KEY ISSUES OF COST-BENEFIT METHODOLOGY FOR IRISH INDUSTRIAL POLICY

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Patrick Honohan

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CONTENTS

Chapter 1

INTRODUCTION AND SUMMARY

Industrial Policy Incentives in Ireland

Industrial development policy in Ireland has long been characterised by its reliance on both discretionary and non-discretionary incentives. The former includes a range of grants for new investment or expansion projects in manufacturing and certain internationally traded service sectors. The latter features a low rate of corporation profits tax rate applicable (up to now) to essentially the same sectors (though the profits tax rate will soon be unified at a low rate for all sectors). Although, like its predecessor export sales relief, the regime does not discriminate between foreign-owned and indigenous firms, it was probably always envisaged chiefly as a mechanism for inducing an inflow of foreign direct investment. The low tax rate, combined with international tax treaties, is of great advantage to US and other firms with unsheltered foreign tax liabilities; the discretionary grants enable the Irish development agencies to compete with other possible destinations for internationally mobile investment projects. The success of the policy is evidenced by the remarkably high share of foreign-owned companies in manufacturing whether measured by employment (45 per cent) or output (70 per cent).

While the benefits of the tax and grant regime are thus evident, there have also been costs. Use of public funds for this policy imposes a tax burden on the rest of the economy which could be very damaging (cf. O'Rourke, 1994). It also potentially damages the rest of the economy by bidding-up the price of labour and other resources (cf. Barry and Hannan, 1995). Indeed, unless supported by other policies, rapid industrial expansion can also entail a variety of external congestion costs which are only recently becoming evident. As the Culliton report (1992) argued, the discretionary element of the grants can encourage rent-seeking that may distract local entrepreneurs from productive activity.

Evaluation of Applications for Grant-aid

Taking as given both the discretionary policy and the existence of grants, the Irish industrial development agencies still need a system of *ex ante* evaluation of specific applications for grant assistance. The Economic and Social Research Institute recently carried out a review of the evaluation model which had been in use by the agencies since the late 1970s and which was

based on economic cost-benefit methodology.[1] Although specifically tailored to the needs of the agencies, several key elements of our approach have a wider application, as they address some important though oft-neglected issues in cost-benefit work in Ireland more generally.

We started from the position that the evaluation model is essentially a management information system designed to improve decision-making in regard to grant approvals. As such, the model should be based on the policy-maker's understanding of the economic distortions to which policy is addressed, and employ a credible quantification of these distortions. It should, when employed, result in satisfactory policy decisions which are not themselves distorting.

Interest in cost-benefit analysis was at its strongest in the 1970s, when economic policies perpetuated distortions, and when (in an era before privatisation) policy-makers looked extensively to semi-autonomous state agencies to target public funds to social goals. Chapter 2 reviews the fluctuating fortunes of cost-benefit, and provides a general introduction to the present application.

The Major Issues

This paper isolates three main issues in cost-benefit that stand out from the study of industrial development grants as having a wider application and being of general interest. First is the need to take better account of system effects in arriving at the appropriate treatment of labour costs (shadow wage). Second is the importance of measuring and valuing the tax and government expenditure flows involved in such incentive schemes. Third, account needs to be taken of deadweight: the fact that (despite the best efforts of the agencies) some grants will be higher than necessary to secure the project. Chapter 3 sets out the basic cost-benefit formula and shows precisely where the assumptions about shadow wage, about the net cost of tax revenue forgone and about the burden of deadweight enter. Each of these three elements is discussed in the following three chapters.

There are other considerations one could bring into the analysis – environmental issues, congestion, technology spin-offs. But increasing elaboration into uncharted territory could weaken rather than strengthen the practical usefulness of a formal evaluation scheme. When the decision-makers know which factors have been quantified, they can make their own allowance for the rest.

