulation of international financial markets, and the oil price shock of 1973 had serious implications for economic activity, employment and policy in the Netherlands. The energy price hike added to the rising inflationary pressures; and it led to a significant appreciation

[1] See Marglin and Schor (1990), Boyer (1995) and Cornwall and Cornwall (2001).

of the Dutch guilder, the country being an important energy (natural gas) exporter. An accelerating rate of price inflation and a drastic decline in export growth, also caused by a fall in world trade growth, became the major symptoms of what became known as the 'Dutch disease'. Dutch GDP growth during the turbulent years 1973–80 fell to 2.8% per annum. The share of profits in GDP dropped sharply: from an average of 44.4% during 1960–73 to 35.6% during 1973–80. This, and the dramatic rise in macro-economic uncertainty, led to a significant decline in Dutch investment growth—to only 1.4% per year. The decline in investment and output growth, in turn, resulted in a slowdown in productivity growth. Dutch unemployment, as in other OECD countries, increased sharply, averaging 5% of the labour force during this period.

The oil crisis of 1979 and the rise in world real interest rates, in response to the adoption of highly restrictive monetarist economic policies in the USA and the UK, hit the Dutch economy much harder than the first oil price hike in 1973. The ensuing recession was exceptionally severe, turning the Netherlands — in the words of Therborn (1986) — into 'perhaps the most spectacular employment failure in the advanced capitalist world'.[1] The high and rising unemployment put the labour unions in a tight corner and, in 1982, made them agree to a central agreement with employers' organisations and government. In this so-called Wassenaar agreement, (voluntary) real wage restraint by workers was exchanged for a promise by firms to increase investment and, hence, employment, and for a promise by government to maintain entitlements under the Dutch welfare state at prevailing levels. Since then, real wage growth in the Netherlands has been about zero (compared with an average growth rate of 5.2% during 1960–80). The post-1984 Dutch wage moderation has been exceptional in an international context: on average, the annual growth rate of Dutch real wages has been 0.47 percentage points below average OECD real wage growth during 1984–96 (while during 1960–80, Dutch real wage growth had been 0.48 percentage points above average OECD wage growth).

The policy of voluntary wage restraint (and labour market flexibilisation) is claimed to have led to a revival of Dutch employment growth—to 2.3% per annum during this period (well above the OECD average)—and a significant decline in standardised unemployment, which, as a percentage of the labour force, was about 3.2 percentage points below the EU-15 average during 1984–2000. It is also argued that real wage restraint has raised GDP growth in two ways. First, by raising the profit share, it supposedly has increased investment (growth), implicitly assuming that the nature of the Dutch economy is profit-led. Second, by improving international cost competitiveness, it is supposed to have raised export growth. In effect, the average annual growth rate of Dutch GDP during 1984–2000 has been about 0.1 percentage point higher than average OECD growth; this was achieved while bringing down the budget deficit to less than zero (well within the EMU norms). The post–1984 macro-economic performance of the Netherlands thus appears to endorse the consensus view that real wage restraint—in conjunction with a more general 'flexibilisation' of labour markets—is a necessary condition for adequate long-run growth. But the Dutch 'success story' needs to be qualified in two important respects.

- As is clear from the tables, Dutch GDP growth is significantly lower during 1984–2000 than during the 1960s and the 1970s, notwithstanding the facts that (i) the profit share, after 1984, was restored to the level of the 1960s, and (ii) the growth rate of relative unit

[1] By 1981, the standardised unemployment rate had increased to almost 12% of the labour force; the broad unemployment rate, which also includes workers in disability pension and early retirement schemes, was about 25%.

labour costs was reduced considerably between 1960–80 and 1984–2000. Why did (private) investment growth not respond more strongly to the rise in profitability, caused by real wage growth restraint? And why did the decline in unit labour cost growth not lead to a stronger response of Dutch export growth?

- The Dutch economy experienced a—widely acknowledged—(absolute and relative) decline in labour productivity growth after 1984. Average annual labour productivity growth declined from 3.9% during 1960–80 to only about 0.5% during 1984–2000.[1] And Dutch labour productivity growth declined much more than OECD productivity growth; during 1984–2000, it was, on average, 0.6 percentage points lower than OECD productivity growth. What are the causes of the Dutch productivity growth crisis? And could it, in any way, be related to the 'supply-side' policies of real wage restraint and labour market flexibilisation? In particular, could it be that these labour market policies have delayed investment in new technology, thus in essence leading to a low productivity growth–low wage growth trajectory?

These questions can only be addressed with the help of a comprehensive theory (or a fully fledged model) of the causal (inter-)relationships between GDP growth, (investment and export) demand, productivity and employment growth, and real wage growth. Keynesian growth theories provide important clues, arguing that demand affects accumulation and, hence, productivity growth; and that, when production takes place under increasing returns to scale, demand will affect productivity as a result of the deepening of the division of labour due to the expansion of the market (Kaldor, 1985; Taylor, 1991; Boyer and Petit, 1991; Setterfield, 2002).

3. A cumulative causation model

3.1 Fundamental assumptions

We start from the following assumptions concerning the functioning of a high-income capitalist economy:

(1) Capital accumulation is influenced by demand (the accelerator effect) and profitability. As a result, economic growth can be either wage-led or profit-led, depending on whether a redistribution of income away from wages and towards profits is capable of raising growth. The economy is said to be profit-led when the negative impact of a rising profit share on consumption is more than offset by its positive impact on investment and exports (see Bhaduri and Marglin, 1990; Taylor, 1991).

(2) Technological change, as reflected by the rate of growth of labour productivity, is demand-determined and hence endogenous to the growth process. In formal terms, this finds expression in the well-known Verdoorn relationship (Verdoorn, 1949; Kaldor, 1966, 1996; Boyer and Petit, 1991; McCombie and Thirlwall, 1994; McCombie *et al.*, 2002). The Verdoorn relationship can be justified in various ways. First, following Young (1928), the positive effect of output growth on productivity growth may be due to the fact that (aggregate) production exhibits increasing returns to scale: average productivity will rise as a result of the deepening of the division of labour due to the expansion of the market (Kaldor, 1996; Boyer & Petit,

[1] It is important to underline that this slowdown of Dutch productivity growth is not the result of (i) a shift in sectoral employment shares from (high-productivity) manufacturing to (low-productivity) services sectors, and/or (ii) problems in specific (services) sectors, but is due to a general across-the-board decline in productivity growth.

1991). Second, because different vintages of capital embody different states of technology, investment contributes simultaneously to aggregate demand, the capital stock and average productivity (Kaldor, 1957). Third, demand expansions, by stimulating the level of economic activity, can stimulate the amount of learning-by-using in an economy.

(3) Labour productivity is also positively affected by real wage growth (Taylor, 1991), as is assumed by the theory of *induced technological change*, which dates back to Marx's *Capital* and was restated by Hicks (1932); more recent formalisations include Kennedy (1964), Funk (2002) and Foley and Michl (1999).

(4) The potential rate of output growth depends on the growth rate of demand, putting 'Say's law in reverse' (Setterfield and Cornwall, 2002). Demand not only affects the utilisation of productive resources at any point in time, but also the very development of these resources over time, through induced technological progress and innovation, and the influence of demand on labour force participation.

(5) The real wage is a distributional variable, which—in most high-income economies—is determined by institutionalised negotiation, bargaining and collaboration between labour unions and employers' associations and often the government (Bhaduri and Marglin, 1990; Taylor, 1991) Accordingly, real wage growth is assumed to be exogenous.

3.2 The model

In essence, our demand-led growth model can be reduced to two relationships (Boyer and Petit, 1991, Setterfield and Cornwall, 2002), namely:

(1) a *productivity regime*, specifying how (potential) productivity gains are obtained: labour productivity growth is a positive function of demand growth and of real wage growth; and

(2) a *demand regime*, specifying how productivity gains (for a given real wage growth) may affect demand (and output) growth: depending on whether the macroeconomic system is profit-led or wage-led, demand growth is either a positive or a negative function of productivity growth and real wage growth.

3.2.1 The productivity regime

If λ is the output–labour ratio, or labour productivity, x is real output, and w (= W/P) is the real wage (the ratio of the nominal wage W and the aggregate price level P), the productivity regime is given by (lettering a 'hat' over a variable denotes its growth rate):

$$\hat{\lambda} = \beta_0 + \beta_1 \hat{x} + \beta_2 \hat{w}; \quad \beta_0,\ \beta_2 > 0; \quad 0 < \beta_1 < 1 \tag{1}$$

Equation (1) combines:

(1) The *Verdoorn relation*. coefficient β_1 is the Verdoorn coefficient, which measures the impact of (demand-determined) output growth on labour productivity growth.

(2) The *induced technological progress* hypothesis: coefficient β_2, which reflects what may be called the degree of 'wage-led' technological progress, measures the extent to which more expensive labour induces firms to intensify their search for and adoption of labour productivity-raising techniques.

If we assume real wage growth $\hat{w}$ to be exogenous (and positive), the productivity regime can be represented, in the $(\hat{\lambda}, \hat{x})$ plane, by the upward-sloping *PR* curve in Figure 1. Because the Verdoorn coefficient measures the ability of an economy to realise productivity gains on the basis of any given rate of demand and output growth, equation (1) may be interpreted *à la* Kaldor (1996) as determining 'potential' labour productivity growth as a function of entrepreneurial dynamism: the larger β_1, the flatter the *PR* curve, and the more entrepreneurial dynamism the economic system displays.

3.2.2 The demand regime

We assume that aggregate production or output x varies with effective demand as follows:

$$x = c + i + e - m \tag{2}$$

where c is aggregate (private plus public) consumption, i is aggregate investment, e is exports, and m is imports; all variables are measured at constant prices.

