Negative economic growth externalities from crumbling public investment in Europe: evidence based on a cross-section analysis for the OECD-countries

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Abstract

Building on an extended version of the neoclassical growth model developed by Robert Solow, this paper addresses the question to what extent the observed dramatic decline of public investment in physical capital and the underdevelopment of active, relative to passive, labour market policies in a lot of European countries has led to a decline in economic growth. On the one hand, the results show that declining public physical capital investment has significantly lowered long-run economic growth. In Belgium for example, the decline can account for a decrease in economic activity of about 0.6% percent points each year. On the other hand, low investment in human capital of the unemployed does not seem to have a direct negative impact while a generous unemployment benefit system, especially the duration of benefits, does seem to have contributed to lower economic growth.

1 Introduction

The macroeconomic development of a lot of 'core' European countries during the 1980s and the 1990s has been very problematic. Increasing (structural) unemployment and significant budgetary contraction, associated with attempts to cut back public debt ratios, seem to be two key negative factors leaning heavily on future long-term growth of European standards of living. Clearly, it should not come as a surprise that these two problems appear together. On the one hand, rising unemployment deteriorates the government's financial balances through higher unemployment benefits and lower social security contributions. On the other hand, the stance of fiscal policy affects the labour market situation through the level of taxes and the level and/or composition of public expenditures (i.e. investment relative to consumption).

One possible channel through which a tight fiscal policy may deteriorate the labour market situation is *the negative impact on economic growth resulting from winding back public investment in both physical and human capital*. Generally spoken, this negative impact can manifest itself in two different ways. On the one hand, public investment is part of the demand side of the economy, affecting short-run economic growth. Modigliani (1996) and Heylen, Goubert and Omey (1996) provide evidence that ongoing contractionary fiscal and monetary policy in Europe, by creating inadequate aggregate demand resulting in economic growth below potential, is to a large extent responsible for the sharp rise of unemployment rates in the 1990s. On the other hand, public investment is part of the supply side of the economy for it is an important input in the private sector production process. Therefore, lower public investment could restrict the long-run growth potential of the economy, through this channel leading to higher unemployment. Given the fact that over the last 20 years, the potential yearly growth of the European economy has decreased from about 4% to 2,5% (European Commission (1993)), the negative supply side effects from lower public investment should not be overlooked. This view is supported by the work of Aschauer (1989), and that of a lot of other authors after him, showing that declining investment in public infrastructure plays a crucial role in the slowdown of productivity growth in the US since the mid 1970s.

The need for higher public investment, in order to stimulate employment growth, has already been stressed by the European Commission (1993) and in a policy initiative paper written by a group of economists at the initiative of Drèze and Malinvaud (1994). However, the resistance (e.g. in Germany) against the proposed European investment programmes proofs that their expected positive contribution to macroeconomic performances is not evident and needs a stronger scientific background.

Building on the *neoclassical growth theory*, this paper tries to provide a piece of this highly needed scientific background by investigating the impact of public investment on long-run economic growth within a cross-section of 21 OECD-countries. First, we will investigate to what extent differences in economic growth are due to differences in public physical investment. Second, given the fact that most authors only consider investment in general education as a proxy for human capital accumulation, an interesting extension would be to analyse whether a similar positive impact on economic growth can be found for government investment in active labour market policies[1]. In this line of thought, an additional question is whether expenditures on passive labour market policies have a negative impact on economic growth. Given the estimation results, we will be able to draw quantitative inferences about the 'loss of economic growth' due to the observed (see section 2) dramatic decline in public infrastructure investment and underdevelopment of active labour market policies.

The remainder of this paper is organised as follows. Section 2 highlights the importance of physical and human capital investment by the public sector as inputs in the production process. Section 3 extends the traditional neoclassical model of long-run economic growth to allow for public physical and human capital accumulation. Section 4 presents the results from our empirical analysis. The final section summarizes and outlines some directions for future research.

2 The role of public investment in the process of economic growth

The purpose of this section is to sketch the potential importance of public investment, in both physical and human capital, in the process of long-run economic growth. In addition, some figures will be presented on the level and the evolution of investment in public physical capital and expenditures on active and passive labour market policies.

2.1 Public investment in physical capital

Much of the traditional work investigating whether fiscal policy is able to affect economic growth uses aggregate measures of government size, e.g. total public expenditures. However, not all components of public expenditures are expected to affect long-run economic growth in the same way. Public investment in physical capital for instance is far more important for macroeconomic performance than public consumption. Apart from the direct multiplier effect, resulting from all types of government expenditures, *public infrastructures are an important input in the private sector production process*, affecting both output and productivity. They not only enlarge the capital stock of a nation but also enable a more efficient use of the existing stock. Intuitively, firms simply can't operate without having an extended system of highways, airports, communication networks, electrical and gas facilities, sewers and other components of public infrastructure at their disposal. Not only the existence but also the quality of the infrastructure is an important element. A highway in bad condition for instance increases the wear on trucks and the time spent driving, resulting in a lower productivity of both private capital and labour (Munnell (1990a)).

Since nonexcludability and large economies of scale are two key factors making the private sector unwilling or unable to produce these large infrastructures, the government faces the task to provide the infrastructural services herself. Therefore, lower public investment can lead, through a less developed or a less well maintained national infrastructure, to lower economic activity.

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[1] Although government outlays for active labour market policies are included in government consumption, we prefer to treat these expenditures as investment rather than as consumption.

This whole intuition is already explicitly present in the theoretical work of Robert Barro (1990) and Nicholas Stern (1991), who emphasize that modern growth theories should not omit the public capital stock. Given this a priori expectation and given large cross-country variation in public investment ratios (see table 2.1), the relationship between public infrastructure investment and economic growth will be analyzed further in this paper within a cross-section of 21 OECD-countries. Our a priori expectation is that countries characterized by low public infrastructure investments are, ceteris paribus, also countries with low rates of long-run economic growth.

Table 2.1

Average levels of real public consumption and real public investment as a share of real GDP

	Real Public consumption							Real Public investment						
	61-65	66-70	71-75	76-80	81-85	86-90	91-95	61-65	66-70	71-75	76-80	81-85	86-90	91-95
Germany	19.78	19.78	19.40	20.36	20.52	20.07	19.61	4.24	4.39	4.18	3.55	2.70	2.47	2.65
France	20.53	19.01	17.94	18.18	18.93	19.01	19.11	3.83	3.81	3.48	3.21	3.15	3.51	3.88
Italy	18.47	17.43	16.81	16.46	16.20	16.55	16.15	3.83	3.48	3.38	3.06	3.61	3.57	2.81
Netherlands	18.62	16.32	15.05	15.04	15.61	15.24	14.37	5.87	6.30	5.04	3.81	3.07	2.63	2.74
Belgium	15.60	16.62	16.39	17.51	17.32	16.59	14.94	3.47	4.22	4.12	3.69	2.85	1.77	1.63
UK	24.02	23.66	22.91	23.73	23.81	21.14	21.06	6.55	7.60	6.53	5.14	3.76	2.89	3.36
Ireland	17.00	16.78	19.11	20.25	20.35	17.79	14.72	5.14	5.88	6.28	5.42	5.14	2.65	2.21
Denmark	19.00	20.09	22.44	24.38	26.93	24.90	24.00	3.88	5.05	4.65	3.85	2.34	2.13	2.00
Spain	13.12	11.22	10.32	11.53	13.44	14.91	16.76	2.31	2.46	2.49	1.97	2.64	4.01	4.40
Norway	15.86	17.40	18.76	19.38	20.71	20.37	21.53	3.35	3.85	4.42	4.22	3.31	3.61	3.41
Sweden	21.79	23.03	24.38	26.13	27.60	26.49	27.33	2.78	3.57	3.01	2.72	2.36	2.04	2.49
Finland	17.08	17.76	17.70	20.29	20.77	21.09	22.39	3.61	4.44	3.83	3.54	3.53	3.34	3.06
Austria	20.11	19.21	17.62	18.21	18.64	18.14	17.02	4.69	5.23	5.49	4.73	3.82	3.48	3.23

Source: OECD, Economic Outlook (Statistical Compendium, 1996/2)

Given the potential impact of public infrastructure investments on economic growth, it is important to note that they have been winded back dramatically over the last two decades (see table 2.1). The most severe decline seems to be situated in the period from the second half of the 1970s till the end of the 1980s. As a result, mid 1990 public investment ratios in Belgium and Ireland for instance have fallen by more than 60% relative to their level during the first part of the 1970s. In Germany, Italy, the Netherlands, the UK, Denmark and Austria the decline amounts to 37%, 17%, 46%, 49%, 57% and 41% respectively.

One could argue however that the sharp decline of public investment in physical capital is associated with the completion of large, unique infrastructures and therefore does not automatically results in a deterioration of the public capital stock. In the Netherlands for instance, investment in the ‘Deltawerken’ consisted of about 30% of total public investment over the period 1958-1986 (Toen-Gout and Jongeling (1993)). Their completion is surely one of the reasons why public investment in the Netherlands is considerably lower nowadays. However, since the observed decline in a lot of European countries is very sharp and ranges over a prolonged period, this argument cannot be the key explanation.

A second explanation for the decline is c*ontractionary fiscal policy*. Table 2.1 shows that in most of the 'core' European countries, government outlays (for both consumption and investment) relative to GDP have (on average) declined during the 1980s and 1990s[2]. Although one must be very careful in drawing conclusions about the budgetary stance in a country looking only at the evolution of public expenditures, this observation gives some evidence that fiscal policy in a lot of European countries has (on average) been restrictive for more than one decade. The same conclusion has been drawn by Heylen, Goubert and Omey (1996), who considered the evolution of the structural (i.e. cyclically adjusted) budget deficit. Fiscal policy was found to be contractionary during large parts of the 1980s and 1990s in most of the counties for which we found decreasing public expenditures. In the line of these predictions, De Haan, Sturm and Sikken (1996) find evidence that fiscal stringency is a key element in the explanation of the sharp decline in public capital investment in a lot of OECD-countries. To the extent that contractionary fiscal policy is indeed part of the true explanation, one can expect a considerable deterioration of the public capital stock and a resulting negative impact on economic growth.