Shadow Wage

Despite high unemployment in Ireland, a shadow wage as low as 15 per cent of market wage (i.e., ignoring 85 per cent of the project's wage costs in making the evaluation) cannot be defended. Employment creation policy is not

[1] The review was carried out by the author and Eoin O'Malley, with a contribution by Philip O'Connell and the assistance of Jane Kelly, Siobhan Kenny and Alan Wall.

as effective in reducing employment as is often believed. The well-documented rapid and substantial migration responses to changes in the difference between Irish and UK unemployment levels confirm this. The fact that unemployment is falling now reflects low unemployment in the UK as well as the strong job growth at home. It is primarily because of this linkage that we argue that the shadow wage used for this kind of job creation measure should be much higher than it has been. Chapter 4 spells out the analysis leading to the recommendation to use a shadow wage of about 80 per cent.

Tax Revenue and the Shadow-price of Public Funds

While the treatment of tax revenues in appraisal can be controversial, the position here (presented in Chapter 5) is clear. Indeed, in contrast to conventional project appraisal, where the major costs are in terms of economic resources, the question of industrial policy is centrally focused on grant and tax costs. Not only must tax revenue be included in the calculation, but account must be taken of the fact that making up for lost tax revenues or the cash cost of grants imposes costs on the economy more than pound-for-pound. The latter consideration is taken account of by applying a premium factor (called the shadow-price of public funds) to all government revenues and expenditures.[2] This factor is estimated to be about 1.5 in Ireland at present, down from over 2 in the mid-1980s (Honohan and Irvine, 1990). Because projects differ in their labour and tax intensity, including tax revenue in the calculation can alter the ranking of projects.

Deadweight in Grant Assistance

What about the investments that would have gone ahead anyway without the inducement of special taxes or grants? Some account must be taken of this deadweight. Of course the agencies do their best to strike a hard bargain, but so do the investors. Knowing that some grants will be unnecessarily generous, but not knowing which ones, implies that the cut-off for grants, the maximum that can be offered, should be lowered. This is quantitatively an important point, and it is not one for which the literature provides a ready answer. Our approach (Chapter 6) has been to develop a simple theory based on modern bargaining theory (cf. Osborne and Rubinstein, 1990), together with empirical estimates[3] of the degree to which manufacturing activity in Ireland is grant-sensitive (the aggregate elasticity of manufacturing activity with respect to the rate of grant), to arrive at an estimate of the allowance that needs to be made for deadweight. Quantification here is somewhat tentative (we suggest 80 per cent deadweight), but the logic of the approach is clear and has a wider applicability.

[2] The fact that government can freely borrow on international capital markets does not alter this: the debt will ultimately have to be serviced out of tax revenue.

[3] In practice we have inferred this from estimates of elasticity of demand for labour in manufacturing (cf. Bradley, Fitz Gerald and Kearney, 1993).

Chapter 2

THE FALL AND RISE OF COST-BENEFIT

Following something of a lull in the early to mid-1980s, there has been a very substantial recovery in academic interest in issues of cost-benefit analysis. The reasons for this evolution are informative and help pinpoint what was less useful about previous work and what is likely to be fruitful in the future.

The late 1970s and early 1980s trend towards the substitution of structural reform policies in preference to selective intervention by governments lies at the root of the decline in cost-benefit analysis around that time.

2.1 Role of Cost-benefit Analysis

Fundamentally, cost-benefit is designed to take account of market failures, i.e., of situations where market prices do not correspond to social value.[4] If there were no market failure, then optimising behaviour by profit-seeking enterprises and by individuals in households should result in a socially optimal outcome – no involuntary unemployment, no missed opportunities to get the most out of national economic resources, no unwarranted environmental degradation. But in the presence of market failure the prices prevailing in the market-place do not provide the signals and incentives that will lead to a good outcome. All of the major classical sources of market failure are relevant to the industrial policy problem:

> Externalities: for example, where my behaviour affects your opportunities, resulting in spillover costs or benefits not borne by me. If I am not taking account (internalising) certain of the costs or benefits of my actions, I will tend to consume or produce what, from Society's point of view is too much, or too little (in the sense that others would be willing to subsidise me to produce more or consume less). The relevance to industrial or R&D linkages will be evident.