Before presenting the structural equations determining c, i, e and m, it is convenient to define $\upsilon = (W/P)\lambda^{-1} = w\lambda^{-1}$ as the real labour cost per unit of output (Taylor, 1991). We assume that W/P is fixed at any point in time, from institutions and a history of bargaining. From these assumptions, and at a given level of labour productivity λ, it follows that there exists a negative relationship between unit labour cost and the profit share. To see this, we first note that the aggregate (value-added) price by definition is equal to the sum of per unit labour cost and per unit capital cost:

$$P = W\lambda^{-1} + \Pi\kappa^{-1} \tag{3}$$

where Π is the nominal price of capital, and κ is the output/capital ratio. Dividing both sides of equation (3) by P and rearranging, we get

$$\pi = \frac{\Pi\kappa^{-1}}{P} = 1 - \frac{W}{P}\lambda^{-1} = 1 - \upsilon \tag{4}$$

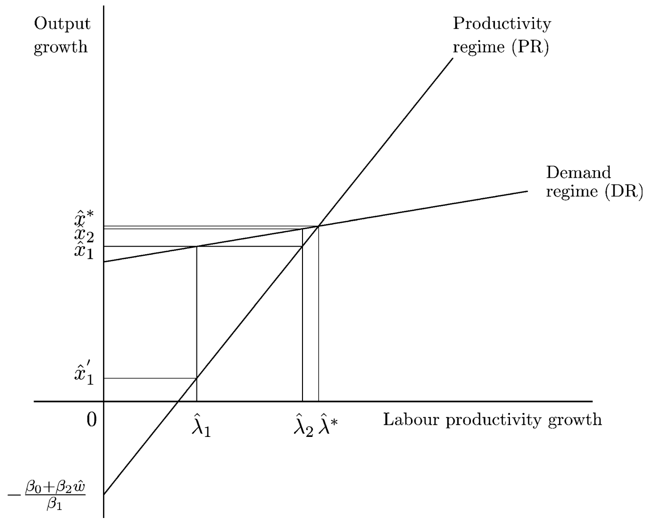

Fig. 1. *The productivity–growth, demand–growth nexus: the profit-led case.*

The profit share π is thus inversely related to real unit labour cost. For later use, we express equation (4) in growth rates

$$\hat{\pi} = \frac{\Delta\pi}{\pi} = -\frac{\upsilon}{\pi}\frac{\Delta\upsilon}{\upsilon} = -\theta\hat{\upsilon} = -\theta(\hat{w} - \hat{\lambda}) \tag{5}$$

Note that $\theta = \upsilon/\pi = \upsilon/(1-\upsilon) > 0$. Equation (5) shows that, given our assumptions, profit share growth will fall as a result of a real wage growth in excess of productivity growth.

Consumption demand is a function of wage and capital income; the average consumption is income-class specific: denoting the saving propensity by σ and using the subscripts w and π to refer to wage income and profit income, respectively, wage earners consume $(1-\sigma_w)$ of their income, while the capitalists' average consumption propensity equals $(1-\sigma_\pi)$. Suppose further that wage-earners save at a rate which is lower than the saving rate out of profits ($\sigma_w < \sigma_\pi$) as a result of the retention of a significant portion of profits by corporations. Hence, the consumption function can be written as:

$$c = (1-\sigma_w)w\lambda^{-1}x + (1-\sigma_\pi)\pi x = [(1-\sigma_w)\upsilon + (1-\sigma_\pi)(1-\upsilon)]x; \quad \sigma_\pi > \sigma_w \tag{6}$$

Import demand is a linear function of output

$$m = \zeta x \tag{7}$$

where ζ is the (average) import propensity.[1] Substituting equations (6) and (7) into (2) and rearranging, we get the following expression for x

$$x = \frac{i+e}{[1-(1-\sigma_w)\upsilon - (1-\sigma_\pi)(1-\upsilon) + \zeta]} = \mu^{-1}(i+e) \tag{8}$$

Note that $\mu^{-1} = 1/[1-(1-\sigma_w)\upsilon - (1-\sigma_\pi)(1-\upsilon) + \zeta]$ is the Keynesian multiplier ($\mu^{-1} > 1$), the magnitude of which depends, via υ on the distribution of income and on the real wage rate and the level of labour productivity, in particular. Totally differentiating equation (8), dividing through by x, and rearranging gives us the following expression for demand-led output growth

$$\hat{x} = -\hat{\mu} + \frac{\mu^{-1}\mathrm{i}}{x}\hat{i} + \frac{\mu^{-1}\mathrm{e}}{x}\hat{e} = -\hat{\mu} + \psi_i\hat{i} + \psi_e\hat{e}, \tag{9}$$

where ψ_i and ψ_e are the (multiplier-adjusted) shares in GDP of investment and exports, respectively. Output growth is a weighted average of investment and export growth, adjusted for changes in the multiplier. The multiplier is endogenous, because any change in real labour cost per unit of output will directly affect its denominator μ, which equals $[\sigma_\pi - \upsilon(\sigma_\pi - \sigma_w) + \zeta]$. Using this expression for μ, we can derive its growth rate as a function of unit labour cost growth as follows

$$\hat{\mu} = -\frac{\upsilon}{\mu}(\sigma_\pi - \sigma_w)\hat{\upsilon} = -\xi(\sigma_\pi - \sigma_w)[\hat{w} - \hat{\lambda}] \tag{10}$$

where ξ is the positive fraction υ/μ. Accordingly, the denominator of the multiplier will decline (and, hence, the multiplier itself will become larger) when (real) unit labour costs

[1] This assumption is not unrealistic, because a large proportion (often more than 50%) of OECD countries' imports consist of intermediate inputs and capital goods, the demand for which depends mainly on real GDP.

rise; in other words, a rise in real wage growth (at constant labour productivity growth), and the consequent decline in the growth of the profit share, will augment the size of the multiplier. With $\hat{\mu}$ being determined, we need to specify investment and export growth functions to complete the model.

Consider first investment. Following Bhaduri and Marglin (1990) and Taylor (1991), we assume that investment, i depends positively on the profit share π and demand (output) x:

$$i = f(\pi, x) \quad \frac{\delta f}{\delta \pi} > 0; \quad \frac{\delta f}{\delta x} > 0 \tag{11}$$

The positive effect on investment of π can be justified by reference to the use of corporate retained profits for relieving financial constraints on investment, or else by thinking of π as the expected rate of return on new investment (assuming that expected profits equal actual profits for simplicity). The positive effect of x reflects the accelerator effect, i.e., the effect of output growth on the demand for new capital equipment. We further assume, as in Blecker (2002), that the investment function takes the following functional form

$$i = a_i b^{\phi_0} \pi^{\phi_1} x^{\phi_2} \quad \phi_0, \phi_1, \phi_2 > 0 \tag{12}$$

where a_i is a positive constant, and b represents other factors (mainly 'animal spirits' of entrepreneurs) influencing investment decisions. Equation (12) can be expressed in growth rates as follows

$$\hat{i} = \phi_0 \hat{b} + \phi_1 \hat{\pi} + \phi_2 \hat{x} \tag{13}$$

Coefficient ϕ_1 is the elasticity of investment with respect to the profit share; ϕ_2 is the elasticity of investment with respect to demand (output).

Next we turn to exports e, which we assume to be a negative function of relative real unit labour cost and a positive function of world demand (z)

$$e = a_e z^{\epsilon_0} \left(\frac{\upsilon}{\upsilon_f} \right)^{-\epsilon_1} \tag{14}$$

a_e is a positive constant, υ_f is the real labour cost associated with one unit of world exports, ϵ_0 is the elasticity of exports with respect to world demand, and ϵ_1 is the elasticity of export volume with respect to changes in real unit labour costs. For simplicity and without loss of generality, we assume that $\upsilon_f = 1$ and that $\epsilon_0 = 1$; linearising equation (14) in growth rates then gives

$$\hat{e} = \hat{z} - \epsilon_1 \hat{\upsilon} \tag{15}$$

That is, exports grow in line with the growth rate of world trade, unless unit labour costs increase or decrease relative to world unit labour costs.

Substitution of equations (5), (10), (13) and (15) into equation (9) yields the following reduced form equation for the demand regime

$$\hat{x} = \frac{[\psi_i \phi_0 \hat{b} + \psi_e \hat{z}]}{[1 - \psi_i \phi_2]} + \frac{[\xi(\sigma_\pi - \sigma_w) - \psi_e \epsilon_1 - \psi_i \phi_1 \theta]}{[1 - \psi_i \phi_2]} [\hat{w} - \hat{\lambda}] \tag{16}$$

Output growth thus depends on two factors:

(1) The growth of the autonomous components of final demand, namely, autonomous investment growth $\hat{b}$ and world export growth $\hat{z}$. To be economically meaningful, the

impact of autonomous demand growth on output growth has to be positive, which requires that $[1 - \psi_i\phi_2] > 0$, i.e., given that $(0 < \psi_i < 1)$, the 'accelerator elasticity' has to fall within the following range: $0 \leq \phi_2 < (1/\psi_i)$.

(2) The growth rate of real unit labour costs $\hat{\upsilon}$ $(= \hat{w} - \hat{\lambda})$. The impact of labour cost growth on output growth is ambiguous in sign. This is so, because real wage growth in excess of labour productivity growth $(\hat{w} > \hat{\lambda})$ or $(\hat{\upsilon} > 0)$ has two opposing effects on output growth. On the one hand, it will reduce export growth (via the export cost elasticity ϵ_1) and investment growth (via the profit share elasticity ϕ_1), and consequently lower output growth. But on the other hand, it will increase the size of the multiplier, because it entails a redistribution of income from profit income towards wage income and a consequent decline in the aggregate savings propensity (because $\sigma_w < \sigma_\pi$). To derive the sign of the derivative of output growth with respect to unit labour cost growth $(d\hat{x}/d\hat{\upsilon})$ from equation (16), recall that $(1 - \psi_1\phi_2) > 0$, $\xi = (\upsilon/\mu)$, $\psi_i = i/(\mu x)$ and $\psi_e = e/(\mu x)$. It then follows that $d\hat{x}/(d\hat{\upsilon})$ will be positive and the economy will be wage-led, if

$$(\sigma_\pi - \sigma_w) > \left(\frac{i}{\pi x}\right)\phi_1\theta + \left(\frac{e}{\upsilon x}\right)\epsilon_1. \tag{17}$$

If the profit-share elasticity of investment (weighted by the ratio of investment to real profit income) and the cost elasticity of exports (weighted by the ratio of exports to real labour income) are relatively small, while σ_π is substantially higher than σ_w, then $d\hat{x}/d\hat{\upsilon} > 0$, and the economic system will be wage-led. In contrast, if the cost sensitivity of export demand is high and investment demand is highly sensitive to the profit share, while $(\sigma_\pi - \sigma_w) \approx 0$, the economy will be profit led, i.e., an increase in real wage growth (relative to productivity growth) will unequivocally reduce output growth.