Additional evidence in favour of this second hypothesis is given by the observation, from table 2.1, that in those countries where total government expenditures have declined, public investment has been reduced considerably sharper than public consumption. Alesina and Perotti (1995) indeed find that during periods of tight fiscal policy, cuts in government expenditures primarily involve cuts in public investment. This is due to "*the political reality that it is easier to cut back or postpone investment spending than it is to cut current expenditures*" (Oxley and Martin (1991)), for investments are a less rigid component of public outlays.

2.2 Public investment in human capital

Traditionally, capital has been introduced in models of economic growth as the stock of physical capital alone. Since the influential paper by Mankiw, Romer and Weil (1992) (MRW hereafter), increasing attention has been paid to the contribution of human capital to economic growth.

From a theoretical point of view, Mankiw (1995) argues that this augmented view on the capital stock is motivated by the observation that the concept of capital accumulation is much broader than investment in physical capital alone. If capital accumulation is defined as the share of income which is saved today in order to produce more income tomorrow, then the acquisition of human capital is an important type of capital accumulation and should not be excluded. Moreover, like physical capital, human capital is a key input in the production process. A higher human capital stock enhances productivity, for workers will not only be faster in doing their jobs but are also more capable to use the 'state-of-the-art' technologies.

From an empirical point of view, including human capital in the traditional neoclassical growth theory is very appealing for it gives the model the power to explain the largest part of cross-country differences in economic growth (see MRW).

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[2] This was the case in Germany, Italy, the Netherlands, Belgium, UK, Ireland, Denmark and Austria.

A lot of authors have already incorporated variables measuring investment in general education, as one type of human capital accumulation, in theories of long-run economic growth. MRW for instance use the secondary school enrollment ratio as a proxy for human capital accumulation. They find a significant positive impact on income per capita and long-run economic growth. Since the government plays a key role in the organisation of the system of general education, it is clear that the government is able to affect economic growth through its investment in human capital.

Next to general education we see another important effort by the government to augment and/or maintain the human capital stock which has till now not yet been included in the analysis. The main objective of *active labour market policies* is to enhance the job-search effectiveness and the qualifications of the (long-term) unemployed in order to make them more competitive on the labour market (Calmfors (1994)). On the one hand, *higher job-search effectiveness*, through for instance job-search counselling, job-brokerage services and subsidised employment in the private sector, reduces the duration of unemployment (OECD (1993)). Since long lasting unemployment erodes the skills and the motivation of the unemployed, reducing the duration of unemployment is an important method to stop the human capital of the unemployed from deteriorating. On the other hand, the *enhanced qualifications* of participants in training and re-training programmes and on the job-training in job creation measures, not only enhance the competitiveness of outsiders relative to insiders but also result in higher productivity once they are at work (OECD (1993)) and should therefore be viewed as adding to the human capital stock. Clearly, given the current European context of high and persistent unemployment, active labour market policies could be an important tool to maintain the human capital stock of workers.

The government can also, unintentionally although, reduce human capital by providing excessive unemployment benefits (*passive labour market policies*). Since high benefits, paid for a long period, reduce the beneficiaries' job-search motivation, long-term unemployment is 'stimulated' (see e.g. Scarpetta (1996)), leading to an erosion of the skills of the unemployed.

Table 2.2 provides data of government expenditures on active labour market policies[3] per unemployed and of the ratio of expenditures on active over passive policies. The data on active policies per unemployed person are expressed in 1991 purchasing power parity dollar values. Since social objectives are the main consideration for certain types of active policies, we also consider a sub-set, apart from total expenditures on active policies, including only measures aimed to improve job-search effectiveness and qualifications of the unemployed (efficiency improving policies)[4]. The data show that although expenditures on active labour market policies in a majority of countries have increased over the last decade, active policies in most of the European countries are considerably underdeveloped relative to passive policies. This observation is one of the reasons frequently quoted in the literature for the long persistence of European unemployment (see e.g. Elmeskov (1993) and Layard et al. (1991)). Since long-term unemployment results in an erosion of the skills of the unemployed, the choice in favour of passive labour market policies is expected to have deteriorated the human capital stock.

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[3] Data are only available from 1985 or 1986 onwards.
[4] See data appendix A for a description of the variables used.

However, note that there exist large cross-country differences. Sweden and Norway, for instance, and to a lesser degree Germany and France are countries spending a large fraction of their overall labour market budget on labour market efficiency improving policies. An interesting question is whether the expected positive impact on the human capital stock of this larger spending on active labour market policies is strong enough to show up in the growth experience of these countries. The possible importance of active labour market policies in this context has already been stressed by the OECD, for one of their objectives for stimulating active labour market policies is to foster economic growth through human capital accumulation (OECD (1990)). An additional question is whether generous unemployment benefits have a negative impact on economic growth.

Table 2.2
Expenditures on active labour market policies

	'Active' expenditures per unemployed				Ratio of 'active' over 'passive' expenditures			
	Total		Efficiency improving		Total		Efficiency improving	
	1986	1994	1986	1994	1986	1994	1986	1994
Germany	4228	5453	2396	2949	0.68	0.59	0.39	0.32
France	2657	3866	1615	2266	0.32	0.59	0.20	0.35
Italy	2254	3703 *	392	398 *	0.79	1.06*	0.14	0.11*
Netherlands	5270	6420	1387	2250	0.38	0.37	0.10	0.13
Belgium	4033	4743	900	2234	0.39	0.47	0.09	0.22
UK	2365	1975	825	1305	0.43	0.38	0.15	0.25
Ireland	2389	3131 **	1297	1375 **	0.44	0.46**	0.24	0.20**
Denmark	4198	5805	2332	2873	0.28	0.39	0.15	0.19
Spain	855	797	654	611	0.25	0.17	0.19	0.14
Norway	8914	10163	4279	4203	1.32	1.02	0.63	0.42
Sweden	28610	12590	11987	5917	2.30	1.18	0.95	0.56
Finland	4799	2836	2109	1435	0.59	0.35	0.26	0.18
Switzerland	9859	3786	4151	1767	0.83	0.31	0.35	0.15
Austria	3675	3173	2673	2267	0.33	0.23	0.24	0.16

Source: OECD, Employment Outlook ('92, '94, '95, '96) and OECD, Economic Outlook (Statistical Compendium, 1996/2)
Note: Expenditures on active labour market policies per unemployed are expressed in '91 purchasing power dollar values.
* data for 1992; ** data for 1991

3 Public investment in the neoclassical model of long-run economic growth

This section provides the theoretical basis that will be applied in the subsequent empirical analysis. First, it will be argued that the traditional neoclassical model is a relevant theoretical approach to the understanding of the role of public investment in cross-country variations in income per capita. Second, the augmented version of the traditional Solow model, as developed by MRW, will be further extended in order to draw inferences about the impact of public investment on long-run economic growth.

3.1 The relevance of the neoclassical model in explaining differences in income per capita

In the second half of the eighties, a new impulse to the understanding of the process of economic growth was given by Romer (1986) and Lucas (1988). Their critique on the neoclassical growth model led to the development of the '*endogenous growth theory*'. The main critique addresses the failure of the Solow model to explain the persistence of positive per capita growth rates. Once the effect of short-run forces has worn off, the economy reaches its steady state in which per capita income remains constant. The only way to escape this 'zero-growth-trap' is assuming technological progress, which is exogenously determined. The endogenous growth theorists try to fill this gap by modelling technological change endogenously.

Although this new growth theory is very appealing, most cross-country empirical research still uses the neoclassical approach as the underlying model. Barro (1996) gives the following explanation for this observation: '*Theories of basic technological change seem most important for understanding why the world as a whole can continue to grow indefinitely in per capita terms. But these theories have less to do with the determination of relative rates of growth across countries, the key element studied in cross-country statistical analyses.*' Therefore, the neoclassical model and endogenous growth models should not be seen as alternatives but rather as complements, both addressing different questions. Mankiw (1995) assumes that technology travels rather quickly around the world, leading to the assumption that all countries have access to the same technology. However a country needs a skilled labour force to introduce the 'state-of-the-art' technology. Therefore, different decisions upon investment in physical and human capital lead to differences in the degree to which advantage is taken from the available international knowledge. As such, models building on the differences in investment rates, e.g. the traditional neoclassical growth theory, provide an important insight in why countries differ in their per capita growth rates.