[4] There is only a relatively small published literature on Irish cost-benefit, despite many unpublished studies. Gray's (1995) review of standard methodology contains some Irish case studies and references. Boyle (1993) describes the wider process of policy evaluation in an Irish context. There are many textbooks on cost-benefit analysis: a good recent one is Zerbe and Dively (1994). Drèze and Stern (1987) and Squire (1989) are fairly recent surveys at a more technical level. Layard and Glaister's (1994) updated book of readings surveys some of the unresolved or disputed issues. Finally, Department of Finance (1994) and HM Treasury (1991) are official appraisal manuals.

Absence of relevant property rights: for example, if nobody owns the watercourses or the seafront, then I can degrade the water quality by discharging waste without cost; whereas if the watercourse had an owner, she would likely impose a fee that would induce me to curtail my discharges. This kind of situation is increasingly relevant in terms of the location decisions for heavy and other industry.

Monopoly power: for example, I have so much influence over the price I can charge that I will restrict output though marginal cost is below price. This can be potentially relevant in the labour market, where centralised pricing decisions may contribute to unemployment.

Taxation: it is not possible for the Government to raise enough revenue to meet various essential functions that it performs without introducing distortions to economic behaviour. Its high tax burden is a feature which Ireland shares with most modern industrial economies, and the distorting effects of taxation are so often perceived as a major source of economic inefficiency that they cannot be neglected in any list of market failures.

Since market-driven choices may lead to socially inferior outcomes, the cost-benefit analyst attempts to construct a set of "as if" or shadow prices, which represent the prices which, if they prevailed in the market, would lead enterprises and individuals to make economic choices that correspond to the optimal welfare of all.[5] The use of these shadow prices to guide public investment policy, the policy of state enterprises, and other public interventions is the goal of cost-benefit. By arranging that the public sector, in its direct economic interventions, behaves as if the shadow prices were in effect, the hope is that the economy as a whole will move closer to the optimum.[6]

[5] A large branch of cost-benefit analysis also considers the distribution of resources between individuals as a potential source of deviation from the social optimum. This branch recognises that, even if the economy were producing at maximum efficiency, the optimum might not have been achieved if welfare is unevenly distributed among members of society. Our approach will, for the most part, assume that the problem of distribution is addressed somewhere else in the policy structure, and must be taken as given by those involved in industrial policy.

[6] One important issue here is that if certain segments of the economy are using shadow prices, while other parts of the economy are still responding to market prices, the outcome could be worse than if all were responding to market prices. More sophisticated applications make sure that these general equilibrium considerations are taken into account in computing shadow prices for guiding public sector decisions.

2.2 Reasons for the Decline in the Use of Cost-benefit

Decline in the use of cost-benefit analysis in the 1970s may be traced to a wider disillusionment with piecemeal state intervention.[7] Why limit oneself to making allowance for market failure in deciding the behaviour of state enterprises and state agencies if the sources of market failure could themselves be eliminated? This was the theme of the structural reform and structural adjustment movements, which were popularly manifested in Thatcherism and Reaganomics, but have actually guided economic policy initiatives since the late 1970s in most countries in the world, to a greater or lesser extent.

These movements were also informed by an abandonment of the assumption that publicly-owned agencies or enterprises would always pursue social goals in a single-minded fashion. Once the relevance of this classic problem of principle and agent was recognised, the technocratic approach of cost-benefit lost some of its attraction.

This is not the place to adjudicate on the success of the attempt to eliminate monopolies, increase competition and lower tax distortions. It is certainly the case that freer trade, the progressive completion of the single market in Europe, and the weakening of trade union power, have lowered the importance of many of the distortions to which cost-benefit solutions had been addressed.

For example, with free trade and elimination of foreign exchange controls, the notion of a shadow price of foreign exchange – once all-important in applications to developing countries, and also sometimes used for Ireland in the past – has lost all relevance.

The development of the international capital market as the residual source of borrowed funds, together with the removal of capital controls, has meant that the world interest rate has largely displaced shadow discount rates based on national rates of time preference or intertemporal substitution.

Despite the higher levels of unemployment which have prevailed since the mid-1970s and, as will be examined below in greater detail, even the shadow price of labour has been set close to or at the market wage in the cost-benefit practice of several industrial countries.