3.2.3 The interaction between productivity and demand regimes

The demand regime (16) describes the impact of any given productivity trend upon demand growth *at an exogenously given rate of real wage growth.* If the economy is profit-led, a step-up in labour productivity growth $\hat{\lambda}$ will raise demand (and hence output) growth, i.e.,

$$\frac{d\hat{x}}{d\hat{\lambda}} > 0 \quad \text{if} \quad (\sigma_\pi - \sigma_w) < \left(\frac{i}{\pi x}\right)\phi_1\theta + \left(\frac{e}{\upsilon x}\right)\epsilon_1 \tag{18}$$

If productivity growth increases (keeping real wage growth constant), unit labour costs decline which raises export growth, and the profit share rises, which spurs investment growth. These positive effects on output growth are strong enough to offset the negative effect on $\hat{x}$, resulting from the redistribution of income from wages to profits and the consequent rise in the aggregate savings propensity. Thus, a profit-led demand regime can be represented, as in Figure 1, by an upward-sloping curve in $(\hat{\lambda}, \hat{x})$ plane. The intersection of the *PR* and *DR* curves determines the equilibrium rates of productivity growth $(\hat{\lambda}^\star)$ and output growth $(\hat{x}^\star)$.[1] Suppose that productivity growth is below its equilibrium value to begin with, for instance at $\hat{\lambda}_1$ in Figure 1. The rate of growth of demand $\hat{x}_1$ permitted by

[1] Note that $\hat{x}^\star$ and $\hat{\lambda}^\star$ are not long-run equilibrium values (in a classical sense), because the model is predicated on $\hat{w} \neq \hat{\lambda}$, which is not sustainable in the limit. $\hat{x}^\star, \hat{\lambda}^\star$ must be regarded as a conditional or provisional equilibrium as defined by Setterfield (2002, p. 4).

labour productivity growth $\hat{\lambda}_1$ is higher than the rate of growth of output $\hat{x}'_1$ required to sustain a labour productivity growth rate of $\hat{\lambda}_1$. Thanks to the Verdoorn effect, captured by the *productivity regime*, the rate of output growth $\hat{x}_1$ will cause an increase in productivity growth to $\hat{\lambda}_2$. This increase in productivity growth will permit demand (and output) growth to rise to $\hat{x}_2$; this happens because the increased productivity growth raises investment growth (by raising the profit share) and export growth (by lowering unit labour cost). Productivity growth and output growth continue to increase in this fashion until they reach their long-run values at $\hat{x}^{\star}$.

However, if the economy is wage-led, the demand regime is downward sloping

$$\frac{d\hat{x}}{d\hat{\lambda}} < 0 \quad \text{if} \quad (\sigma_{\pi} - \sigma_{w}) > \left(\frac{i}{\pi x}\right)\phi_1\theta + \left(\frac{e}{\upsilon x}\right)\epsilon_1 \tag{19}$$

In this case, the negative impact on output growth of the income redistribution (towards higher-saving profit income) implied by a higher productivity growth more than outweighs its positive effects on investment (via the profit share) and exports (via costs). In Luddite fashion, technological advance cuts labour's real spending power, and aggregate demand and growth recede. Thus, demand is decreasing with productivity growth as in Figure 2. Intuitively, if workers are relatively small savers (i.e., σ_w is relatively small compared with σ_{π}), then redistribution leads to a relatively large loss in consumption demand. Suppose initial productivity growth is $\hat{\lambda}_1$ and demand growth is $\hat{x}_1$, which is higher than the output growth rate required to sustain a productivity growth of $\hat{x}'_1$. Via the Verdoorn effect, $\hat{x}_1$ will cause an increase in productivity growth to $\hat{\lambda}_2$, which will reduce output growth to $\hat{x}_2$; this occurs because the higher productivity growth implies a redistribution of income from (lower-saving) wages to higher (higher-saving) profits, as a result of which there is a loss in consumption (and aggregate) demand. Productivity growth continues to increase and output growth continues to decrease, until they reach their equilibrium values. The necessary and sufficient conditions for a positive and stable growth equilibrium ($\hat{\lambda}^{\star}$, $\hat{x}^{\star}$) are given in the Appendix.

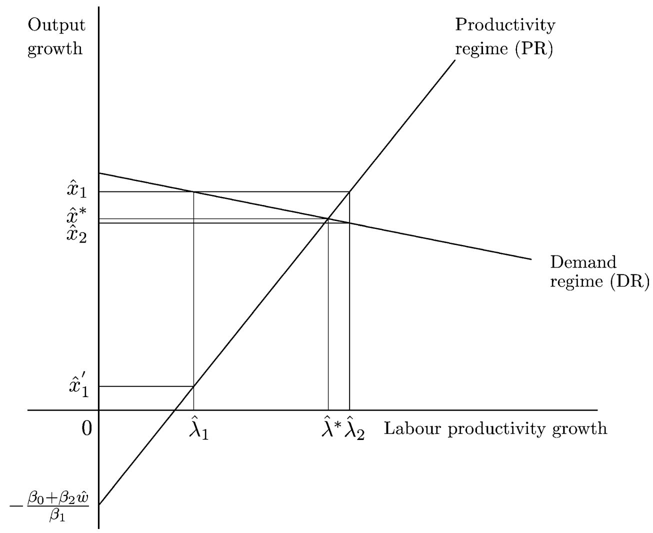

Fig. 2. *The productivity-growth, demand-growth nexus: the wage-led case.*

Restating and rearranging equations (1) and (16), we can express our demand-driven growth model in reduced form as follows

$$\hat{x}_{\mathrm{DR}} = \frac{[\psi_i\phi_0\hat{b} + \psi_e\hat{z}]}{[1-\psi_i\phi_2]} + C\hat{w} - C\hat{\lambda}; \quad C = \frac{[\xi(\sigma_\pi - \sigma_w) - \psi_e\epsilon_1 - \psi_i\phi_1\theta]}{[1-\psi_i\phi_2]} \tag{20}$$

$$\hat{x}_{\mathrm{PR}} = -\beta_0\beta_1^\star - \beta_2\beta_1^\star\hat{w} + \beta_1^\star\hat{\lambda}; \quad \beta_1^\star = \frac{1}{\beta_1}, \quad \beta_0, \beta_2 > 0, \quad 0 < \beta_1 < 1. \tag{21}$$

where $\hat{x}_{\mathrm{DR}}$ is the rate of output growth permitted by productivity growth, or the *demand regime*; and $\hat{x}_{\mathrm{PR}}$ is the rate of output required to sustain productivity growth, or the *productivity regime*. Coefficient C is the slope of the *DR* curve (16).

- If $C > 0$, a decline in the growth of unit labour costs $(\hat{w} - \hat{\lambda})$ caused by an increase in $\hat{\lambda}$ negatively affects $\hat{x}$; the *DR* curve slopes downwards and the demand regime is wage-led.
- Conversely, if $C < 0$, the demand regime is profit-led, and the *DR* is upward-sloping.

Coefficient $\beta_1^\star$, the inverse of the Verdoorn coefficient $0 < \beta_1 < 1$, is the slope of the *PR* curve (in the $\hat{\lambda}$, $\hat{x}$ plane).

We assume that $0 \leq \phi_2 < (1/\psi_i)$ and that $\hat{b} = 0$, $\hat{z} > 0$ and $\hat{w} > 0$. Equilibrium requires that $\hat{x}_{\mathrm{DR}} = \hat{x}_{\mathrm{PR}}$; from this, the equilibrium growth rates of labour productivity and output growth are

$$\hat{\lambda}^\star = \frac{\beta_0}{1+\beta_1 C} + \left[\frac{1}{1+\beta_1 C}\right]\left[\frac{\psi_e}{1-\psi_i\phi_2}\right]\beta_1\hat{z} + \left[\beta_2 + \beta_1\left[\frac{1}{1+\beta_1 C}\right](1-\beta_2)C\right]\hat{w} \tag{22}$$

$$\hat{x}^\star = -\frac{\beta_0 C}{1+\beta_1 C} + \left[\frac{1}{1+\beta_1 C}\right]\left[\frac{\psi_e}{1-\psi_i\phi_2}\right]\hat{z} + \left[\frac{(1-\beta_2)C}{1+\beta_1 C}\right]\hat{w} \tag{23}$$

Equilibrium productivity and output growth thus depend on the growth in world trade and in the real wage rate. A change in any these two variables leads to adjustments in demand (productivity), which spill over into changes in productivity (demand) growth; this, in turn, has a feedback effect on demand (productivity), and so on. The equilibrium expressions (22) and (23) capture the *total*, direct and indirect, effect on equilibrium productivity and output growth of changes in the exogenous variables.

Consider, first, a change in world trade growth: $\Delta\hat{z} > 0$. Its first-round effect is to raise demand (and output) growth: from the *DR* equation (16), we get $\Delta\hat{x} = [\psi_e/(1-\psi_i\phi_2)]\Delta\hat{z} = Z\Delta\hat{z}$, where Z is the foreign–trade growth multiplier. The increase in output growth, in turn, has a (positive) 'Verdoorn' effect on productivity growth: from the *PR* equation (1), it follows that $\Delta\hat{\lambda} = \beta_1 Z\Delta\hat{z}$. The increased rate of productivity growth feeds back into demand (and output) growth, i.e., $\Delta\hat{x} = -C\beta_1 Z\Delta\hat{z}$; this is the second-round effect of $\Delta\hat{z}$ on output growth, which is positive if $C < 0$ (the demand regime is profit-led) and negative if $C > 0$ (the demand regime is wage-led). The second-round change in $\hat{x}$ leads to a further 'Verdoorn' change in $\hat{\lambda}$, which, in turn, results in a third-round change in $\hat{x}$. This process continues, and it can be checked that the *total* impact on output growth of $\Delta\hat{z}$ is equal to $\Delta\hat{x} = \left[1 - \beta_1 C + \beta_1^2 C^2 - \beta_1^3 C^3 + \ldots\right] \quad Z\Delta\hat{z} = [1/(1+\beta_1 C)]Z\Delta\hat{z}$. That is, the initial foreign-trade multiplier impact on output growth of $\Delta\hat{z}$ is amended by its

(Verdoorn) effect on productivity growth; in fact, the standard foreign-trade multiplier Z is augmented by an endogenous-technology multiplier $[1/(1+\beta_1 C)] > 0$, because, from the stability condition it follows that $(1 + \beta_1 C) > 0$. We will call the expression $[Z/(1+\beta_1 C)]$ the *technology-augmented* foreign-trade multiplier. Note that if $\beta_1 = 0$, i.e., there are no Verdoorn effects, the endogenous technology multiplier vanishes. If $\beta_1 > 0$ and $C > 0$, the technology-augmented foreign-trade multiplier will be smaller than the standard foreign-trade multiplier: at the given real wage, the rise in productivity growth, due to $\Delta\hat{z} > 0$, implies a redistribution of income from wages to profits; the consequent negative impact on consumption growth is larger (in absolute terms) than the positive effects on investment and exports. Conversely, if $\beta_1 > 0$ and the demand regime is profit-led ($C < 0$), the technology-augmented foreign-trade multiplier will be larger than the standard one.