3.2 An extended version of the neoclassical model

3.2.1 Set up of the model

We start from a *Cobb-Douglas production function*, allowing for four factors of production: the private capital stock (K^{pr}), the public capital stock (K^{pu}), the human capital stock (K^{h}) and the stock of effective labour (AL). The effect of government expenditures on active and passive labour market policies on output is channelled through changes in the human capital stock. All countries are assumed to have access to the same technology (A), which is modelled as a '*labour augmenting*' or '*Harrod-neutral*' technological progress[5]. Assuming *constant*

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[5] In the Solow model, technological progress is modelled as labour-augmenting because this is the only way to introduce stability in the model, i.e. to make sure that the economy has a steady state (see Barro and Sala-i-Martin (1995)). However, if we assume that the production function is Cobb-Douglas, it doesn't matter how technological process is modelled, for any technological process can be remodelled to labour-augmenting (Romer (1996)). For instance, a capital-augmenting technological process can be rewritten as $Y(t) = K(t)^{\alpha}(L(t)\widehat{A}(t))^{1-\alpha}$, with $\widehat{A}(t) = A(t)^{(1-\alpha)/\alpha}$.

returns to scale[6] across all factors of production, this function is homogeneous of the first degree, implying a *positive but diminishing marginal product of capital*. Output (Y) at time t is therefore determined by:

$$Y(t) = \left(K^{pr}(t)\right)^{\alpha_{pr}} \left(K^{pu}(t)\right)^{\alpha_{pu}} \left(K^{h}(t)\right)^{\alpha_{h}} \left(A(t)L(t)\right)^{1-\alpha_{pr}-\alpha_{pu}-\alpha_{h}} \qquad (3.1)$$

$$\alpha_i > 0 \quad \text{and} \quad \sum_i \alpha_i < 1 \qquad \text{with } i = pr, pu, h$$

with α_i denoting the elasticities of output with respect to private capital, public capital and human capital and ($1 - \sum_i \alpha_i$) the elasticity with respect to effective labour. The growth rate of technology (g) and of the labour force (n) are exogenously determined:[7]

$$d\left(L(t)\right)/d(t) = n\,L(t) \qquad \text{or} \qquad L(t) = L(0)e^{nt} \qquad (3.2)$$

$$d\left(A(t)\right)/d(t) = g\,A(t) \qquad \text{or} \qquad A(t) = A(0)e^{gt} \qquad (3.3)$$

with L(0) and A(0) being the initial values for L and A respectively. From (3.2) and (3.3) it follows that effective labour is growing at the rate n+g. Now define the capital stocks per effective unit of labour ($k_e \equiv K/AL$) and the output per effective unit of labour ($y_e \equiv Y/AL$). It is straightforward to show that (3.1) can be rewritten as:

$$y_e(t) = \left(k_e^{pr}(t)\right)^{\alpha_{pr}} \left(k_e^{pu}(t)\right)^{\alpha_{pu}} \left(k_e^{h}(t)\right)^{\alpha_{h}} = \prod_i \left(k_e^{i}(t)\right)^{\alpha_i} \qquad \text{with } i = pr, pu, h \qquad (3.4)$$

3.2.2 The steady state of the economy

3.2.2.1 Modelling steady state income per capita and growth

Since the growth rates of the labour force and technology are exogenously determined, the analysis of the dynamics of the economy focuses on *the dynamics of the capital stock*. Moreover, the accumulation of public sector physical and human capital is conceptually very similar to the accumulation of private sector physical capital for they both need the input of physical capital, human capital and (raw) labour. Therefore (and in order to keep the model simple) they are all modelled in the same way[8]. Furthermore, it is assumed that each type of capital depreciates at the same rate (δ) in all countries. After letting s^j denote the fraction of

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[6] As an answer to the critique of the 'endogenous growth theorists', Solow (1994) noted that constant returns to scale are not needed for the model to work. The assumption is mainly a nice way to simplify the model, for the analysis can then be conducted in terms of ratios and can be modelled under perfect competition. However, the main implication from imposing constant returns to scale is that countries are assumed to be big enough such that there exist no further gains from specialisation, i.e. new capital and labour inputs are basically employed in the same way as the existing stock (Romer (1996)).

[7] Note that the model is set in continuous time. However, setting the model in discrete time basically results in the same conclusions.

[8] On first sight, modelling human capital accumulation in the same way as physical capital accumulation is a very crude approach. Note however that Romer (1996) finds that relaxing this assumption doesn't alter the basic insights about cross-country differences.

total output invested in capital of type j, the growth of k^j_e can be written as (for details see technical appendix A):

$$d\left(k_e^j(t)\right)\Big/d(t) = s^j y_e(t) - (n+g+\delta)k_e^j(t) \qquad (3.5)$$

The first term on the RHS measures total realized investment per effective worker in capital of type j, while the second term measures 'break-even investment', or the investment needed to offset the negative effect on the capital stock per effective worker of population growth, technological progress and depreciation of the capital stock. The difference between the two terms gives the net change of the capital stock per effective unit of labour.

Figure (3.1) shows equation (3.5) graphically. Since the Cobb-Douglas function satisfies the Inada conditions[9], the s^j $y_e(t)$ curve is vertical when k^j_e goes to zero and therefore steeper than the $(n+g+\delta)k^j_e$ line. The same conditions imply that for very large values of k^j_e the slope of the s^j $y_e(t)$ curve must fall below the slope of the $(n+g+\delta)k^j_e$ line. Therefore, the two lines must intersect. Since we have a diminishing marginal product of capital, the two curves will only cross once for (strictly) positive values of k^j_e.

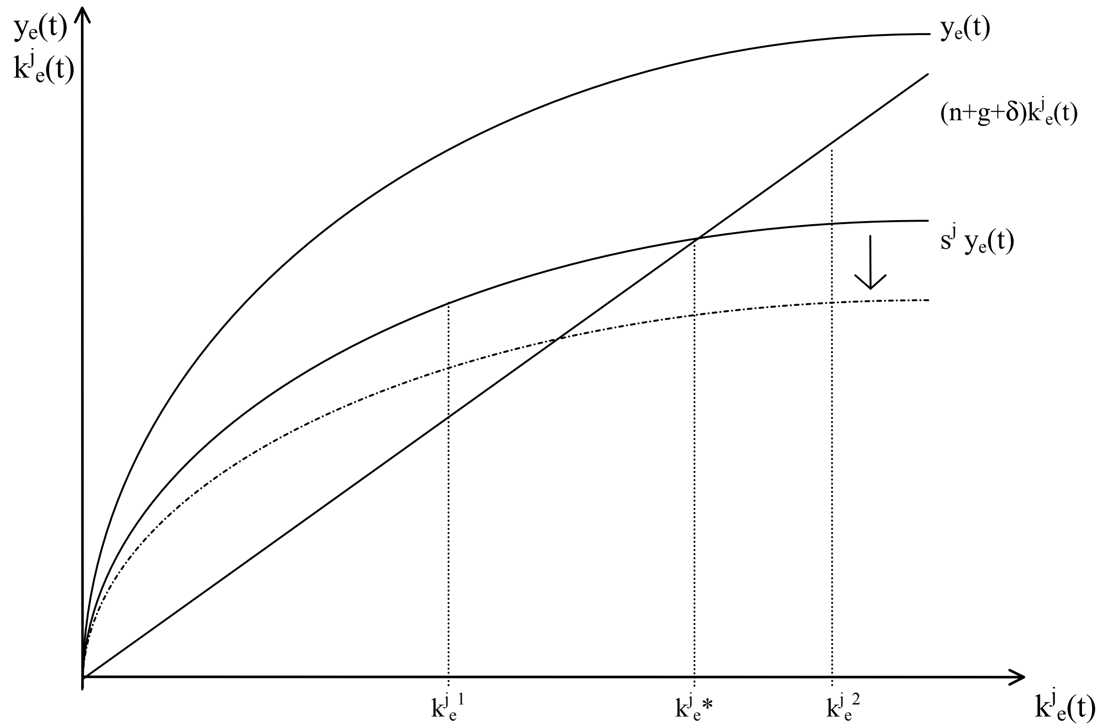

Figure (3.1)

With capital per effective worker equal to $k^{j\,1}_e$, realized investment is larger than break-even investment. Therefore k^j_e must increase till the steady state value k^j_e* is reached. When capital per effective worker equals $k^{j\,2}_e$, realized investment is smaller than break-even investment, implying a decreasing k^j_e.

[9] The Inada conditions imply that the marginal product of each type of capital goes to infinity as capital approaches zero and goes to zero as capital approaches infinity. It is straightforward to check that the Cobb-Douglas production function satisfies these conditions.

Now define the *steady state* of the economy as the situation in which the three types of capital stocks per effective unit of labour remain constant[10]. Substituting (3.4) in (3.5) and imposing the 'steady state conditions' yields the following equation for each type of capital j:

$$s^j \prod_i \left(k_e^{i*}\right)^{\alpha_i} = (n+g+\delta)k_e^{j*} \tag{3.6}$$

Since there are 3 categories of capital, equation (3.6) leads to a system of 3 equations. After calculating the solution for each category, substituting this solution in the production function, and writing the result in terms of income per capita (y≡Y/L) one gets (for details see technical appendix B):

$$\begin{aligned}\ln(y^*) = \ln\left(A(0)\right) + gt + \frac{\alpha_{pr}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pr}\right) + \frac{\alpha_{pu}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pu}\right) \\ + \frac{\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^h\right) - \frac{\alpha_{pr}+\alpha_{pu}+\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln(n+g+\delta)\end{aligned} \tag{3.7}$$

Following the approach of Mankiw et al. (1992), the index A(0) not only reflects technology but also resource endowments, climate, institutions and a large number of other factors that may vary across countries. It follows that A(0) may differ from country to country. Therefore ln(A(0)) can be split up in a part (a') common to all countries and a country-specific component (ε).

$$\ln\left(A(0)\right) = a' + \varepsilon \tag{3.8}$$

Moreover, since the rate of technological progress is assumed to be the same for all countries, the term gt on the RHS of equation (3.7) does not contribute to the explanation of cross-country differences and can therefore be included in the constant term. These assumptions lead to the following final equation, used in *cross-sectional analyses*:

$$\begin{aligned}\ln(y^*) = a + \frac{\alpha_{pr}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pr}\right) + \frac{\alpha_{pu}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pu}\right) \\ + \frac{\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^h\right) - \frac{\alpha_{pr}+\alpha_{pu}+\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln(n+g+\delta) + \varepsilon\end{aligned} \tag{3.9}$$

with $a = a' + gt$

3.2.2.2 Implications for investment in public capital

What we are interested in, are the qualitative as well as quantitative implications of cross-country differences in the level of public investment for the steady state level of income per capita and its growth rate.

[10] Variables which are at their steady state level are denoted by a *.