2.3 The Come-back

But cost-benefit has made a come-back. Why? Part of the reason is nothing more than a reaction to its comparative neglect in the mid 1980s. Not everything can be solved by structural adjustment, and Government inevitably remains heavily involved in influencing economic activity. The continuing role for Government and its agencies in project development and large-scale

[7] In addition, certain self-serving applications of cost-benefit analysis helped discredit the technique in some quarters. The fact that choosing shadow-prices is by no means an exact science provided scope for the manipulation of cost-benefit techniques to become a potential source of distortion itself.

physical planning means a continuing need for consistent methods of evaluation which are not merely based on financial profitability. Thus issues of transport congestion and the value of time, safety regulation and the value of a life, and such like, continue to require a cost-benefit type approach. The more obvious reason for the return to cost-benefit is the increasing public awareness of environmental issues which have not found satisfactory market solutions, and which inherently call for public policy intervention.[8] In particular it is increasingly private sector investment projects that are now being subjected to cost-benefit analysis, whereas in the past it was mostly public sector projects.[9]

If the shadow price can be worked out analytically, would it not be best for public policy to attempt to push market prices in the direction of the shadow prices, for example, through taxation? This is the approach advocated in many environmental contexts, and it has much to recommend it. This solution does require a decision to be taken at the highest levels of government. In the context of a free-trade area such as the European Union, it may require supra-national authority, or at least a co-operative international arrangement. Indeed, a world solution may be required for some large policies such as that relating to CO_2 emissions. It is the consideration that a higher layer of government may be required to achieve the best solution (equalising the shadow and market prices) that ensures a continued role for traditional cost-benefit interventions, i.e., public bodies acting on the basis of shadow prices which differ from market prices.

2.4 Layers of Government and System-wide Impact

Theoreticians have made significant progress in advancing our understanding of how to analyse the economy-wide impact of a cost-benefit procedure.[10] This so-called "general equilibrium" approach will prove to be an essential component of our approach in this paper.

An important element of recent theoretical work has been designed to clarify the appropriate behaviour of distinct layers of government which have different instruments at their disposal. Although the full optimum may not be attainable, it is important, in determining the optimal behaviour of a particular

[8] The cutting-edge of applied cost-benefit analysis at present is in the evaluation of unmarketable environmental goods, such as clean air and water, biological diversity (e.g., preservation of wetlands) and future climate risk. Attempting to determine the social value of this kind of thing by survey techniques, asking a representative sample of people what value they place on it ("contingent valuation"), raises conceptual and practical problems which are very hotly debated at present(cf. the debate between Diamond and Hausman, 1994, Hanemann, 1994 and Portney, 1994). This area is likely to become increasingly important in industrial policy in Ireland in the future.

[9] The present application is a hybrid: analysis of public grant policy directed towards influencing private investment decisions – though we do not explicitly cover the environmental issues in this paper.

[10] Notably in Drèze and Stern (1987, 1990), Hoehn and Randall (1989).

layer of government, to decide in advance what externalities it should take into account in deciding its actions, and what externalities it should leave uncorrected as being the appropriate responsibility of another layer.

2.5 The Need for Operational Simplicity

Although the pendulum of political economy, and the emergence of environmental awareness, have been the main driving forces in the cycle of interest in cost-benefit in recent decades, there is another, more practical factor, which has proved to be important, namely the need for simplicity. Project appraisal techniques which had heavy data requirements, and required elaborate and opaque calculations to produce answers – many of which lacked intuitive appeal – were never likely to catch-on in practice. Reappraisal by some of the authors of the most widely used cost-benefit manuals has pointed towards the need for a drastic simplification of cost-benefit procedures if they are to be applied in routine situations (such as arise with the industrial development agencies).[11] This message must be taken seriously in the overhaul of industrial policy appraisal procedures.

[11] Cf. Little and Mirrlees (1991).

Chapter 3

EVALUATION OF APPLICATIONS FOR GRANT-AID: THE BASIC FORMULA

The formal cost-benefit appraisal system operated up to now by the industrial development agencies has been based on a standard criterion function which expresses the discounted present value of the project benefits as a multiple of the grant paid. Our modifications remain within this general framework.