Likewise, we can distinguish a direct multiplier effect on output growth of a change in real wage growth and a technology-augmented real-wage multiplier. Suppose $\Delta\hat{w} > 0$. From (16), the first-round effect of this on $\hat{x}$ is equal to $C\Delta\hat{x}$, where C represents the direct growth multiplier. The change in output growth leads to a (Verdoorn) change in $\hat{\lambda}$; but, in addition, real wage growth has a direct (positive) effect on $\hat{\lambda}$ by inducing a higher rate of technological progress. Accordingly, from the *PR* equation (1), we get: $\Delta\hat{\lambda} = \beta_1 C\Delta\hat{w} + \beta_2\Delta\hat{w}$. Increased productivity growth, in turn, affects output growth, which next leads to a further (Verdoorn) effect on $\hat{\lambda}$, and so forth.[1] The *total* change in $\hat{x}$ due to $\Delta\hat{w}$ is equal to $\Delta\hat{x} = \left[1 - \beta_1 C + \beta_1^2 C^2 - \beta_1^3 C^3 + \ldots\right](1-\beta_2)C\Delta\hat{w} = [1/(1+\beta_1 C)](1-\beta_2)C\Delta\hat{w}$. We can now see that the total effect consists of two parts:

- a *direct* impact, represented by C, and
- *indirect, endogenous productivity, effects*, operating via induced technological change (β_2) and via the Verdoorn relation (captured by the term $1/(1 + \beta_1 C)$).

Two crucial insights follow immediately from this decomposition:

- Induced technological change (i.e., $\beta_2 > 0$) reduces the direct impact (in absolute terms) on output growth of higher real wage growth; this is not surprising, because the higher β_2, the smaller the change in the growth of real labour cost per unit of output (for any $\Delta\hat{w}$) and therefore the smaller will be the impact on $\hat{x}$.
- The Verdoorn effect *reduces* the direct (positive) impact of $\Delta\hat{w}$ on $\hat{x}$ when the demand regime is wage-led, but it *increases*, in absolute terms, the direct (negative) impact on $\hat{x}$ of increased real wage growth when the demand regime is profit-led. Owing to the Verdoorn effect, wage-led regimes become less strongly wage-led, whereas profit-led ones become more intensely profit-led, the higher β_1.

3.3 The impact of real wage restraint

The equilibrium expressions (22) and (23) can be used to analyse how equilibrium productivity and output growth are affected by real wage growth restraint, i.e., a decline in $\hat{w}$. As explained, the total impact of real wage restraint on equilibrium demand and output growth is given by

$$\frac{\mathrm{d}\hat{x}^\star}{\mathrm{d}\hat{w}} = \left[\frac{1}{1+\beta_1 C}\right](1-\beta_2)C = \left[\frac{(1-\beta_2)C}{1+\beta_1 C}\right] \tag{24}$$

[1] It can be checked that the second-round effect of $\Delta\hat{w}$ on output growth equals $\Delta\hat{x} = -C^2\beta_1\Delta\hat{w} - C\beta_2\Delta\hat{w}$, the third-round effect is $\Delta\hat{x} = -C^3\beta_1^2\Delta\hat{w} + C^2\beta_1\beta_2\Delta\hat{w}$, the fourth-round effect is $\Delta\hat{x} = -C^4\beta_1^3\Delta\hat{w} - C^3\beta_1^2\beta_2\Delta\hat{w}$, etc.

What can we say about the sign of $d\hat{x}^\star/d\hat{w}$? It follows from the model's stability condition that the denominator of the right-hand-side of (24) is positive (see the Appendix). Hence, the sign depends on whether the numerator is positive or negative.

(1) When the demand regime is *wage-led* ($C > 0$), the numerator will be positive if $0 \leq \beta_2 < 1$, i.e., the elasticity of productivity growth with respect to real wage growth (the 'induced technological progress effect') is smaller than unity; in this case, real wage restraint unequivocally reduces output growth, as in earlier models (Bhaduri and Marglin, 1990; Taylor, 1991; Blecker, 2002) in which productivity (growth) is exogenously given. However, the standard conclusion is no longer valid and must be amended when the induced technological progress coefficient, i.e., $\beta_2 \geq 1$. For instance, if $\beta_2 = 1$, $d\hat{x}^\star/(d\hat{w}) = 0$, i.e., a reduction in real wage growth has *no* impact on output growth, because it induces a fall in productivity growth of exactly the same magnitude; as a result, the growth rate of unit labour cost does not change ($\hat{v} = \hat{w} - \hat{\lambda}$) and, from (16), it follows that the rate of output growth remains unchanged. And, if $\beta_2 > 1$, $d\hat{x}^\star/d\hat{w} < 0$, i.e., real wage growth restraint leads to an increase in output growth, *notwithstanding the wage-led nature of the demand regime*. This 'perverse' output growth response is due to the fact that, because $\beta_2 > 1$, the decrease in real wage growth leads to an even larger decline in labour productivity growth; as a result, the growth rate of unit labour cost increases, raising labour's and reducing capital's share in income; accordingly, the aggregate propensity to save declines, and consumption and output growth increase. Stated otherwise, if $\beta_2 > 1$, the *productivity regime* dominates the *demand regime* in determining the output growth response.

(2) When, in contrast, the demand regime is *profit-led* ($C < 0$), the numerator of 24 will be negative if $0 \leq \beta_2 < 1$; real wage restraint will then increase output growth, as in the standard ('exogenous technology') models. But, as in the wage-led demand regime, the standard conclusion is no longer valid if $\beta_2 \geq 1$. If $\beta_2 = 1$, $d\hat{x}^\star/d\hat{w} = 0$, for the same reason as in the wage-led demand regime. And, if $\beta_2 > 1$, $d\hat{x}^\star/d\hat{w} > 0$, i.e., real wage growth restraint reduces output growth, *notwithstanding the profit-led nature of the demand regime*. Output growth responds 'perversely', because the *productivity regime* now dominates the *demand regime* in determining the output growth response.

What can we say about the impact of real wage restraint on equilibrium labour productivity growth? From equation (22), it follows that

$$\frac{d\hat{\lambda}^\star}{d\hat{w}} = \beta_2 + \beta_1 \frac{d\hat{x}^\star}{d\hat{w}} = \left[\frac{\beta_2 + \beta_1 C}{1 + \beta_1 C}\right] \tag{25}$$

A decline in real wage growth has a *direct* and an *indirect* effect on productivity growth. The direct effect equals β_2, which cannot be negative, because $\beta_2 \geq 0$; hence, a decline in real wage growth reduces labour productivity growth. The indirect effect is equal to the change in long-run demand growth, caused by the decline in real wage growth, i.e., $d\hat{x}^\star/d\hat{w}$, multiplied by the Verdoorn elasticity β_1. In contrast to the direct productivity growth effect of real wage restraint, which cannot be positive, the indirect effect can be positive or negative, depending on the sign of $d\hat{x}^\star/d\hat{w}$. As a result, the sign of $d\hat{\lambda}^\star/d\hat{w}$ can also be positive or negative. From the stability condition, it follows that the denominator of the right-hand-side of 25 is positive. Hence, the sign of $d\hat{\lambda}^\star/d\hat{w}$ depends on the sign of the numerator of the right-hand-side of 25. Again, two cases can be distinguished:

(1) If the economy is wage-led, the numerator is always positive, because $C > 0$; consequently, real wage restraint will always reduce long-run productivity growth, both directly (lowering the inducement to innovate and improve technology) and indirectly (by lowering demand growth, which in turn reduces productivity growth via the Verdoorn channel).

(2) If the economy is profit-led (i.e., $C < 0$), the numerator of 25 can be positive, zero, or negative, depending on the size of β_2. If $0 \leq \beta_2 \leq -\beta_1 C$, the numerator will be negative: a decline in real wage growth will lead to an increase in productivity growth. In this case, the negative direct impact on $\hat{\lambda}$ of a decline in $\hat{w}$ (through induced technological progress) is more than offset by a positive (indirect) Verdoorn effect on productivity growth. But if the induced technological progress effect is sufficiently large, i.e., $\beta_2 > -\beta_1 C$, then this is no longer true and $d\hat{\lambda}^\star/d\hat{w} > 0$, which means that real wage growth restraint will lead to a fall in long-run productivity growth.

The variety in macroeconomic responses to a strategy of real wage growth restraint is illustrated for a wage-led economy in Figure 3. The DR_0 will shift downwards to DR_1 owing to an exogenous decline in $\hat{w}$. If $\beta_2 = 0$, the new growth equilibrium $(\hat{\lambda}_1, \hat{x}_1)$ is determined by the intersection of DR_1 and PR_0. If $0 < \beta_2 < 1$, the PR_0 curve shifts upwards to PR_1 owing to the fall in real wage growth. The new growth equilibrium in this case is given by $(\hat{\lambda}_2, \hat{x}_2)$. In both cases, equilibrium productivity and output growth rates decline compared with the initial growth path $(\hat{\lambda}_0, \hat{x}_0)$. But if $\beta_2 > 1$, the PR_0 may shift towards PR_2; the new growth equilibrium is $(\hat{\lambda}_3, \hat{x}_3)$, in which output growth is higher and productivity growth is lower than at the outset.

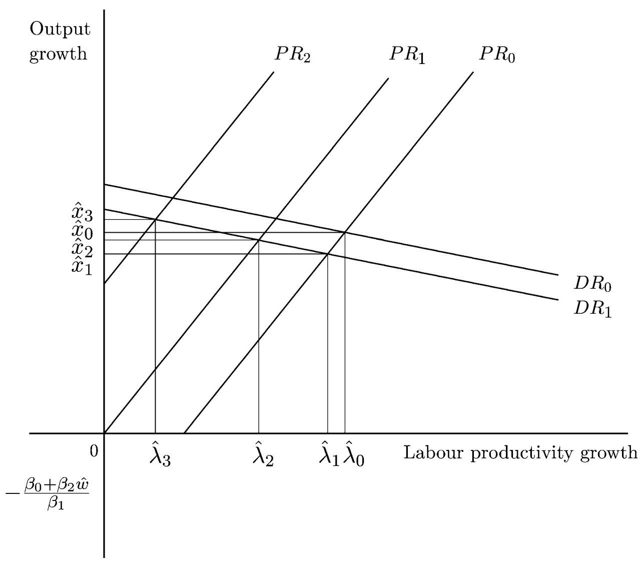

Fig. 3. *The impact of real wage restraint on productivity and demand: the wage-led case.*

Because of its effect on $\hat{x}^\star$ and $\hat{\lambda}^\star$, a decline in real wage growth has implications for long-run employment growth $\hat{l}^\star$ as well. Noting that, by definition, $\hat{l}^\star = \hat{x}^\star - \hat{\lambda}^\star$, it follows that

$$\frac{d\hat{l}^\star}{d\hat{w}} = \frac{d\hat{x}^\star}{d\hat{w}} - \frac{d\hat{\lambda}^\star}{d\hat{w}} = (1-\beta_1)\frac{d\hat{x}^\star}{d\hat{w}} - \beta_2 \tag{26}$$

That is, a decline in $\hat{w}$ has three, identifiable, effects on employment growth:

(1) It reduces (raises) equilibrium output growth, when the demand regime is wage-led (profit-led), thereby reducing (raising) employment growth.