Qualitative effects

From equation (3.7) it is clear that in the steady state, income per capita grows at the exogenously determined rate of technological progress (the economy is on the so-called balanced growth path). Moreover, since all economies are assumed to have access to the same technology, they are all growing at the same rate. Therefore, the observed dramatic decline in public physical investment and the underdevelopment of active labour market policies will not have any effect on *the long-term growth rate of income per capita*.

In contrast, *the level of steady state income per capita* is determined by the investment ratios. Other determinants are the rate of technological progress, the population growth rate and the rate of capital deterioration. The lower the investment ratios, the lower the equilibrium income per capita. Therefore, if two countries differ only with respect to the fraction of total output invested by the government, the country with the lowest public investment will have the lowest level of income per capita. Alternatively, a decrease in the public investment ratio results in a lower steady state income per capita. Graphically, this can be presented by a downwards shift of the actual investment line (see the dotted line in figure 3.1).

Quantitative effects

Since equations (3.7) and (3.9) are in logarithmic terms, the coefficients are elasticities of steady state income per capita with respect to the considered variables. One of the nice things of the neoclassical model is that it enables us to draw *quantitative predictions* about these elasticities, giving an a priori indication of the magnitude of the influence of the considered variables. Moreover, in an empirical analysis, these predictions can then be compared with the obtained estimation results in order to give an idea about the reality content of the model.

Under the assumption of perfect competition, factors of production are paid their marginal products. This implies that α_j is equal to the share of total income paid to capital of type j and ($1 - \sum \alpha_i$) equal to the share of total income paid to labour[11]. The shares of private capital and total labour can fairly easily be computed from the national income accounts. Traditionally, most authors find numbers of about 1/3 for the private capital share and 2/3 for the share of total labour in a broad sample of 98 countries (see e.g. MRW). Finding a reasonable way to split up the share of total labour into the share of raw labour (i.e. labour which possesses no human capital) and the share of human capital, is more difficult however. If we assume that the wage earned by unskilled workers is a good proxy for the return to raw labour, then α_h can

[11] If firms are maximising their profits, perfect competition leads to the equalisation of the marginal products of the factors of production and what they are paid as compensation. When labour is paid a real wage W and the real cost of capital of type j is C_j, then

$$W = \partial(Y)/\partial(L) \qquad \text{and} \qquad C_j = \partial(Y)/\partial\left(K^j\right)$$

$$W = \left(1 - \sum_i \alpha_i\right) Y/L \qquad\qquad C_j = \alpha_j Y/K^j$$

$$\left(1 - \sum_i \alpha_i\right) = WL/Y \qquad\qquad \alpha_j = C_j K^j / Y,$$

WL/Y and C_jK^j/Y being the shares of labour respectively capital in total income.

be calculated from the fact that (in the United States) unskilled labour receives approximately 1/3 to 1/2 of total labour earnings. Since the share of all labour in total income is about 2/3, the share of human capital lies between 1/3 and 4/9 (see Romer (1996)).

However, if public capital is introduced in the model, as is done above, this type of analysis becomes problematic. Since public physical capital is an unpaid factor of production, we can't calculate its share in total income and can't draw quantitative conclusions concerning the coefficients appearing in equation (3.9). However, this does not mean that we can't say anything. As an answer to a similar problem, Munnell (1990b) assumes that the benefits from the contribution of public physical capital to the production of total output are distributed among the private factors of production proportionally to their output elasticities. From the output elasticities implied by the estimated elasticity coefficients, we can then calculate the implied share of each private factor of production in the total output.

3.2.3 Out-of-equilibrium dynamics

A very robust empirical observation is the enormous cross-country variation in growth rates of income per capita (see e.g. Barro and Sala-i-Martin (1995)). Since the model developed above can only explain differences in income per capita, and not in its rate of growth, there seems to exist a large gap between the theory and what is observed in the real world. Note however that equation (3.9) only establishes the eventual long-term relationship between the explanatory variables and income per capita, i.e. when all short run forces have worn off. After a shock in one of the explanatory variables, the economy doesn't jump immediately to its new long-run equilibrium but will only slowly converge to it, implying deviations from the steady state relationship.

3.2.3.1 Modelling the process of convergence

Mathematically, this process of convergence can be modelled by considering a log-linearization around the steady state (see technical appendix C):

$$\frac{d\ln\left(y_e(t)\right)}{d(t)} = \lambda\left[\ln\left(y_e^{*}\right) - \ln\left(y_e(t)\right)\right]$$

$$\text{With } \lambda \equiv \left(1-\alpha_{pr}-\alpha_{pu}-\alpha_h\right)\left(n+g+\delta\right) \qquad 0<\lambda<1 \tag{3.10}$$

Where y_e* denotes the steady state value of income per effective worker and $y_e(t)$ the out-of-equilibrium value at time t. Each period a fraction (λ) of the gap between the steady state and the current income per effective worker is closed. Equation (3.10) is a differential equation of the first degree, for which the solution equals:

$$\ln\left(y_e(t)\right) = \left(1-e^{-\lambda t}\right)\ln\left(y_e^{*}\right) + e^{-\lambda t}\ln\left(y_e(0)\right) \tag{3.11}$$

where $y_e(0)$ denotes the starting date of the convergence process. Subtracting $\ln(y_e(0))$ from both sides of the equation yields:

$$\ln\left(y_e(t)\right)-\ln\left(y_e(0)\right)=\left(1-e^{-\lambda t}\right)\ln\left(y_e^{\,*}\right)-\left(1-e^{-\lambda t}\right)\ln\left(y_e(0)\right) \tag{3.12}$$

Substituting for ln(y_e*) from (B.7), writing in terms of income per capita and imposing the same assumptions as used to derive equation (3.9), results in the following final form applicable in cross-section regression analyses:

$$\ln\left(y(t)\right)-\ln\left(y(0)\right)=\beta_0+\sum_i \beta_i \ln\left(s^i\right)+\beta_n \ln\left(n+g+\delta\right)+\beta_y \ln\left(y(0)\right)+\varepsilon \tag{3.13}$$

With $\beta_i=\left(1-e^{-\lambda t}\right)\left(\dfrac{\alpha_i}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\right)$ i = pr, pu, h

$$\beta_n=-\left(1-e^{-\lambda t}\right)\left(\frac{\alpha_{pr}+\alpha_{pu}+\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\right)$$

$$\beta_y=-\left(1-e^{-\lambda t}\right)$$

According to this equation, cross-country differences in long-run economic growth are only determined by differences in investment ratios, population growth rates and initial levels of income per capita[12].

3.2.3.2 Implications for investment in public infrastructure

In contrast to the implications of equations (3.7) and (3.9), equation (3.13) implies that changes in public investment affect both *the level and the growth rate of income per capita*. A decrease in public investment not only lowers the (long-run) equilibrium level of income per capita but also pushes economic growth below the rate of technological progress along the transition path towards the new equilibrium. This lower growth emerges from the fact that a decrease in investment implies a lower output in the first period, resulting in a downward spiral of investments and output in the subsequent periods. Because we have constructed the model under a positive but decreasing marginal product of capital, this negative spiral will eventually wear off and the economy will move slowly towards its new equilibrium, inducing the rate of economic growth to converge back towards the rate of technological progress.

A very important parameter is the speed of convergence. If the convergence is only a slow process, out-of-equilibrium dynamics result in significant deviations from the steady state growth rates over a long period. Moreover, since during such a long transition period new shocks are likely to occur, shifting again the position of the steady state, the economy may never reach the balanced growth path. Equation (3.10) allows us to draw quantitative conclusions about the speed of convergence predicted by our model[13]. Assuming that the shares of private physical capital and human capital are both equal to 1/3 (i.e. after receiving a

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[12] The rate of technological process and the depreciation rate are assumed to be the same for all countries. Therefore, they don't contribute to the understanding of cross-country differences.

[13] As mentioned above, we cannot calculate the share of public physical capital in total income. Note however that it is possible to make quantitative predictions if we assume that the benefits from government investment are distributed among human and physical capital alone (i.e. excluding 'raw' labour).

part of the benefits from the contribution of public physical capital to total production), the share of raw labour equals 1/3. Assuming moreover that (n+g+δ) equals 6%[14], equation (3.10) implies a rate of convergence of 2% per year (i.e. the value found in a large part of the empirical literature on economic growth). This speed of convergence implies that the economy moves halfway to its steady state in about 35 (=70/2) years. With such a slow convergence, a decrease in public investment creates a long transition period during which growth rates lie below the rate of technological progress.

4 Empirical analysis

Building on the theory outlined in section 3, the following simple question will be addressed: what are the implications for economic growth of the observed decline in public infrastructure investment and the underdevelopment of active labour market policies?

4.1 Public investment in physical capital

4.1.1 Specification and data selection

MRW show that after adding a proxy for human capital investment, the neoclassical model is able to account for the largest part of cross-country variations in economic growth. To serve as a benchmark for the further refinements, we will first try to reconstruct these empirical findings, using our own data set and variables. Note that since the investment ratio in the specification of MRW includes both private and public investment, we cannot disentangle their separate effects. This approach implies that in calculating the factor shares, the benefits of public physical capital are entirely appropriated to private physical capital, causing an upward bias on the calculated share of private capital and a downward bias on the calculated share of human capital. Second, we allow for a break up of total physical capital investment into public and private investment. By doing so, we are able to draw inferences about the impact of public investment on economic growth and we can follow the more realistic approach of distributing the benefits from public capital among private physical capital and human capital proportionally to their calculated output elasticities.

In order to obtain consistent OLS estimates however, the country-specific shift in the production function (ε) must be independent of the explanatory variables. Although the possibility of correlation is quite high[15], MRW provide several reasons for making the assumption of independence. Most important to note however is that in the cross-sectional framework used, this assumption is simply an 'econometric necessity', since finding instrumental variables (the alternative for OLS) that are correlated with the explanatory variables but uncorrelated with ε is an almost impossible task (Islam (1995)).