Oversimplifying to convey the essential point, it may be said that the old model took the cost to be the grant outlay, and the benefit to be 85 per cent of the wages generated through jobs created.[12] This is equivalent to using a shadow wage rate of just 15 per cent, well below rates commonly reported in the literature. On the other hand, in order to be approved, projects had to satisfy a threshold benefit to cost ratio set arbitrarily at 4 to 1.

While retaining the general approach, we see a need to modify the formula in three major respects, each of which forms the basis for one of the following three chapters.[13]

First, the shadow wage rate needs to be increased to take better account of known general equilibrium effects. This also has a knock-on effect on the shadow prices of other inputs, since they are linked to the shadow wage through the estimated labour content of the inputs.

Second, there has to be a fuller treatment of taxation, including tax revenue as a benefit offsetting grant costs and also applying a weighting (the shadow prices of public funds) before adding revenue benefits to private benefits. There is no basis for ignoring (as the old method did) tax revenue, including income tax and expenditure taxes, generated by the project as an offset to the grant cost incurred.

Third, projected benefits must be reduced by a deadweight factor, designed to take account both of the response elasticity of projects and jobs to grant levels and the degree to which an increase in grants can be confined to those projects that are actually dependent on it.

[12] Both directly in the project being grant-aided and indirectly from the project's sub-supply needs, cf. O'Malley (1995).

[13] Several additional modifications are not discussed in the present paper.

Our modifications partly reflect a new emphasis in the cost-benefit literature on system effects and also the increased importance and higher rates of taxation. This new approach does result in some alteration of the ranking of projects, and introduces a completely new approach to the threshold, though not a drastic change in practice to the cut-off.

Although most of the discussion of the following chapters can be followed without recourse to mathematical notation, it is worth explicitly setting out the criterion function which underlies the discussion. Thus, for any given grant-aid application, the following ratio of costs to benefits function is calculated on the basis of projected flows:

$$(1-\theta)\{\sum_i x_i\ p_i\ [(1-\nu_i)+\phi\ \tau_i]+\phi\ \tau_0\ \pi\ \}/(\phi g) \qquad (1)$$

using the following notation:

π is profits,

p_i are the market prices of each input i,

ν_i are the ratios of shadow to market prices,

x_i are the volumes of each input,

τ_i are the tax rates on each input (inclusive of a standard allowance for saving on social welfare payments resulting from a fall in unemployment),

τ_0 is the tax rate on profits,

θ is the deadweight factor – the allowance for the fact that some grants will have been unnecessarily large,

ϕ is the shadow price of public funds,

g is the grant cost.

All of these elements are calculated in present value terms. The changes from the old formula are the inclusion of the shadow price of public funds ϕ (this would previously have been unity) and in the deadweight factor θ (this would previously have been zero – but a threshold of 4 would have been imposed).

In words, the formula simply sums the value (at shadow prices adjusted for the shadow price of public funds) of all the inputs, adds the taxes on inputs and profits and reduces the total by the deadweight factor to get a figure of the "benefits", before dividing by the grant cost.

It may be helpful to looking at the formula step by step, beginning with the term immediately after the summation sign, which measures the net social benefit of one input (*i*) used in the project plus net tax revenue.[14]

$$x_i\ p_i\ [(1-\nu_i)+\phi\,\tau_i] \tag{2}$$

Here $x_i p_i$ is the total market cost of the use of input *i*. If the shadow price of that input is equal to the market price, *i* does not contribute net value to the project. That is the meaning of the term: $1 - \nu_i$, it maps the market cost of the use of input *i* to the net social value. The tax rate τ_i is multiplied by the marginal cost of social funds ϕ as discussed in greater detail in Chapter 5 below.

This term is summed over all the inputs,[15] and the tax revenue from profits – again multiplied by the marginal cost of social funds – is added to obtain the part between parentheses:

$$\sum_i x_i\ p_i\ [(1-\nu_i)+\phi\,\tau_i]+\phi\,\tau_0\,\pi \tag{3}$$

which represents the total "benefits".

Finally, this is all premultiplied by the adjustment for deadweight (1-θ), before being divided by the grant "cost" *g*, which is also multiplied by the marginal cost of social funds ϕ.