(2) A reduction in real wage growth does, directly, lower labour productivity growth via β_2 (lowering the rate of induced technological progress); this will increase $\hat{l}^\star$.

(3) Real wage restraint does, indirectly, affect productivity growth via the Verdoorn relation. The effect of this on employment growth can be positive or negative:
   - If the demand regime is wage-led (i.e., $(d\hat{x}^\star/d\hat{w}) > 0$), real wage restraint will reduce $\hat{x}^\star$ as well as (via the Verdoorn effect) $\hat{\lambda}^\star$; and the consequent slow-down in productivity growth will raise employment growth $\hat{l}^\star$.
   - If the demand regime is profit-led (i.e., $(d\hat{x}^\star/d\hat{w}) < 0$), real wage restraint will increase $\hat{x}^\star$ as well as (via the Verdoorn effect) $\hat{\lambda}^\star$; the consequent acceleration in productivity growth will reduce $\hat{l}^\star$.

   The implication for both wage-led and profit-led demand regimes is that the higher β_1, the smaller (in absolute terms) the impact on employment growth of a reduction in $\hat{w}$.

Clearly, the net impact on long-term employment growth of a reduction in $\hat{w}$ depends on the magnitude of each of these three effects, which may be opposite in sign.

To understand how the *net* employment impact of real wage restraint comes about, consider first the situation in which $\beta_1 = \beta_2 = 0$, i.e., technology and productivity growth are exogenous and constant. Under these assumptions, $(d\hat{l}^\star/d\hat{w}) = (d\hat{x}^\star/d\hat{w}) = C$. Hence, employment growth will decline (rise) following the real wage growth restraint in a wage-led (profit-led) system. This basic result does not change if $0 < \beta_1 < 1$, i.e., if productivity growth responds positively to demand growth, although the change in employment growth will become smaller (in absolute terms). However, the net employment impact of a reduction in $\hat{w}$ becomes more complicated once we introduce induced technological progress ($\beta_2 > 0$). The picture changes in particular when the demand regime is wage-led, because $(d\hat{l}^\star/d\hat{w})$ will become negative for relatively high values of β_2; in other words, in a wage-led system, higher real wage growth may cause a decline in employment growth, mainly because of its (positive) impact on induced technological progress and productivity growth, and the consequent negative effect on the growth of demand. For a profit-led demand regime, the sign of $(d\hat{l}^\star/d\hat{w})$ does not change when $\beta_2 > 0$.

3.4 A classification and interpretation of growth trajectories

How a policy of real wage growth restraint will affect output growth, productivity growth and employment growth thus depends on the nature of the demand regime as well as the nature of the productivity regime. To systematise our discussion, we classify the changes in the equilibrium growth path, *caused by real wage restraint*, according to

(1) whether the demand regime is wage-led or profit-led, which depends on whether the sign of $(d\hat{x}^\star/d\hat{w})$ in equation (24) is positive or negative; and likewise,

(2) whether the productivity regime is wage-led or profit-led: analogous to the typology of demand regimes, the productivity regime is called:
   (a) *wage-led*, if labour productivity growth is positively affected by a rise in real wage growth, i.e., $d\hat{\lambda}^\star/(d\hat{w}) > 0$ in equation (25). This is the case if $\beta_2 > -\beta_1 C$, i.e., the induced technological progress effect (β_2) is larger (in absolute terms) than the Verdoorn effect ($-\beta_1 C$).
   (b) *profit-led*, if labour productivity growth is negatively affected by a rise in real wage growth, i.e., $d\hat{\lambda}^\star/d\hat{w} < 0$ in 25. This requires that $\beta_2 < -\beta_1 C$, i.e., the induced technological progress effect is smaller (in absolute terms) than the Verdoorn effect.

This leads us to the (2×2) classification of growth trajectories given in Table 4. It must be noted that the Appendix presents a larger, complete classification of growth trajectories; we focus here on the empirically most relevant trajectories, in which $0 < \beta_2 < 1$.

Consider first the growth trajectory of an economic system characterised by a profit-led demand regime and a profit-led productivity regime. This trajectory is labelled *'technologically progressive exhilarationist'*, because a reduction in real wage growth will raise GDP growth, labour productivity growth and employment growth in self-reinforcing fashion.

- GDP growth will increase in response to a decline in real wage growth, because $C < 0$ and hence $(d\hat{x}^\star/d\hat{w}) < 0$.
- Real wage growth restraint has two opposing effects on labour productivity growth. First, it directly reduces productivity growth by retarding (endogenous) wage-cost induced technological change. Second, the reduction in wage growth (indirectly) raises labour productivity growth via the Verdoorn relation, because demand and GDP growth are increased. The *net* impact on labour productivity growth is positive (because $\beta_2 < -\beta_1 C$) and, accordingly, productivity growth is profit-led.
- Employment growth will rise as a consequence of a reduction in real wage growth, because the 'profit-led' increase in GDP growth is larger than the rise in productivity growth.

By implication, if the economy is on a technologically progressive exhilarationist growth trajectory, there indeed exists a trade-off between output growth and productivity growth, on the one hand, and more egalitarian distributional outcomes (proxied by higher real wage growth) on the other hand. A redistribution of income from wages to profits will in this case improve medium-run economic performance.

Table 4. *A (2×2) classification of growth trajectories*

		Nature of demand regime	
		Profit-led	Wage-led
Nature of productivity regime	Profit-led	Technologically progressive exhilarationist	Ø
Nature of productivity regime	Wage-led	Technologically regressive exhilarationist	Technologically regressive stagnationist

The second growth trajectory, called 'technologically regressive exhilarationist', concerns an economy with a profit-led aggregate demand regime and a wage-led productivity regime. Now, a reduction in real wage growth results in increased GDP growth, but reduced labour productivity growth. Productivity growth declines in response to real wage restraint, because the negative impact on productivity growth of the wage-cost induced slowdown in technological progress is larger (in absolute terms) than the positive Verdoorn effect. As GDP growth rises, while productivity growth declines, employment growth increases significantly as a consequence of real wage moderation. Thus, while there exists a trade-off between GDP (and employment) growth and egalitarianism, as in the first trajectory, there is no longer a trade-off between labour productivity growth (and technological dynamism in general) and real wage growth. Along this trajectory, increased technological dynamism and more egalitarian distributional outcomes are not only mutually compatible, but the latter may even be a pre-condition for the former.

The existence of an economic system in which the demand regime is wage-led and the productivity regime is profit-led, is ruled out by definition, because the condition that $\beta_2 < -\beta_1 C$ cannot be met, since $\beta_1, \beta_2 > 0$ and $C > 0$. That is, if the demand regime is wage-led, the Verdoorn effect and the induced technological change effect, caused by a reduction in real wage growth, work in the same direction, i.e., to reduce productivity growth. Consequently, if the demand regime is wage-led, the productivity regime must also be wage-led; the associated growth trajectory is labelled 'technologically regressive stagnationist'. Now, a reduction in real wage growth leads to a decline in demand and GDP growth as well as a fall in productivity growth—and, consequently, there is no macroeconomic trade-off between (i) GDP and productivity growth, and (ii) more egalitarian distributional outcomes (brought about by real wage increases). The impact of a reduction in real wage growth on employment growth, however, is ambiguous: if, in response to the real wage moderation, productivity growth declines more than GDP growth, the growth rate of employment will increase. From equation (26), it follows that this will be the case, if

$$\frac{d\hat{x}^\star}{d\hat{w}} < \frac{\beta_2}{(1-\beta_1)} \tag{27}$$

Whether or not this condition is met depends on the magnitude of the model parameters, namely, β_1, β_2 and C.

4. The effects of real wage restraint: the Netherlands (1960–2000)

Dutch macroeconomic performance after 1984 has been remarkably different from the OECD average in two major respects: below-average productivity growth and above-average employment growth. How can this divergence of the Dutch growth trajectory after 1984 be explained? It is widely agreed that Dutch economic policy after 1982 has been unique in the (voluntary) restraint of real wage growth—the essence of the Dutch 'polder model'. It is therefore reasonable to ask to what extent real wage growth restraint has contributed to the (relative) slowdown of productivity growth and to the rise in employment growth in the Netherlands. To answer this question we empirically apply our 'cumulative causation' model.

4.1 Estimation results

To do so, the growth model parameters are estimated using time-series data for the Netherlands (1960–2000). The (single equation) estimation results are shown in Table 5.

Table 5. *Regression Results*

Equation:	(1) $\hat{\lambda}$	(29) σ	(13) Δ log i	(15) $\hat{e}$
Dep. var.:	(i)	(ii)	(iii)	(iv)
Constant	−1.014		-0.009^{**}	
	(1.52)		(1.88)	
σ_w		0.140^{**}		
		(2.23)		
$\hat{x}$	0.630^{***}			
	(4.37)			
$\hat{w}$	0.520^{***}			
	(4.40)			
π		0.354^{**}		
		(2.17)		
Δ log π_{-1}			0.392^{**}	
			(2.17)	
Δ log x			1.336^{***}	
			(4.56)	
$\hat{z}$				0.976^{***}
				(18.99)
$\hat{\upsilon}$				-0.188^{**}
				(1.83)
Adj. R^2	0.64	0.10	0.36	0.91
SE	1.34	0.02	0.01	2.19
D.W.	1.68	2.24	1.76	1.71
F-stat.	35.20	4.97	11.77	196.41
prob > *F*	0.00	0.03	0.00	0.00
Obs.	40	41	39	40
d.f.	37	39	37	38
Period	1961–2000	1960–2000	1960–2000	1960–2000

Notes: Numbers in parentheses below each coefficient are *t*–statistics. *indicates statistical significance at the 10% level; **indicates statistical significance at the 5% level; ***indicates statistical significance at the 1% level. SE = standard error. *D.W.* = Durbin–Watson statistic. *F* is the *F*-statistic and *prob* > *F* is the associated probability of observing an *F*-statistic that large or larger. Obs. = number of observations. d.f. = degrees of freedom. The method of estimation was OLS for equations (13) and (15) and AR(1) for equations (1) and (29); for AR(1) estimations, the transformed *D.W.* statistic is reported. *Symbols:* $\hat{\lambda}$, $\hat{x}$, $\hat{w}$, $\hat{e}$, $\hat{z}$, and σ_w are defined in Table 1 and in the text. σ = the aggregate savings rate; i = gross fixed investment (at constant 1995 prices); π = the share of profits in GDP at factor cost; x = GDP at constant 1995 market prices; $\hat{\upsilon}$ = the growth rate of Dutch real unit labour cost *minus* that of OECD real unit labour cost.

Data sources: see sources to Tables 1–3.