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[14] For the rationale behind these numbers, see Mankiw (1995).

[15] Investment decisions and fertility behaviour are likely to be affected by the index A(0) since the latter not only reflects technology but also resource endowments, climate, institutions and a lot of other factors that may vary across countries.

Data for real GDP and the share of total real investment in real GDP are from the Penn World Table (mark 5.6), constructed by Summers and Heston (1995). Data concerning the ratio of real private and real public investment to real GDP and gross enrollment ratios[16] are from the Barro and Lee (1994) data set. Data for the working-age population, i.e. total population with age between 15 and 64, are from the OECD.[17] In order to make international volume comparisons possible, real variables are all denominated in 1985 purchasing power parity dollar values. Since data concerning the break up of total investment in the private and the public component are only available from 1970 till 1985, we restrict our attention to this period.

4.1.2 Regression results

Table 4.1 reports the results[18] for 21 OECD-countries[19] over the period 1970-1985. The bottom part of the table shows the implied factor shares and the implied rate of convergence, calculated from the regression in which the coefficients on the investment ratios and the population growth rate are restricted to sum to zero (these restricted regressions are not reported here).

Regressions (1) and (2) are run *under the assumption that all countries are in their steady state in 1985*. Regression (1) shows that all explanatory variables enter with the right sign and, except for the total investment ratio, are highly significant. However, the low estimated coefficient on the total investment ratio, relative to the estimated coefficient on the higher school enrollment ratio, results in a strong rejection of the model's main quantitative predictions concerning the factor shares (i.e. $\alpha_{pr} \cong 1/3$ and $\alpha_h \cong 1/3$). Note that even if the restrictive assumption that countries are in their steady state is maintained, the public investment ratio enters significantly at the 5% level when we allow a break down of the total investment ratio in the private and the public investment ratio (regression (2)). However, the coefficient on private investment becomes negative, yielding implied factor shares that are even farther away from the model's predictions. These findings lead to the conclusion that the model does a poor job if we assume that countries are in their steady state.

In contrast, regression (3) shows that the total investment ratio enters highly significant when we allow for *departures from the steady state*. However, although the model performs relatively well, the human capital proxy is not significant and the implied share of private

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[16] Since a lot of different agents invest time and money in building up the human capital stock, the total resources devoted to human capital accumulation are very hard to measure, even when attention is restricted to education alone. In order to overcome these measurement problems, most authors use school enrollment rates as proxies for human capital accumulation through general education. Mankiw et al. (1992) for instance use the secondary school enrollment ratio. We find however that this variable is statistically outperformed by the higher school enrollment ratio when both are included in one regression. Since both enrollment ratios are strongly correlated, leading to a multicollinearity problem, we prefer to use only the higher school enrollment ratio.

[17] See data appendix A for more information on the construction of the variables and their sources.

[18] One of the possible problems in regressions using cross-sectional data is heteroscedasticity. However, since all regressions pass the heteroscedasticity test, we don't compute heteroscedasticity-consistent standard errors.

[19] From the 24 OECD-countries, Luxembourg and Iceland where excluded because they have a population smaller than one million. In addition, Switzerland was excluded because information for human capital investment is incomplete and because no data for public investment ratios were available.

physical capital is too high, while that of human capital is too low, contradicting again, although less strongly, the model's main quantitative predictions. Note, that this result is in line with the expected biases when investment in physical capital is introduced as an aggregate including both private and public investment.

Table 4.1

Regression results investigating the impact of public physical capital investment (1975-1990)							
Dependent variable	(1) n = 21 $\ln(Y_{85})$	(2) n = 21 $\ln(Y_{85})$	(3) n = 21 $\ln(Y_{85}/Y_{70})$	(4) n = 21 $\ln(Y_{85}/Y_{70})$	(5) n = 57 $\ln(Y_e/Y_i)$	(6) n = 21 $\ln(Y_{85}/Y_{70})$	(7) n = 21 $\ln(Y_{85}/Y_{70})$
Constant	8.188	8.227	2.004	2.668	1.119	2.756	2.176
ln(I/Y)	0.131 (0.227)		0.340 (0.112)°°°				
ln(PI/Y)		-0.026 (0.177)		0.207 (0.090)°°	0.072 (0.031)°°	0.244 (0.104)°°	0.192 (0.133)
ln(GI/Y)		0.193 (0.091)°°		0.149 (0.043)°°°	0.042 (0.016)°°°		
$\ln(GI^i/Y)$						0.119 (0.048)°°	
ln(GC/Y)							0.032 (0.125)
ln(ENRH)	0.757 (0.092)°°°	0.880 (0.103)°°°	0.130 (0.093)	0.227 (0.100)°°	0.067 (0.036)°	0.183 (0.110)	0.108 (0.125)
$\ln(n+g+\delta)$	-0.985 (0.367)°°	-1.169 (0.353)°°°	-0.402 (0.192)°	-0.491 (0.190)°°	-0.133 (0.077)°	-0.402 (0.210)°	-0.324 (0.294)
$\ln(Y_{70})$			-0.234 (0.100)°°	-0.285 (0.096)°°°	-0.112 (0.039)°°°	-0.279 (0.108)°°	-0.245 (0.128)°
Gap					0.0161 (0.004)°°°		
R^2	0.820	0.850	0.488	0.579	0.463	0.468	0.252
Restriction test (p-value)	0.843	0.792	0.772	0.680	0.559	0.581	
Implied λ			0.0181	0.0228	0.0238	0.0224	
Implied α^{pr}	0.08	0.00	0.47	0.30	0.30	0.34	
Implied α^{h}	0.40	0.52	0.18	0.36	0.30	0.29	

Standard errors are in parentheses. ° Significantly different from zero at 10%; °° Significantly different from zero at 5%; °°° Significantly different from zero at 1%.
g and δ are set equal to 0.02 and 0.03 respectively (see MRW for motivation).
Yi (Ye) in the pooled regression is real GDP per capita in the beginning (end) of each five-year period.

The model performs remarkably better when we introduce private and public physical capital separately in the specification allowing for departures from steady state (see regression (4)). First, all estimated coefficients enter significantly different from zero with the right sign, the speed of convergence lies very close to the expected 2% per year (implying long transition periods) and the restriction that the coefficients on the investment ratios and the population growth rate should sum to zero is not rejected. Second, in addition to the earlier results, the implied factor shares now coincide remarkably well with the predicted value of 1/3 for both private physical capital and human capital. Moreover, the model is able to explain a considerably larger fraction of cross-country variation in long-run economic growth. *These results provide evidence that public physical capital investments are a key input in the private sector production process for they affect both the steady state level of income per capita and the rate of economic growth on the transition path towards the equilibrium.*

The estimates emerging from the cross-section data imply that a 10 percent decrease in the public physical capital share lowers 1985 real output by 1.49 percent, implying approximately a 0.1 percentage point lower yearly growth rate of real GDP per capita. If we go back to the data in table 2.1 , we observe that the real government investment share in GDP in Belgium in the mid 1980s actually lies 30% below its level in the beginning of the 1970s, implying a loss of economic growth of about 0.3 percentage points per year. The situation is even worse if we look at the data for the mid 1990s. Assuming that the regression results over the period 1970-1985 also apply to the period 1970-1995, the 60% lower public investment ratio costs Belgium about 0.6 percentage points real economic growth per year. In Ireland, Germany, Italy, the Netherlands, the UK, Denmark and Austria the loss of economic growth amounts to 0.6 , 0.4 , 0.2 , 0.5 , 0.5 , 0.6 and 0.4 percentage points respectively.

The results obtained above are based on a data sample including only 21 observation points, which is from an econometric point of view relatively small. One possible way out of this problem is to pool the cross-section observations with the available time series observations. Since the public investment ratio in the Barro and Lee data set is reported on a five year average basis over the period 1970-1985, we have 3 observation points per country, yielding a sample of 63 pooled observations. This larger sample should enable a more efficient estimation and inference. Note however that the switch from the cross-section regression to a pooled regression implied splitting up the period from 1970 to 1985 into three shorter subperiods of 5 year each. Therefore, the dependent variable, i.e. the five year average economic growth, is very likely to be influenced by business cycle fluctuations. The noise created by these short term disturbances could be sufficient to disable the detection of the long-run relationship between public investment and economic growth as predicted by the theory[20]. In order to filter out these high frequency disturbances, I include the average output gap over each period of five year in the pooled regression (see regression (5))[21]. Since data on the output gap are not available for New Zealand and Turkey, we eventually have a pooled data set of 57 observations

After correcting for business cycle fluctuations, the model again performs remarkably well: the speed of convergence and the implied factor shares lie very close to their predicted values. More important to note however is that the public investment ratio enters again significantly different from zero. Moreover, its estimated impact on economic growth is remarkably well in line with the results obtained from the simple cross-section regression. Again assuming that the regression results can be extended to the period 1970-1995, the observed 60% lower public investment ratio costs Belgium each year on average about 0.5 percentage points of real economic growth per capita.

[20] The first results from such a pooled regression (not reported here) where indeed not satisfactory since public investment and school enrollment rates did not have a significant positive impact on economic growth and the calculated implied factor shares were far away from their predicted values.

[21] Note that the output gap enters significantly, indicating that an important part of the five year average economic growth can indeed be explained by business cycle fluctuations. I also included the output gap in the cross-section regressions over the period 1970-1985 (the results are not reported here). Since these regressions use averages over a longer period, thereby lowering the impact of short term disturbances, the output gap did not enter significantly and did not alter the estimates on the other variables.