The next three chapters, in effect, discuss the choice of the three key parameters ν, ϕ, and θ. To anticipate the conclusions we can say here that, in contrast to the old procedure, we arrive at much higher figures for the ν's, especially for labour where we use 0.8 instead of 0.15;[16] The suggested value of ϕ is 1.5 (previously, in effect it was 1) and for θ ii is 0.8. Of course the other difference from the past is the inclusion of the tax revenues.

[14] As will be described below, in the case of labour, the tax element includes savings on social welfare. Thus we can think of these two elements as being essentially (i) the private benefit obtained by those individuals who are no longer involuntarily unemployed and (ii) the net additional cash flow to the Exchequer resulting from the additional employment and reduction in unemployment.

[15] All outputs are assumed to have shadow price equal to market price, so they do not contribute any net social benefit.

[16] As part of the wider review mentioned in Chapter 1, Eoin O'Malley has implemented an input-output approach allowing the ν_i's for other inputs to be deduced from any given value of ν_0.

Chapter 4

MIGRATION AND THE SHADOW PRICE OF LABOUR

The shadow wage rate is the key parameter required to carry out cost-benefit analysis of Irish industrial policy. In terms of the general formula presented in the previous chapter, labour is the most important input, and the labour component of other domestic inputs is also important. That is why it is so important to get the shadow price of labour (the shadow wage) right. A high shadow wage implies that the labour resources being used have a high value in alternative use and conversely. In this chapter we argue that the high mobility of Irish workers implies and reflects the strength of alternative opportunities available to much of the Irish labour force abroad, and that this implies a high shadow wage.

4.1 Current Practice

In practice, the low shadow price of labour has been the major driver in the industrial development agencies' cost-benefit methodology. McKeon (1979-1980) remarked that the figure used was computed on the basis of assumed opportunity costs applied to the actual profile of employees recruited. For those not previously employed in Ireland a zero opportunity cost was assumed, while for those coming from employment in the agricultural, service and manufacturing sectors, the opportunity cost was set equal to the estimated market wage. McKeon also provides a table showing a sample distribution in 1980, from which one could infer that the shadow wage would be at least two-fifths of the market wage, since 47 per cent of the sample came from other employment.

At a subsequent stage the shadow price was fixed at a much lower figure, namely 15 per cent of the market wage. It appears that the lower figure reflected an application of the previous approach to new survey information about the profile of employees (McMahon, 1985). But we will argue that both theoretical considerations applied to Ireland, and the example of other countries suggest that this 15 per cent figure is much too low.

It may be noted that the agencies were not alone in using low shadow wages. Some recent cost-benefit studies of candidate projects for EU Structural Funding in Ireland have used even lower rates, without providing any justification.[17]

[17] Discussed in Honohan (1997). One of the studies in effect used a shadow wage of minus 5 per cent of the market wage; this appears to be a world record low value.

On theoretical grounds, the partial equilibrium methodology of using a sample profile of recruits must be rejected in favour of a general equilibrium analysis which takes account of the overall system response. In our view, the major theoretical argument here relates to migration.[18] The rapid and substantial response of net migration to employment availability at home and abroad implies that job creation does not reduce unemployment one-for-one. As we will explain, the theoretical literature on the impact of migration on shadow wage rates shows that, even in the presence of involuntary unemployment, migration could fully eliminate any gap between shadow wage and market wage except to the extent that job creation does have an impact on unemployment.

International practice also argues against a major gap between market and shadow wage. In Canada, the shadow wage used is 95 per cent of the market wage; in the UK the shadow wage is set equal to the market wage. Even for developing countries, practice points in the same direction. According to Little and Mirrlees (1991) "there is a consensus that the shadow wage is probably not very different from the wage paid" for modern-sector urban wages in developing countries.[19,20] It is no longer credible to use as low a shadow wage as has been the practice to date in Ireland.

At this stage it may be desirable to recall that, as with most applications of cost-benefit analysis, we maintain the Utilitarian premise that what is to be optimised is an aggregate of the economic welfare of the individuals in society. The familiarity of this assumption to economists should not allow one to neglect the fact that it reflects a very focused philosophical and political position. Thus, the social decisions in relation to the level of unemployment which our method proposes are based on the impact of unemployment on individual welfare, and not on an independently determined employment goal for society.[21]

4.2 The Basic Theoretical Insight

It has long been recognised in the literature that migration could affect the shadow price of labour. A quarter of a century ago, Harris and Todaro (1970)

[18] The migration aspect was also mentioned by Ruane (1979), though her (1980) paper focuses instead on distributional issues.