Column (i) shows the results for the *PR* equation.[1] The estimated Verdoorn coefficient β_1 is statistically significant at the 1% level. Our estimate of 0.63 is higher than the value of 0.5, obtained in most econometric studies of Verdoorn's law. The induced technological progress coefficient β_2 is also significant at the 1% level; its value of +0.52 implies that a 1 percentage point increase (decline) in real wage growth is associated with a 0.52 percentage

[1] The estimated coefficients reflect the medium-run structure of the Dutch economy. The analysis of (any) structural change during 1960–2000 is beyond the scope of our present analysis.

point increase (fall) in labour productivity growth. Our estimate is quite close to an earlier estimate $\beta_2 = 0.41$ by the CPB (1992).[1]

Turning to the *DR* curve (16), we start by noting that the classical assumption that $\sigma_w < \sigma_\pi$ is in line with available empirical evidence for the Netherlands.[2] Our estimate of the effect of income distribution on savings and consumption is based on a transformation of the following identity for (real) private savings s (Bowles and Boyer, 1995)

$$s = [\sigma_w \upsilon + \sigma_\pi \pi] x \tag{28}$$

Recalling that $\upsilon = 1-\pi$, we can write the aggregate savings propensity ($\sigma = s/x$) as

$$\sigma = s/x = \sigma_w + (\sigma_\pi - \sigma_w)\pi \tag{29}$$

The estimation results appear in column (ii) of Table 5. The parameters, estimated by AR(1), are consistent with the two propensity hypothesis, the (statistically significant) *difference* (σ_π–σ_w) being 0.35. Our estimate of the propensity to save out of wage income is statistically significant; $\sigma_w = 0.14$. By implication, $\sigma_\pi = 0.49$.

The investment demand equation (12) has been estimated in logarithmic form as follows

$$\log i = \Xi + \phi_1 \log \pi + \phi_2 \log x \tag{30}$$

where $\Xi = \log a_i + \phi_0 \log b$; note that differentiation of (30) with respect to time yields the investment growth equation (13). In the regression, the profit share is introduced with a lag. Because of the presence of first-order autocorrelation in the data, equation (30) was reformulated and estimated in the first differences of the variables. The regression results appear in column (iii). The coefficient of π is statistically significant at the 5% level and has a value of 0.39. Our estimate of π is higher than the (long-term) average estimate of 0.28 for France, Germany, Japan, the UK and the USA for the period 1953–87 by Bowles and Boyer (1995); but it is lower than Glyn's (1996) estimate of 0.44 for 12 OECD countries (not including the Netherlands) during 1973–92. Turning next to the elasticity ϕ_2, demand growth has a significant effect on investment growth, taking a value that is not statistically significantly different from unity (as is also found by Jacobs and Sterken, 1995).

Finally, column (vii) presents the regression results for the export growth equation (15). The overall fit of the equation is high (the adjusted R^2 is 0.91). The coefficient of world trade growth $\hat{z}$ takes a (statistically significant at 1%) value that is not significantly different from unity; hence, Dutch exports tend to grow in line with world trade, as assumed in equation (15). The coefficient of relative real unit labour cost ϵ_1 is negative and significant at the 5% level. Its value (-0.19) is similar to the estimate of -0.17 obtained by Jacobs and Sterken (1995) for the period 1981–92. Further evidence of a low sensitivity of Dutch export growth to labour cost growth is provided by Carlin *et al.* (2001), who obtain a cost elasticity of exports of only -0.12. As Carlin *et al.* (2001) argue, the low sensitivity of export demand to labour cost reflects the importance of other factors such as embodied technological improvements, quality and market power.

We further calculated the following average shares for the period 1960–2000: the real wage share $\upsilon = 0.592$; the profit share $\pi = (1-\upsilon) = 0.408$; the investment–GDP ratio

[1] As the theoretical model emphasises, there is simultaneity in equation (1). However, estimation of this equation by 2SLS, with $\hat{x}$ as the instrumental variable and $\hat{w}$ and $\hat{z}$ as predetermined variables, yields estimates of β_1 and β_2, which are statistically not different from the estimates reported in Table 5. Likewise, estimation of the reduced-form productivity growth equation (22) yields 'indirect least squares' estimates of the original structural coefficients β_1 and β_2, which are very close to the estimates reported here.

[2] See Kuipers *et al.* (1990), CPB (1992), Fase *et al.* (1992) and CPB (1997).

$(i/x) = 0.224$; the export–GDP ratio$(e/x) = 0.513$; the import–GDP ratio $\zeta = 0.489$; and $\theta = \upsilon/\pi = 1.32$. The multiplier μ^{-1} equals 0.765, and hence $\xi = \upsilon\mu^{-1} = 0.735$. Using these estimates, it is possible to determine the slope of the *DR* curve as follows

$$\frac{d\hat{x}}{d\hat{\lambda}} = -\frac{d\hat{x}}{d\hat{w}} = -\frac{[\xi(\sigma_\pi - \sigma_w) - \psi_e\epsilon_1 - \psi_i\phi_1\theta]}{[1 - \psi_i\phi_2]} = -0.06 \tag{31}$$

Thus, the nature of the Dutch demand regime during 1960–2000 is found to be *wage-led*, because $(d\hat{x}/d\hat{w}) = +0.06 > 0$; that is, a reduction in real wage growth by one percentage point will reduce Dutch real GDP growth by 0.06 percentage points. While this may seem quite a remarkable conclusion, we must note that the size of $(d\hat{x}/d\hat{w})$ is close to zero. This being the case, the slope of the *DR* curve may change sign—shifting from wage-led to profit-led—in response to small changes in the estimated model parameters. Hence, although our estimates appear to be empirically robust and are in line with findings from other studies, the conclusion that the Dutch aggregate demand regime is wage-led, remains a cautious one. We can more safely conclude, however, that the effects on Dutch aggregate demand of an economy-wide change in real wage growth are likely to be very small, which holds true for other OECD countries as well (Bowles and Boyer, 1995).[1]

4.2 Explaining post-1984 dutch macroeconomic performance

Qualitatively, the growth effects of the policy of real wage growth restraint depend on the nature of the Dutch growth trajectory, as defined in Table 4. Because the Dutch Demand Regime is wage-led and because $0 < \beta_2 < 1$, the nature of the Dutch growth process is *technologically regressive stagnationist*: a decline in $\hat{w}$ will reduce both output and productivity growth; employment growth, however, may rise or fall. Using the estimated model, we analyse the quantitative contributions to the change in Dutch output, productivity and employment growth between 1960–80 and 1984–2000 of

(1) the decline in real wage growth $\hat{w}$ (by -5.3 percentage points), and
(2) the decline in world trade growth $\hat{z}$ (by about -1.2 percentage points).

This is accomplished by first-differencing the reduced form equation (22) and (23) and calculating the (various) contributions of $\hat{w}$ and $\hat{z}$. The results of the decomposition are shown in Table 6.

Consider first the sources of the decline (by about one percentage-point) in average annual Dutch real GDP growth between 1960–80 and 1984–2000. First differencing of equation (23) yields

$$\Delta\hat{x}^\star = \Psi Z\Delta\hat{z} + \Psi(1 - \beta_2)C\Delta\hat{w}, \quad \Psi = \frac{1}{1 + \beta_1 C} \tag{32}$$

which shows that the decline in GDP growth $\Delta\hat{x}^\star$ can be attributed to a change in aggregate demand growth, caused, in turn, by changes in world trade growth and real wage growth. The impact on $\hat{x}^\star$ of the decline in world trade growth $\hat{z}$ consists of

(1) a *direct*, foreign-trade multiplier impact on GDP growth, which equals $Z\Delta\hat{z}$. This effect, as Table 6 shows, accounts for about 76% of the decline in Dutch real GDP growth between 1960–1980 and 1984–2000.

[1] In terms of Figure 2, this means that the *DR* curve is almost horizontal; Dutch demand growth thus depends almost completely on world demand growth and autonomous investment growth.

Table 6. *Percentage of the change in Dutch output growth, productivity growth and employment growth between 1960–80 and 1984–2000 explained by each component*

	$\Delta\hat{x}^\star$ −1.01	$\Delta\hat{\lambda}^\star$ −3.32	$\Delta\hat{l}^\star$
Demand			
1. A decline in $\hat{z}$:	73.64		−32.40
Foreign trade multiplier effect	76.46		−33.64
Trade-induced technological change	−2.82		1.24
2. A decline in $\hat{w}$:	14.55		−6.40
Real wage multiplier effect	31.48		−13.85
Real wage-induced technological change	−16.93		7.45
Technology			
3. Verdoorn effects:		16.96	24.43
3a. Due to decline in $\hat{z}$		14.16	20.40
Foreign trade multiplier effect		14.71	21.18
Trade-induced technological change		−0.54	−0.78
3b. Due to decline in $\hat{w}$:		2.80	4.03
Real wage multiplier effect		6.06	8.72
Real wage-induced technological change		−3.26	−4.69
4. Induced technological change		82.28	118.48
Total	88.19	99.24	104.11

Source: Author's estimates.

(2) an *indirect* impact, operating via the Verdoorn effect on productivity growth. This indirect impact is captured by the endogenous technology multiplier Ψ. $\Psi = 0.96$, which, by reducing the foreign-trade multiplier, offsets the negative impact on $\hat{x}^\star$ of the decline in trade growth by about 2.8%.

Similarly, from equation (32), the impact on $\hat{x}^\star$ of the decline in $\hat{w}$ can be decomposed into

(1) a *direct* impact, equal to $C\Delta\hat{w}$. Since $C > 0$ in a wage-led demand regime, real wage growth restraint reduces $\hat{x}^\star$. In the Dutch case, 31% of the fall in real GDP growth can be directly attributed to the decline in real wage growth.

(2) *indirect* effects, because productivity growth changes as a result of induced technological change and Verdoorn effects. The impact on $\hat{x}^\star$ of induced technological change is captured by the expression $(1-\beta_2)$, which, because $\beta_2 = 0.52$, can be seen to reduce (in absolute terms) the direct impact on output growth of lower real wage growth by about 52%. The Verdoorn effect is given by the endogenous technology multiplier Ψ. Because $\Psi = 0.96$, the negative impact of real wage restraint on output growth becomes smaller (in absolute terms). The combined impact of induced technological change and Verdoorn effects, due to real wage restraint, are considerable, as Table 6 shows. They make a negative contribution to the fall in $\hat{x}^\star$ (of almost −17%), partly offsetting the direct effect; accordingly, the positive contribution to $\Delta\hat{x}^\star$ of real wage restraint is reduced from 31% (directly) to 14.6%.