4.1.3 The direction of causality

The statistically significant relationship between public investment and economic activity established by the regression results in table 4.1 does not necessarily imply that causation runs from high public investment to high subsequent economic growth. Ultimately, our ideas about the direction of causation must come from economic theory. Despite the theoretical arguments in section 2, there are however no a priori reasons to believe that public investment is not influenced by economic growth. Since government revenue strongly depends on economic activity, higher (lower) levels of output could stimulate (reduce) government expenditures on both consumption and investment. Therefore, finding a significant positive correlation between public investment and growth might very well be evidence that economic growth has a positive impact on public investments, rather than the other way around.

In order to examine this *possible reverse causation problem*, I first reestimate regression (4) including only the share of public investment in GDP at the start of the period under consideration. Since the public investment ratio in the Barro and Lee data set is only reported on a five year average basis, the average over the period 1970-1975 has to be used as a proxy. However, this approach should still be able to exclude, to a large extent, the possibility of a positive feedback from economic growth on public investment. Regression (6) shows that this approach slightly lowers the estimated coefficient on the public investment ratio and slightly raises its standard error. However, the coefficient remains statistically different from zero at the 5% level, giving evidence that the main source of the earlier established relationship is due to a positive impact of public investment on subsequent economic growth.

A second possible way to examine reverse causation effects is to include government consumption instead of investment. Given the earlier stated expectation that government consumption does not have the same potential to increase long-run economic growth, finding a positive correlation with economic growth is an indication that economic activity influences government expenditures. In that case, reverse causation effects are expected to be a major concern. However, regression (7) shows that although the estimated coefficient on government consumption is positive, it is rather small and statistically not different from zero.

4.2 Labour market policies

4.2.1 Specification and data selection

The government's effort to augment and/or maintain the human capital stock of the unemployed is measured by *real government expenditures on active labour market policies per unemployed person relative to real GDP per capita*. Expenditures include public employment services and administration, labour market training, youth measures, subsidized employment and measures for the disabled[22]. Since some of these 'active' programmes are primarily designed to serve social goals (OECD (1990)), a stronger effect on economic growth can be expected if we maintain only those programmes aimed to improve labour market efficiency. This subset includes public employment services, labour market training and

[22] See data appendix A for a description of the variables used.

subsidised employment excluding direct job creation in the public sector. Youth measures are excluded from this sub-set because the need for such programmes mainly depends on the country's education system, e.g. countries with an extended system of upper school education need less of such programmes, making international comparison very difficult (OECD (1990)). Because labour market training is the most direct investment in the human capital stock, we also analyse the separate effect of this measure.

The generosity of unemployment benefits is measured by *real government expenditures on unemployment compensation and early retirement schemes for labour market reasons expressed per unemployed person and relative to real GDP per capita.*

Data on active and passive labour market policies are from the OECD Employment Outlook (several issues) and are available from 1985 onwards. However, in order to be able to draw inferences about the long-term relationships, we need averages over a relatively long time period. Since data for real GDP and for the share of total real investment in real GDP, taken from the Penn World Table 5.6, are only available till 1990 for all countries included in the sample, we will investigate the growth experience over the period 1975-1990. The averages of expenditures on active and passive labour market policies over the period 1985-1990 are then taken as a proxy for the average of the expenditures over the sample period as a whole. The results from the subsequent regressions must therefore not be considered as exact estimates of the quantitative impact of labour market policies on long-run economic growth but rather as an indication of the direction of their impact.

4.2.2 Regression results

Section 4.1 shows that the model does not perform well under the assumption that all countries are in their steady state. Therefore, table 4.2 reports only the results form the regressions allowing for departures from steady state. These results apply to 20 OECD-countries[23] over the period 1975-1990. Regression (1) shows that total expenditures on active labour market policies enter with the wrong sign, while expenditures on passive labour market policies enter with the right sign. However, both are not statistically different from zero. Regression (2), including only active labour market policies aimed to improve labour market efficiency, basically leads to the same results. The results for expenditures on training programmes, see regression (3), are somewhat better for expenditures on passive labour market policies now enter significantly negative at the 10% level.

However, the pair-wise correlations among active and passive labour market policies are relatively high[24], suggesting that the insignificant estimates could be due to the presence of (weak) multicollinearity. One possible way to deal with this problem is to drop one of the collinear variables. Regression (4) shows that when expenditures on active labour market

[23] Turkey was excluded because information for expenditures on passive labour market policies were not available.

[24] The pair-wise correlation between PLMP and ALMPT, ALMPE and TRAINING are equal to 0.64, 0.56 and 0.54 respectively.

policies are introduced alone[25], their effect is still negative and insignificant. This results suggests that *active labour market policies do not have the potential to foster long-run economic growth*, contradicting the expectations of the OECD (1990). Note however that in recent years, active labour market policies are more and more viewed as '*bridging strategies*'. They primarily serve to maintain employability of the unemployed, such that a general revival of economic growth can absorb the unemployed spontaneously (OECD (1996)). In other words, they are expected to enhance the labour intensiveness of economic growth rather than to foster economic growth itself.

Table 4.2

Regression results investigating the impact of labour market policies

Dependent variable	(1) n = 20 $\ln(Y_{75}/Y_{90})$	(2) n = 20 $\ln(Y_{75}/Y_{90})$	(3) n = 20 $\ln(Y_{75}/Y_{90})$	(4) n = 20 $\ln(Y_{75}/Y_{90})$	(5) n = 20 $\ln(Y_{75}/Y_{90})$	(6) n = 19 $\ln(Y_{75}/Y_{90})$
Constant	-0.656	-0.429	-0.696	0.258	-0.345	1.254
ln(I/Y)	0.330 (0.134)°°	0.338 (0.134)°°	0.328 (0.135)°°	0.326 (0.140)°°	0.334 (0.130)°°	0.241 (0.117)°
ln(ALMPT)	-0.023 (0.044)					
ln(ALMPE)		-0.019 (0.037)		-0.046 (0.034)		
ln(TRAINING)			-0.001 (0.027)			
ln(PLMP)	-0.067 (0.049)	-0.071 (0.046)	-0.084 (0.047)°		-0.082 (0.039)°°	
ln(DURUNBE)						-0.060 (0.021)°°°
ln(REPLACE)						0.015 (0.023)
$\ln(n+g+\delta)$	-0.996 (0.417)°°	-0.922 (0.363)	-0.899 (0.369)°°	-0.815 (0.373)°°	-0.876 (0.343)°°	-0.585 (0.289)°
$\ln(Y_{75})$	-0.119 (0.082)	-0.121 (0.083)	-0.126 (0.081)	-0.181 (0.076)°°	-0.117 (0.081)	-0.240 (0.071)°°°
R^2	0.441	0.440	0.434	0.389	0.467	0.602
Implied λ	0.0127	0.0129	0.0135	0.0200	0.0124	0.0274

Standard errors are in parentheses. ° Significantly different from zero at 10%; °° Significantly different from zero at 5%; °°° Significantly different from zero at 1%.
g and δ are set equal to 0.02 and 0.03 respectively (see MRW for motivation).

In contrast, including only expenditures on passive labour market policies (regression (5)) raises the significance of its coefficient to the 5% level, giving evidence that *generous unemployment benefits can reduce the long-run economic growth of an economy*. In order to investigate the negative impact of passive labour market policies in more detail, the generosity of the unemployment insurance system can be decomposed into two important aspects. First, the time period during which the unemployed are entitled to benefits, i.e. the duration of unemployment benefits. Second, the level of benefits relative to previous earnings, i.e. the replacement ratio. Data upon these two components can be found in Layard et al. (1991, p. 51). Data on the replacement ratio and on the duration of unemployment benefits both refer to

[25] Only the results for efficiency improving policies are reported. However, the results from the other two measures are very similar.

1985. Since such institutional factors are relatively inert over time, we can more easily assume that these numbers apply to the whole sample period. Following, Layard et al. (1991), benefits paid over an indefinitely long time period are coded as four years. Regression (6) shows that the negative effect on long-run economic growth of a generous unemployment benefit system is due to one particular aspect, i.e. the duration of unemployment benefits. The replacement ratio does not seem to have a negative effect on economic growth. This finding lies fairly well in line with our a priori expectations. If benefits are paid for a short time period only, even if they are very high, the unemployed are stimulated to search intensively for a new job for a certain income is not guaranteed for a long time. On the contrary, benefits paid for a long time, even if they are not that high, provide the unemployed with a certain alternative income and are therefore expected to reduce the beneficiaries' job-search motivation, leading to an erosion of their skills as they become longer unemployed.

5 Conclusion

The starting point of this paper was the huge current European labour market problem and the hypothesis that public investment, in both physical and human capital, can contribute to employment growth. One possible link between public investment and the labour market situation is the impact of government investment on long-run economic growth. As a first step in investigating this link, this paper addressed the question to what extent the observed dramatic decline of government investment and the underdevelopment of active, relative to passive, labour market policies in a lot of European countries has led to a decline in economic growth.

Theoretically, it was argued that public investment in both infrastructures and human capital of workers have the potential to affect the long-run equilibrium level of income per capita as well as the rate of economic growth on the transition path towards this equilibrium. Moreover, given the observed slow rate of convergence, negative shocks in public investment ratio's push the economy below its equilibrium rate of growth for a long period.

Empirically, evidence was found that public physical capital investment indeed affects both steady state income per capita and out-of-equilibrium economic growth. The estimates imply that a 60% decline in the investment ratio, i.e. the decline observed in Belgium over the period 1970-1995, results on average in a 0.6 percentage points lower yearly economic growth. In addition, these results also show that extending the neoclassical model to allow for a separate impact of public and private investment greatly improves the fit of the model. In contrast to the results from the specification used by MRW, the higher school enrollment ratio is highly significant and the model is able to explain a larger fraction of the cross-country variation in economic growth.