[19] A survey by MacArthur (1994) of shadow wage rates used in semi-input-output analyses of shadow prices reveals that the lowest of 33 shadow wages used was 0.26 times the market wage – and that was for unskilled labour in Ecuador. The unweighted mean of the shadow wages used was 0.67 and the maximum value was 1.13.

[20] Some apparent contradictions to this consensus turn out to have little relevance to the problem at issue. For example, a study for Northern Ireland by Kirkpatrick and MacArthur (1990) arrived at a very low shadow price for a worker leaving unemployment for a job. But the approach used in that study wholly neglected migration and other systemic responses and is mainly relevant to ring-fenced employment schemes targeted at the long-term unemployed.

[21] Sen (1975) discusses some alternatives.

proposed a simple model of migration which displays the basic argument. They considered two regions between which labour is free to migrate. The first region relies on subsistence agriculture, the other is a modern urban economy whose wage rate w_m is pitched above market clearing levels and results in a rate of unemployment u. The agricultural region has full employment, but at a low and constant labour productivity w_a.

If potential migrants equate their expected earnings in the two regions,

$$w_a = (1-u)\,w_m\,, \tag{4}$$

the equilibrium unemployment rate will be:

$$u = 1 - \frac{w_a}{w_m}\,. \tag{5}$$

Since the creation of an extra job in the urban sector will induce $1/(1-u)$ migrants (just enough to restore the equilibrium unemployment rate), the opportunity cost of the extra job is the loss of output of these migrants. Thus, the shadow price of labour v is:

$$v = \frac{w_a}{1-u} = w_m \tag{6}$$

The implication of this very simple model is that, despite the persistence of unemployment in the urban region (indeed, *because* of the persistence of unemployment) the shadow wage rate is not lower than the wage actually paid in the urban region.

Though quickly endorsed by Harberger, Stiglitz and other distinguished economists, this result did not immediately attract general acceptance because of the very strong assumptions on which it was based and also because observed unemployment rates in the urban areas of developing countries seemed much lower than would be implied by the relation (5) above. As Sen (1975) put it, "the invisible hand strikes again" in a way that seems unduly reductionist, and a number of objections can be raised to the analysis.

But subsequent analysis has shown that some of these objections have less force against the high shadow wage conclusion than might have been expected. Much more elaborate and realistic models still lead to the conclusion that the shadow wage rate should be close to the marginal product of labour in the urban sector.[22]

[22] These models assume that the objective of the social planner is to maximise a weighted average of individual *expected* utilities, i.e., the standard approach and one which is also adopted here. It is worth noting, however, that if the social planner were instead to take account of the *ex post* inequality in utilities resulting from the

4.3 Qualifying the Basic Theory

Although devised to account for rural-urban migration in developing countries, this literature has an obvious application to Ireland. In lieu of the agricultural region we have emigrant population working in the UK and elsewhere. In lieu of the fixed agricultural income, these emigrants receive a "utility package" which is insensitive to Irish labour market conditions. Irish wage rates are largely set by negotiation and are higher than would be necessary to clear the market.[23] The hypotheses that Irish unemployment adjusts fully to changes in the UK rate of unemployment and that fluctuations in domestic employment levels have only a transitory effect on domestic unemployment obtain some empirical support from econometric studies (Honohan, 1984, 1992, Bradley, Whelan and Wright, 1995).[24] Ignoring, for a moment, the duration of this transition, we thus have the necessary components for an application in Ireland of the theories leading to a shadow-price of labour equal to the going wage rate. (Annex 1 elaborates on the question of quantification in the Irish context).

In order to escape the tyranny of the invisible hand, we must therefore closely scrutinise the key assumptions of these models to see what deviation may be justified. It seems that the result hinges on whether job creation in the city alters (i) the unemployment rate in the city or (ii) living conditions in the rural area. In the simple model above neither occurs.