When combined, the declines in world trade growth and in real wage growth account for about 88% of the decline in Dutch real GDP growth. This 'under-estimation' (by about 12%) of the decline in Dutch output growth suggests that Dutch GDP growth has been negatively affected by other factors, not included in the model. One major neglected factor is the globalisation of finance—a process, in which many (large) Dutch firms increasingly used their (growing) profits for foreign direct investment, equity participation, and outright stock market speculation (see Storm and Naastepad, 2003, for evidence). As a result, the post–1984 improvement in the profitability of Dutch firms did not raise *domestic* investments to the extent as predicted by the model. Acknowledging that the decline in Dutch economic growth is underexplained by about 12%, we conclude that the decline (by 1.2 percentage point) in world trade growth by far is the major source of the decline in Dutch output growth. And remarkably, the impact of the—internationally unprecedented—decline in real wage growth (by 5.3 percentage points) was only limited: we estimate that it has reduced the rate of GDP growth by less than 0.15 percentage points. Dutch real GDP growth thus appears to have been quite resilient to real wage rate changes.

What are the sources of the Dutch productivity growth decline—by 3.3 percentage points—between 1960–80 and 1984–2000? First differencing of equation (22) gives

$$\Delta\hat{\lambda}^{\star} = \beta_1 \Psi Z \Delta\hat{z} + \beta_1 \Psi (1 - \beta_2) C \Delta\hat{w} + \beta_2 \Delta\hat{w} \tag{33}$$

which is a decomposition of the change in labour productivity growth into Verdoorn effects and an induced technological progress effect. The latter effect, captured by the expression $\beta_2 \Delta\hat{w}$, accounts for as much as 82% of the Dutch productivity slowdown after 1984. Verdoorn effects more or less explain the rest of the productivity growth decline.

The first set of Verdoorn effects are due to the decline in world trade, $\hat{z}$. They are given by the first term on the right-hand-side of equation (33): export growth and, hence, output growth decline, and this does negatively affect productivity growth directly, i.e., $\beta_1 Z \Delta\hat{z}$, and indirectly via the endogenous technology multiplier Ψ. The direct effect is negative and accounts for almost 15% of the productivity slowdown; the indirect trade–induced Verdoorn effect is very small. The second set of Verdoorn effects results from the change in output growth, caused by the decline in real wage growth $\hat{w}$. This real-wage–induced Verdoorn effect, given by the second term on the right-hand-side of equation (33), in turn consists of a direct effect, $\beta_1 C \Delta\hat{w}$, and indirect effects. It can be seen that the direct, real-wage multiplier effect is quite large; it is positive, because the decline in $\hat{w}$ reduces $\hat{x}^{\star}$ and, hence, $\hat{\lambda}^{\star}$, accounting for 6% of the productivity growth decline. Again, the indirect effect is opposite in sign to the direct effect, and reduces these direct impacts by more than 50%. Taken together, the Dutch productivity slowdown is remarkably well explained by equation (33). The declines in world trade growth and real wage growth, when combined, account for 99% of the Dutch productivity growth slowdown after 1984. Clearly, the decline in real wage growth is the major cause of the Dutch productivity crisis, explaining, both directly (by retarding induced technological change) and indirectly (through Verdoorn effects), 85% of the productivity growth decline.

Finally, we turn to explaining the (in international perspective spectacular) increase in the growth rate of Dutch employment (by 2.3 percentage points) between 1960–80 and 1984–2000. By definition

$$\Delta\hat{l}^{\star} = \Delta\hat{x}^{\star} - \Delta\hat{\lambda}^{\star} \tag{34}$$

Using equations (32) and (33), we identify the sources of the rise in employment growth at the demand and the supply (productivity) side (see Table 6). The combined demand and productivity growth sources account for 104% of the increase in Dutch employment growth between 1960–80 and 1984–2000.

Consider the demand side first. Dutch employment growth was negatively affected by the decline in demand growth $\hat{x}^\star$ caused by the decrease in world trade growth. Directly and indirectly (via its impact on productivity growth), the decline in $\hat{z}$ made a contribution to the rise in employment growth of -32%. Employment growth was further negatively affected by the decline in demand, caused by real wage growth restraint; this contributed -6.4% to increased employment growth $\hat{l}^\star$. The Dutch 'employment miracle' cannot, therefore, be attributed to demand factors. But then how can one explain the Dutch employment miracle?

The answer lies in the productivity side of the Dutch economy: post–1984, the growth rate of Dutch labour productivity declined (considerably) more than that of real GDP, thereby raising employment growth. The consequent 'employment miracle' is, in other words, the direct result of the Dutch productivity crisis and, as such, it is a symptom of technological stagnancy rather than of economic dynamism (as is often claimed). As Table 6 shows, the total contribution to the rise in $\hat{l}^\star$ of the decline in productivity growth equals about 143%. Perhaps not surprisingly, the single most important source of the employment growth, resulting from the productivity growth slowdown, is real wage growth restraint. By (directly and indirectly) retarding productivity growth, the decline in $\hat{w}$ accounts for as much as 122.5% of the increase in employment growth. It is noteworthy that the direct (induced technological change) channel, via which real wage restraint affects productivity and employment growth, is much more important (in absolute terms) than the indirect (Verdoorn) channel. The second source of the productivity growth slowdown and consequent employment growth increase is trade-related: the fall in output growth, caused by the decline in $\hat{z}$, has a negative (Verdoorn) impact on productivity growth; this, in turn, raises employment growth, accounting for 24% of $\Delta\hat{l}^\star$.

5. Conclusions and implications

Real wage restraint (as part of a general policy of labour market liberalisation and deregulation) has been and continues to be one of the central post–1980 OECD economic policies to revive sluggish output and productivity growth and reduce (the high rate of) unemployment. This paper has argued that real wage growth restraint has been and will be far less effective in improving macroeconomic performance than is usually recognised. The reason is that a reduction in real wage growth is likely to slow down productivity growth: directly, by lowering the rate of 'wage-led' (induced) technological progress, and indirectly, by Verdoorn effects (if the demand regime is wage-led). As a result, real labour cost growth declines less than real wage growth, thus constraining the latter's impact on demand and output growth. This possibility is not recognised in neoclassical growth models, in which increased profitability (due to the fall in real wage growth) implies an increase in aggregate savings, higher investment, and hence higher output as well as productivity growth. It is also neglected in Marxian models of 'profit squeeze' and Kaleckian models of profit-led growth, which predict that higher profitability raises investment and GDP growth. And it is due to this neglect that these models are incapable of explaining the important fact that, although profit rates recovered to their Golden Age levels as a result of significant real wage moderation, post-1980 OECD macroeconomic performance continues to fall short of performance during 1960–80.

To substantiate our point, we developed a general Keynesian growth model, which integrates the wage-led or profit-led aggregate demand system proposed by Bhaduri and Marglin (1990), Taylor (1991) and others, and a neo-Kaldorian supply system incorporating the productivity-growth enhancing effects of higher demand and higher real wages. The model thus not only includes the *net* impact on demand of a real wage change, *at a given labour productivity* as in Bhaduri and Marglin (1990), but, in addition, it describes how the real wage change as well as the change in demand affect productivity and how the consequent productivity change, in turn, feeds back into aggregate demand, because, through its impact on unit labour cost, it affects income distribution, consumption, investment and exports. Using our unifying framework, we identified the (often differing) effects of real wage growth restraint on output, productivity and employment growth in various growth trajectories. Three conclusions emerge from the theoretical analysis.

- In a wage-led demand regime, the outcome of real wage growth restraint is stagnationist, so long as the elasticity of productivity growth with respect to real wage growth, i.e., β_2, is smaller than unity: both output growth and productivity growth decline. Employment growth will rise if productivity growth declines more than output growth.
- In a profit-led demand regime, a decline in real wage growth raises output and productivity growth, so long as its negative direct impact on productivity growth is more than offset by the positive Verdoorn effect, due to the higher output growth. The growth trajectory is exhilarationist. However, when the negative direct impact of real wage restraint on productivity growth is larger (in absolute terms) than the positive Verdoorn effect, productivity growth declines, and the trajectory is called 'technologically regressive exhilarationist'. In this case, employment growth will strongly increase as a result of wage moderation.
- When $\beta_2 > 1$, wage growth restraint will lead to a more than proportional decline in productivity growth in both demand regimes. The growth rate of unit labour costs will increase, causing a decline (rise) in output growth in the profit-led (wage-led) regime. The introduction of wage-led (induced) endogenous technological change and productivity growth, thus fundamentally alters the nature of the growth process.

We applied our growth model to the Netherlands, where, after 1982, the growth in real wages was restrained with unparalleled zeal, reflecting the policy consensus that, the Dutch system being profit-led, the consequent increase in profitability would revitalise investment, which, in turn, would raise productivity growth (through supply-side effects) and output growth (through the Keynesian multiplier). We econometrically estimated the determinants of Dutch productivity growth, and of investment, savings, and exports over the period 1960–2000, and find that the Dutch growth trajectory is outright 'stagnationist'. Perhaps even more remarkably, the growth rate of Dutch aggregate demand is relatively *insensitive* to changes in real wage growth. We find what may seem surprisingly little responsiveness of investment to profits—confirming the results for other OECD countries of Bowles and Boyer (1995)—and of exports to unit labour costs—confirming findings by Carlin *et al.* (2001). The crucial implication is that the trade-off between growth and distribution is less ubiquitous than is commonly presumed, even in economies highly open to international trade. However, whereas demand growth is quite resilient to changes in real wage growth, the impact of real wage moderation on Dutch labour productivity growth is large. Real wage restraint explains—both directly (by retarding induced technological change) and indirectly (through Verdoorn effects)—85% of the decline in Dutch productivity growth after 1984. The effort to revive stagnant investment by curbing real wage growth, while having only a marginal impact on the *rate* of GDP growth, thus had a tremendous impact on the *nature* of GDP growth: owing to the slowdown of productivity growth, Dutch output growth became significantly more labour-intensive during 1984–2000. The Dutch employment miracle is, therefore, the by-product of 'wage-led' technological regression.

Thus, both our theoretical and empirical analysis cast considerable doubt upon the presupposition that real wage restraint—in conjunction with a more general 'flexibilisation' of labour markets—is a necessary condition for adequate long-run macroeconomic performance of the OECD countries. If the other OECD countries too are on a stagnationist, or, alternatively, a technologically regressive exhilarationist, growth trajectory, real wage restraint will inevitably lead to a further slowdown in their productivity growth and a (temporary) increase in their employment growth, without having much effect on their output growth. While, to some, the increase in employment and the reduction in unemployment may appear politically desirable, as it may provide OECD Welfare States relief from fiscal pressures, it has to be recognised that this relief will only be temporary, because the employment gains are based on remarkably weak foundations. Underlying, as our analysis has shown, there is technological stagnation, which finds expression in a severe productivity growth crisis. The negative long-term consequences for GDP growth of this technological *malaise* are obvious, once it is recognised that the export market performance of the OECD countries depends mostly on embodied technology, quality and innovativeness (Carlin *et al.*, 2001). By contrast, the case for a more egalitarian and, at the same time, technologically more dynamic alternative, based on increased real wage growth and a strategic integration with world markets (i.e., competing on the basis of technological superiority rather than labour costs), appears substantially more persuasive.