A more ambiguous result was found for expenditures on labour market policies. On the one hand, the government seems to reduce long-run economic growth by providing excessive unemployment benefits. Especially the duration of these benefits has strong negative effects. On the other hand, no direct significant impact was found for government investment in active labour market policies. However, the possibility was raised that active labour market policies are more efficient in insuring that economic growth is translated in employment growth rather than that they are able to foster economic growth itself. This is a possibility that surely deserves attention in future research upon the link between public investment and employment growth.

The results mentioned above are obtained using a data set of averages over a specific, short time interval. In future research, it would be useful to extend this data set to a longer time period, thereby combining time series and cross-sectional data. This panel data approach should enable a more detailed study of the dynamics of the relationship between public investment and long-run economic growth. Moreover, the panel data framework makes it possible to relax the assumption of one identical international production function (Islam (1995)). This will allow us to set up a richer specification of the production function with respect to public investments, i.e. they not only enter as a factor of production but also affect the efficiency with which all factors of production are transformed into output. This approach opens up a nice possibility to combine the large body of time series research, spurred by the work of Aschauer (1989), investigating the impact of public capital on productivity growth with the traditional cross-sectional growth empirics.

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Technical appendix A

The change of the capital stock of type j over time equals the total investment in that specific type (I^j) minus the depreciation of the existing capital stock of that type:

$$\frac{d\left(K^j(t)\right)}{d(t)} = I^j(t) - \delta K^j(t) \qquad \text{with j = pr, pu, h} \qquad (A.1)$$

The depreciation rate of the capital stock (δ) is assumed to be the same for each type of capital. After letting s^j denote the fraction of output invested in the total economy in capital of type j, (A.1) can be written as:

$$\frac{d\left(K^j(t)\right)}{d(t)} = s^j Y(t) - \delta K^j(t) \qquad (A.2)$$

From the definition of k^j_e and upon using the chain rule, the dynamics of k^j_e can be modelled by:

$$\frac{d\left(k_e^j(t)\right)}{d(t)} = \frac{\partial\left(k_e^j(t)\right)}{\partial\left(K^j(t)\right)}\frac{d\left(K^j(t)\right)}{d(t)} + \frac{\partial\left(k_e^j(t)\right)}{\partial\left(L(t)\right)}\frac{d\left(L(t)\right)}{d(t)} + \frac{\partial\left(k_e^j(t)\right)}{\partial\left(A(t)\right)}\frac{d\left(A(t)\right)}{d(t)} \qquad (A.3)$$

$$\frac{d\left(k_e^j(t)\right)}{d(t)} = \frac{1}{A(t)L(t)}\frac{d\left(K^j(t)\right)}{d(t)} - \frac{K^j(t)}{A(t)L^2(t)}\frac{d\left(L(t)\right)}{d(t)} - \frac{K^j(t)}{A^2(t)L(t)}\frac{d\left(A(t)\right)}{d(t)} \qquad (A.4)$$

Using the equations (A.2), (3.2), (3.3) and the definitions $k^j_e \equiv K^j/AL$, $y_e \equiv Y/AL$ yields:

$$\frac{d\left(k_e^j(t)\right)}{d(t)} = \frac{s^j Y(t) - \delta K^j(t)}{A(t)L(t)} - g\, k_e^j(t) - n\, k_e^j(t) \qquad (A.5)$$

$$\frac{d\left(k_e^j(t)\right)}{d(t)} = s^j y_e(t) - (n + g + \delta) k_e^j(t) \qquad (A.6)$$

Technical appendix B

Note that equation (3.6) can be rewritten as:

$$\left(k_e^{j*}\right)^{(\alpha_j-1)} \prod_{i,i\neq j}\left(k_e^{i*}\right)^{\alpha_i} = \left(\frac{n+g+\delta}{s^j}\right) \tag{B.1}$$

Writing (B.1) in logs yields:

$$\left(\alpha_j - 1\right)\ln\left(k_e^{j*}\right) + \sum_{i,i\neq j}\alpha_i \ln\left(k_e^{i*}\right) = \ln(n+g+\delta) - \ln\left(s^j\right) \tag{B.2}$$

Since there are 3 categories of capital, equation (B.2) leads to a system of 3 equations, which can be written in matrix notation as:

$$\begin{bmatrix} (\alpha_{pr}-1) & \alpha_{pu} & \alpha_h \\ \alpha_{pr} & (\alpha_{pu}-1) & \alpha_h \\ \alpha_{pr} & \alpha_{pu} & (\alpha_h - 1) \end{bmatrix} \begin{bmatrix} \ln\left(k_e^{pr*}\right) \\ \ln\left(k_e^{pu*}\right) \\ \ln\left(k_e^{h*}\right) \end{bmatrix} = \begin{bmatrix} \ln(n+g+\delta) - \ln\left(s^{pr}\right) \\ \ln(n+g+\delta) - \ln\left(s^{pu}\right) \\ \ln(n+g+\delta) - \ln\left(s^{h}\right) \end{bmatrix} \tag{B.3}$$

Taking the inverse of the matrix of the elasticity coefficients and premultiplying both sides of equation (B.3) by this inverse yields:

$$\begin{bmatrix} \ln\left(k_e^{pr*}\right) \\ \ln\left(k_e^{pu*}\right) \\ \ln\left(k_e^{h*}\right) \end{bmatrix} = \frac{1}{1-\sum_i \alpha_i} \begin{bmatrix} 1-\sum_{i,i\neq pr}\alpha_i & \alpha_{pu} & \alpha_h \\ \alpha_{pr} & 1-\sum_{i,i\neq pu}\alpha_i & \alpha_h \\ \alpha_{pr} & \alpha_{pu} & 1-\sum_{i,i\neq h}\alpha_i \end{bmatrix} \begin{bmatrix} \ln\left(s^{pr}\right) - \ln(n+g+\delta) \\ \ln\left(s^{pu}\right) - \ln(n+g+\delta) \\ \ln\left(s^{h}\right) - \ln(n+g+\delta) \end{bmatrix} \tag{B.4}$$

Or: $$\ln\left(k_e^{j*}\right) = \ln\left(s^j\right) + \left(\left(\sum_i \alpha_i \ln\left(s^i\right)\right) - \ln(n+g+\delta)\right) \Big/ \left(1 - \sum_{i=1}^{m}\alpha_i\right) \tag{B.5}$$

Taking logs of equation (3.4), assuming that the economy is in its steady state:

$$\ln\left(y_e^*\right) = \alpha_{pr}\ln\left(k_e^{pr*}\right) + \alpha_{pu}\ln\left(k_e^{pu*}\right) + \alpha_h \ln\left(k_e^{h*}\right) \tag{B.6}$$

and substituting in the solution for $\ln(k_e^{j*})$ from (B.5) yields:

$$\ln\left(y_e^*\right) = \frac{\alpha_{pr}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pr}\right) + \frac{\alpha_{pu}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pu}\right) + \frac{\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^h\right) - \frac{\alpha_{pr}+\alpha_{pu}+\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln(n+g+\delta) \qquad \text{(B.7)}$$

Writing (B.7) in terms of income per capita (y≡Y/L) and using (3.3):

$$\ln(y^*) = \ln(A(0)) + gt + \frac{\alpha_{pr}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pr}\right) + \frac{\alpha_{pu}}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^{pu}\right) + \frac{\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln\left(s^h\right) - \frac{\alpha_{pr}+\alpha_{pu}+\alpha_h}{1-\alpha_{pr}-\alpha_{pu}-\alpha_h}\ln(n+g+\delta) \qquad \text{(B.8)}$$

Technical appendix C

In order to keep the derivation of equation (3.10) simple, we model the process of convergence when only one type of capital is considered (α_{pu} and α_h are for instance equal to zero). First rewrite equation (3.5) as:

$$\frac{d(k_e(t))/d(t)}{k_e(t)} = \frac{d\ln(k_e(t))}{d(t)} = sk_e(t)^{-(1-\alpha)} - (n+g+\delta) \tag{C.1}$$

Note that:

$$k_e(t)^{-(1-\alpha)} = e^{-(1-\alpha)\ln(k_e(t))} \tag{C.2}$$

Substituting (C.2) in (C.1) yields:

$$\frac{d\ln(k_e(t))}{d(t)} = se^{-(1-\alpha)\ln(k_e(t))} - (n+g+\delta) \tag{C.3}$$

Now consider a log-linearization of $e^{-(1-\alpha)\ln(k_e(t))}$ by using a first-order Taylor expansion of $\ln(k_e)$ round $\ln(k_e^*)$:

$$e^{-(1-\alpha)\ln(k_e(t))} = e^{-(1-\alpha)\ln(k_e^*)} - (1-\alpha)e^{-(1-\alpha)\ln(k_e^*)}\left[\ln(k_e(t)) - \ln(k_e^*)\right] \tag{C.4}$$

Substituting (C.4) in (C.3) yields:

$$\frac{d\ln(k_e(t))}{d(t)} = se^{-(1-\alpha)\ln(k_e^*)} - s(1-\alpha)e^{-(1-\alpha)\ln(k_e^*)}\left[\ln(k_e(t)) - \ln(k_e^*)\right] - (n+g+\delta)$$

(C.5)

From equation (3.6) it's clear that:

$$s(k_e^*)^{-(1-\alpha)} = (n+g+\delta) \tag{C.6}$$

$$se^{-(1-\alpha)\ln(k_e^*)} = (n+g+\delta) \tag{C.7}$$

Finally, substituting (C.7) in (C.5) yields:

$$\frac{d\ln(k_e(t))}{d(t)} = \lambda\left[\ln(k_e^*) - \ln(k_e(t))\right] \tag{C.8}$$

With $\lambda = (1-\alpha)(n+g+\delta)$

The same process applies to the dynamics of $y_e(t)$. Writing equation (3.4) in logarithmic terms yields:

$$\ln\left(y_e(t)\right) = \alpha \ln\left(k_e(t)\right) \tag{C.9}$$

$$\ln\left(y_e^*\right) = \alpha \ln\left(k_e^*\right) \tag{C.10}$$

Subtracting (C.10) from (C.9):

$$\ln\left(y_e(t)\right) - \ln\left(y_e^*\right) = \alpha\left[\ln\left(k_e(t)\right) - \ln\left(k_e^*\right)\right] \tag{C.11}$$

Differentiating (C.9) with respect to time:

$$\frac{d\ln\left(y_e(t)\right)}{d(t)} = \alpha\frac{d\ln\left(k_e(t)\right)}{d(t)} \tag{C.12}$$

Substituting (C.11) and (C.12) in (C.8):

$$\frac{d\ln\left(y_e(t)\right)}{d(t)} = \lambda\left[\ln\left(y_e^*\right) - \ln\left(y_e(t)\right)\right] \tag{C.13}$$

With $\lambda = (1-\alpha)\ (n+g+\delta)$

Using the same methodology, it can be shown that in the case where three types of capital are considered, one finds:

$$\frac{d\ln\left(y_e(t)\right)}{d(t)} = \lambda\left[\ln\left(y_e^*\right) - \ln\left(y_e(t)\right)\right] \tag{C.14}$$

With $\lambda = (1-\alpha_{pr}-\alpha_{pu}-\alpha_h)\ (n+g+\delta)$

Data appendix A

A. Notes on the calculation and the sources of the variables used

Y_x	Ratio of real GDP to working age population in year x, 1985 international prices. Source: Summers and Heston; The Penn World Table, Mark 5.6 (1995).
n	Average annual population growth rate. Source: OECD, Economic Outlook (Statistical Compendium 1996/2).
I/Y	Average ratio of total (private and public) real investment to real GDP, 1985 international prices. Source: Summers and Heston; The Penn World Table, Mark 5.6 (1995).
PI/Y	Average ratio of real private investment to real GDP over the period 1970-1985, 1985 international prices. Source: Barro and Lee (1994)
GI/Y	Average ratio of real public investment to real GDP over the period 1970-1985, 1985 international prices. Source: Barro and Lee (1994)
GI^i/Y	Average ratio of real public investment to real GDP over the period 1970-1975, 1985 international prices. Source: Barro and Lee (1994)
GC/Y	Average share of real government consumption in real GDP over the period 1970-1985, 1985 international prices. Source: Summers and Heston; The Penn World Table, Mark 5.6 (1995).
ENRH	Average of the gross enrollment ratios in higher education over the period 1970-1985. Source: Barro and Lee (1994)
Gap	The gap between actual real GDP and potential real GDP (in percent) Source: OECD, Economic Outlook (Statistical Compendium, 1996/2)
ALMPT, ALMPE and TRAINING	Average of active labour market policies per unemployed person relative to the ratio of GDP to working age population over the period 1985-1990: total, efficiency improving and training respectively. Source: OECD, Employment Outlook (1992, 1994, 1995, 1996) OECD, Economic Outlook (Statistical Compendium, 1996/2)
PLMP	Average of passive labour market policies per unemployed person relative to the ratio of GDP to working age population over the period 1985-1990. Source: OECD, Employment Outlook (1992, 1994, 1995, 1996) OECD, Economic Outlook (Statistical Compendium, 1996/2)
DURUNBE	Duration of unemployment benefits (in years), 1985. Source: Layard et al. (1991), table 5 p. 51.
REPLACE	Replacement ratio over the initial period of unemployment for a single man under 50 (gross benefits as a percentage of the gross wage), 1985. Source: Layard et al. (1991), table 5 p. 51.

B. Short description of the content of active labour market policies

(a) Public employment services and administration: services such as information, placement and counselling provided by a public agency.

(b) Labour market training

- (b.1) Training for the unemployed and those at risk: organisation of training programmes by the government, subsidies to employers providing on-the-job-training to the unemployed, ...
- (b.2) Training for employed adults: general efforts to upgrade the skills of the adult labour force.

(c) Youth measures

- (c.1) Apprenticeship and related general youth training: programmes aimed to improve the transition from school to work.
- (c.2) For unemployed and disadvantaged youth: a broad set of measures ranging from augmented support to encourage enrollment in normal education to remedial education in basic skills and work-practice schemes.

(d) Subsidised employment

- (d.1) Subsidies to regular employment in the private sector: recruitment subsidies to employers mainly targeting the long-term unemployed.
- (d.2) Subsidies to unemployment persons starting enterprises: financial assistance to the unemployed starting their own business.
- (d.3) Direct job creation (public or non-profit): special public employment programmes for the unemployed, meant as a temporary substitute to regular employment.

(e) Measures for the disabled: broad set of programmes aimed to enhance the integration in the labour market of those persons that are unemployed due to physical, mental and social factors.

=> Total active labour market policies: (a)+(b)+(c)+(d)+(e)
=> Efficiency improving active labour market policies: (a)+(b)+(d.1)+(d.2)
=> Training: (b)

Data appendix B

Data used in the regressions investigating the impact of public physical capital investment (period 1970-1985)

	Y_{70}	Y_{85}	I/Y	PI/Y	GI/Y	GIi/Y	GC/Y	ENRH	n
Germany	14808	17907	0.27	0.26	0.04	0.04	0.15	0.24	0.0068
France	14767	18498	0.27	0.27	0.03	0.03	0.15	0.25	0.0094
Italy	11800	15986	0.26	0.26	0.03	0.02	0.12	0.24	0.0075
Netherlands	14706	16854	0.24	0.21	0.05	0.07	0.12	0.27	0.0132
Belgium	13204	16764	0.23	0.23	0.03	0.03	0.12	0.24	0.0058
UK	13579	17120	0.18	0.14	0.06	0.08	0.19	0.19	0.0041
Ireland	8697	12131	0.27	0.27	0.04	0.04	0.15	0.19	0.0149
Denmark	15007	19513	0.25	0.24	0.04	0.05	0.21	0.26	0.0045
Spain	9416	11631	0.25	0.26	0.02	0.03	0.10	0.21	0.0116
Greece	6570	9467	0.26	0.23	0.06	0.07	0.13	0.19	0.0097
Portugal	5576	8045	0.24	0.19	0.08	0.09	0.17	0.11	0.0120
US	20929	24966	0.21	0.21	0.03	0.03	0.14	0.55	0.0150
Canada	16255	22437	0.23	0.23	0.03	0.03	0.13	0.43	0.0185
Japan	10654	17269	0.35	0.30	0.08	0.07	0.09	0.25	0.0094
Australia	16767	20498	0.28	0.22	0.08	0.09	0.12	0.23	0.0177
Norway	12823	22008	0.32	0.26	0.09	0.09	0.16	0.23	0.0063
New Zealand	13874	15479	0.24	0.20	0.06	0.07	0.14	0.27	0.0159
Sweden	16440	20822	0.23	0.21	0.04	0.05	0.22	0.28	0.0016
Finland	12240	17692	0.35	0.34	0.04	0.04	0.15	0.27	0.0060
Austria	12132	16492	0.26	0.25	0.04	0.04	0.14	0.20	0.0069
Turkey	4061	5183	0.23	0.14	0.11	0.09	0.12	0.08	0.0301

Data used in the regressions investigating the impact of labour market policies (period 1975-1990)

	y_{75}	y_{90}	I/Y	ALMPT	ALMPE	TRAINING	PLMP	DURUNBE	REPLACE	ENRH	n
Germany	15758	20634	0.25	0.20	0.12	0.06	0.26	4.00	0.63	0.27	0.0070
France	16450	21103	0.26	0.12	0.07	0.05	0.32	3.75	0.57	0.27	0.0084
Italy	12978	18427	0.25	0.08	0.02	0.00	0.10	0.50	0.02	0.26	0.0067
Netherlands	16057	18904	0.22	0.25	0.07	0.05	0.62	4.00	0.70	0.29	0.0111
Belgium	15049	19761	0.22	0.19	0.06	0.02	0.47	4.00	0.60	0.27	0.0042
UK	14878	20234	0.17	0.12	0.06	0.03	0.22	4.00	0.36	0.20	0.0043
Ireland	9976	15131	0.25	0.16	0.08	0.06	0.34	4.00	0.50	0.21	0.0100
Denmark	15991	20649	0.23	0.14	0.07	0.06	0.49	2.50	0.90	0.29	0.0045
Spain	11580	14326	0.24	0.06	0.05	0.01	0.23	3.50	0.80	0.24	0.0108
Greece	8142	10133	0.22	0.08	0.06	0.03	0.11	NA	NA	0.21	0.0105
Portugal	6758	11361	0.21	0.11	0.06	0.03	0.07	0.50	0.60	0.11	0.0076
US	21271	27467	0.21	0.06	0.04	0.02	0.11	0.50	0.50	0.57	0.0114
Canada	18711	24751	0.25	0.08	0.08	0.04	0.26	0.50	0.60	0.46	0.0142
Japan	12403	20562	0.34	0.06	0.05	0.01	0.12	0.50	0.60	0.28	0.0087
Australia	18040	21526	0.27	0.06	0.04	0.01	0.21	4.00	0.39	0.26	0.0172
Norway	15633	23020	0.29	0.25	0.12	0.06	0.25	1.50	0.65	0.26	0.0061
New Zealand	15147	15372	0.24	0.25	0.17	0.10	0.37	4.00	0.38	0.29	0.0108
Sweden	18629	22906	0.21	1.25	0.55	0.35	0.54	1.20	0.80	0.30	0.0032
Finland	14262	20887	0.32	0.29	0.12	0.08	0.40	4.00	0.75	0.31	0.0037
Austria	14394	18806	0.25	0.13	0.10	0.04	0.45	4.00	0.60	0.23	0.0070