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Appendix A. Stability of the equilibrium position

Let us write the growth model in reduced form as:

$$\hat{x}_{\mathrm{DR}} = A + C\hat{w} - C\hat{\lambda}, \quad A = \frac{[\psi_i \phi_0 \hat{b} + \psi_e \hat{z}]}{[1 - \psi_i \phi_2]}, \quad C = \frac{[\xi(\sigma_\pi - \sigma_w) - \psi_e \epsilon_1 - \psi_i \phi_1 \theta]}{[1 - \psi_i \phi_2]} \tag{35}$$

$$\hat{x}_{\mathrm{PR}} = -B + \beta_1{}^\star \hat{\lambda}, \quad B = \frac{\beta_0}{\beta_1} + \frac{\beta_2}{\beta_1}\hat{w}, \quad \beta_1{}^\star = \frac{1}{\beta_1}, \quad \beta_0, \beta_2 > 0, \quad 0 < \beta_1 < 1 \tag{36}$$

where $\hat{x}_{\mathrm{DR}}$ is the rate of output growth according to the *demand regime* and $\hat{x}_{\mathrm{PR}}$ is the rate of output according to the *productivity regime*. Assuming that $0 \leq \phi_2 < (1/\psi_i)$ and that $\hat{b}, \hat{z} > 0$, it follows that $A > 0$; we further assume that $\hat{w} > 0$ and hence $B > 0$. Equilibrium requires that $\hat{x}_{\mathrm{DR}} = \hat{x}_{\mathrm{PR}}$; from this, the equilibrium growth rate of labour productivity should be

$$\hat{\lambda}^\star = \frac{(A + B + C\hat{w})}{(\beta_1^\star + C)} \quad A, B > 0. \tag{37}$$

We shall confine our analysis to the case in which $\hat{\lambda}^\star > 0$. In a wage-led system, $C > 0$ and hence a positive equilibrium productivity growth rate does always exist. In a profit-led system, however, when $C < 0$, this need not be the case; $\hat{\lambda}^\star$ will be positive only if

- $\beta_1^\star > -C$ and $(A + C\hat{w}) > -B$, i.e., the slope of the *PR* curve must exceed the slope of the *DR* curve *and* the intercept term of the *DR* curve must be larger than the intercept of the *PR* curve; this can be shown to represent a stable equilibrium growth position; or else:
- $\beta_1^\star > -C$ and $(A + C\hat{w}) < -B$, i.e., the slope of *DR* must exceed the slope of *PR and* the intercept of *PR* must be larger than that of *DR*; this equilibrium position can be shown to be unstable.

The stability of the equilibrium position requires that, from any initial condition $\hat{\lambda}_0 \neq \hat{\lambda}^\star$, labour productivity growth converges to its equilibrium value $\hat{\lambda}^\star$. Let us assume that the rate of change in productivity growth (with respect to time) at any moment is directly proportional to the output growth gap $\hat{x}_{DR} - \hat{x}_{PR}$ prevailing at that moment. Accordingly, we can write

$$\frac{d\hat{\lambda}}{dt} = q(\hat{x}_{DR} - \hat{x}_{PR}) \quad q > 0 \tag{38}$$

where q represents a (constant) adjustment coefficient. With this specification of the dynamic adjustment process, we have stable productivity growth, i.e., $d\hat{\lambda}/(dt) = 0$, only if $\hat{x}_{DR} = \hat{x}_{PR}$. Substitution of equations (35) and (36) into (38), and rearranging gives

$$\frac{d\hat{\lambda}}{dt} + q(\beta_1{}^\star + C)\hat{\lambda} = q(A + B + C\hat{w}) \tag{39}$$

The solution of this differential equation—the time path of labour productivity growth—can be written as

$$\hat{\lambda}_t = \left[\hat{\lambda}_0 - \frac{(A + B + C\hat{w})}{(\beta_1{}^\star + C)}\right]e^{-q(\beta_1{}^\star + C)t} + \frac{(A + B + C\hat{w})}{(\beta_1{}^\star + C)} = [\hat{\lambda}_0 - \hat{\lambda}^\star]e^{-q(\beta_1{}^\star + C)t} + \hat{\lambda}^\star \tag{40}$$

If the equilibrium is to be stable

$$\lim_{t \to \infty} \hat{\lambda}_t = \hat{\lambda}^\star \tag{41}$$

which is possible if, and only if,

$$q(\beta_1{}^\star + C) > 0 \quad \Rightarrow \quad \beta_1{}^\star > -C \tag{42}$$

Dynamic stability thus requires that the slope of the *PR* curve exceed the slope of the *DR* curve. When $C > 0$, condition (42) is certainly satisfied. However, when the demand regime is profit-led, i.e., $C < 0$, the condition is non-trivial: the *PR* curve should rise more rapidly than the *DR* curve. If the equilibrium value of $\hat{\lambda}$ is to be positive and stable, $\beta_1{}^\star > -C$ and $(A + C\hat{w}) > -B$.

Appendix B. A complete classification of growth trajectories

Table A1 presents a configuration of possible changes in the equilibrium growth path, caused by a policy of real wage restraint, depending on (i) the nature of the demand regime, and (ii) the degree of 'wage-led' (induced) technological progress, i.e., the size of β_2. On the basis of this configuration, we draw out the following conclusions:

(1) *If the aggregate demand regime is wage-led*, real wage restraint will *always* lead to a fall in labour productivity growth; however, its impact on output growth is ambiguous in sign and depends on the size of the induced technological progress effect β_2:

Table A1. *The productivity, output and employment growth effects of real wage restraint: a classification*[ab]

	Nature of Aggregate Demand Regime			
	Profit-led			
	$\beta_2 = 0$ (Ia)	$0 < \beta_2 \leq -\beta_1 C$ (Ib)	$\beta_2 > -\beta_1 C$ (Ic)	Wage-led (Id)
$0 \leq \beta_2 < 1$	$d\hat{\lambda}^*/d\hat{w} < 0$ $d\hat{x}^*/d\hat{w} < 0$ $d\hat{l}^*/d\hat{w} < 0$	$d\hat{\lambda}^*/d\hat{w} < 0$ $d\hat{x}^*/d\hat{w} < 0$ $d\hat{l}^*/d\hat{w} < -\beta_2$	$d\hat{\lambda}^*/d\hat{w} > 0$ $d\hat{x}^*/d\hat{w} < 0$ $d\hat{l}^*/d\hat{w} < -\beta_2$	$0 < d\hat{\lambda}^*/d\hat{w} < 1$ $d\hat{x}^*/d\hat{w} > 0$ $d\hat{l}^*/d\hat{w} > -\beta_2$
			(IIa)	(IIb)
$\beta_2 = 1$	n.r.	n.r.	$d\hat{\lambda}^*/d\hat{w} = 1$ $d\hat{x}^*/d\hat{w} = 0$ $d\hat{l}^*/d\hat{w} = -\beta_2 = -1$	$d\hat{\lambda}^*/d\hat{w} = 1$ $d\hat{x}^*/d\hat{w} = 0$ $d\hat{l}^*/d\hat{w} = -\beta_2 = -1$
			(IIIa)	(IIIb)
$\beta_2 > 1$	n.r.	n.r.	$d\hat{\lambda}^*/d\hat{w} > 1$ $d\hat{x}^*/d\hat{w} > 0$ $-\beta_2 < d\hat{l}^*/d\hat{w} < -1$	$d\hat{\lambda}^*/d\hat{w} > 1$ $d\hat{x}^*/d\hat{w} < 0$ $d\hat{l}^*/d\hat{w} < -\beta_2$

[a]Symbols are defined in the main text. Note that $0 \leq \beta_1 \leq 1$ and $1 > -\beta_1 C$. When the aggregate demand regime is profit-led, $C < 0$; when it is wage-led, $C > 0$. Numbers between brackets refer to growth trajectories defined in the text.
[b]n.r. = not relevant.

- If $0 \leq \beta_2 < 1$, real wage restraint reduces both output growth and productivity growth—as in cell Id of Table A1. The impact on employment growth can be negative or positive, depending on whether output growth declines more (less) than productivity growth. The nature of the growth trajectory depicted in cell Id is *technologically regressive stagnationist*.
- If $\beta_2 = 1$: a reduction in real wage growth results in a proportional decline in labour productivity growth, leaving unit labour cost growth unaffected; hence, output growth is left unchanged (cell IIb). Employment growth, however, rises as a result of the fall in productivity growth. Hence, cell IIb describes a growth trajectory, in which real wage restraint changes the nature of the growth process (from 'intensive' to 'extensive'), but not the rate of growth.
- If $\beta_2 > 1$, real wage growth restraint leads to a more than proportional decrease in productivity growth and—since $(\hat{\upsilon} = \hat{w} - \hat{\lambda})$—to a *rise* in the growth rate of real labour cost $\hat{\upsilon}$. This rise in $\hat{\upsilon}$ leads, perhaps surprisingly, to a rise in $\hat{x}^*$. But productivity growth declines; as a result, the real wage growth restraint leads to a significant rise in equilibrium employment growth as, indicated in cell IIIb. This increase in $\hat{l}^*$ is mostly due to technological retardation, since in absolute terms, the productivity growth decline is larger than the output growth increase.

(2) *If the aggregate demand regime is profit-led* and if $0 \leq \beta_2 < -\beta_1 C < 1$, both productivity and output growth rise in a process of positive cumulative causation due to a decline in $\hat{w}$, as in cells Ia and Ib. Employment growth also increases, because output growth increases more than productivity growth. The growth trajectories of cells Ia and Ib are *technologically progressive exhilarationist*. But if $-\beta_1 C < \beta_2 < 1$, output growth increases, whereas productivity growth is reduced compared with a decline in real wage growth. In effect, employment growth increases

significantly. This outcome is depicted in cell Ic, which portrays a *technologically regressive exhilarationist* growth trajectory. Two more profit-led trajectories can be distinguished:

- If $\beta_2 = 1 > -\beta_1 C$: because a reduction in real wage growth leads to a proportional decline in productivity growth, unit labour cost growth and hence output growth remain unchanged (cell IIa). Employment growth rises as a result of the reduced labour productivity growth.
- $\beta_2 > 1 > -\beta_1 C$: real wage restraint, by raising $\hat{\upsilon}$, results in a fall in output growth (cell *IIIa*). Because $\hat{\lambda}^\star$ declines more than $\hat{x}^\star$, the rate of employment growth increases; here, the increase in $\hat{l}^\star$ is completely due to the deceleration of technological progress.