At first sight it might seem that a different specification of the utility function whose optimisation drives the behaviour of potential migrants might matter. But, as shown by Heady (1981), much more realistic utility functions still predict the result that the rate of urban unemployment is insensitive to job creation in the city, and hence would not alter the condition $v = w_m$. Heady's model allows the migrant to consider the possibility of a number of different possible outcomes – perhaps a long wait before a job materialised, perhaps an immediate job followed by a layoff followed by return to the rural sector, and so on. In particular this allows for preferences such that potential migrants would require an earnings premium to induce them to travel. So long as the expected utility of these options can be expressed as a function of the wages and the numbers employed in both regions, the same type of reasoning can be applied. Expected utility will be equalised as between those who migrate and

persistence of unemployment, this would tend to raise the shadow price of labour rather than lowering it, because the higher the shadow wage, the higher the urban population and so the higher the number of unemployed.

[23] Note that higher-than-market-clearing wage rates can be rationalised in a number of ways, including the efficiency wage theory, insider-outsider models, etc.

[24] This does not preclude a role for relative wage rates and relative unemployment benefit rates.

those who do not, and maintenance of this equilibrium will ensure that the urban unemployment rate will remain insensitive to job creation there.[25]

In a developing country context, it is quite likely that, by reducing population pressure on the land, urban job creation would impact rural incomes favourably, thereby upsetting the simple shadow price rule (6). But it is hard to see how emigration from the UK to Ireland could have much impact on the UK labour market, so the relevance of this generalisation to the Irish case is doubtful.

Several other generalisations[26] likewise fail to provide any convincing support for reducing the shadow wage below the market wage. For example, Bell (1991) notes that the prices of goods might be different because of barriers to trade, and spending preferences may change for those who migrate. Likewise, the unearned income of migrants may differ from that of the host population. These factors can certainly cause the shadow price of labour to deviate from the wage rate, but there is no presumption as to which way the effect will go. Furthermore, several of these effects seem unlikely to be of quantitative significance in the Irish context. For example, price distortions due to barriers to trade seem negligible in the Irish context.

So far we have implicitly assumed that the urban wage has been set above the market clearing level by some autonomous process. A feed-back effect of job creation onto the urban wage could upset the relationship of Equation (6) above. A tendency for increased employment to drive up the wage would increase the shadow wage rate. But such an effect is not guaranteed. For example, as noted by Sah and Stiglitz (1985), efficiency wage theories which assume that the wage is above market-clearing level because of a link between wage rate and productivity, and because private firms are minimising the labour cost per efficiency unit, predict no sensitivity of the market wage to employment levels.

Of the various assumptions whose relaxation would have a systematic impact on the shadow price, one of the most striking is the implicit idea that the pool of potential migrants is homogeneous. If we relax this condition, allowing segments of the population to differ in their propensity to migrate, then an expansion in domestic employment could have an impact on domestic unemployment. After all, if all of the most mobile immigrants have already arrived, then it will take a lower unemployment rate to induce further immigration. The marginal migrant will still be indifferent between staying abroad or coming home, but the lower unemployment will confer an external

[25] This formulation does not deal with the possibilities that the subjective probabilities do not equal the objective probabilities, or that expected utility theory does not apply (cf. Sen, 1975). If the migration response is not necessarily tied to equalisation of expected utility, then, as shown by Sah and Stiglitz (1985), the shadow wage rate is higher the more workers migrate, and vice versa.

[26] Particularly relevant papers not otherwise mentioned are Bell and Devarajan (1983), Burgess (1989), Dinwiddy and Teal (1987) and Gemmel and Papps (1991).

benefit on those who are at home. If so the shadow price of labour would be lower than the wage. As noted, this would require the unemployment rate to be sensitive to the level of domestic employment. In this context it has to be stressed that, while not inconsistent with a zero long-term response, the empirical evidence for Ireland referred to earlier cannot conclusively refute the hypothesis that there is some sensitivity.

4.4 Some Possible Misconceptions

Recognising that the proposed increase in the shadow-wage could be controversial, it is worth summarising the policy message that is being drawn from the analysis, and clarifying a few points on which there may be misconceptions.

First, it should be clear that the goal of reduction in unemployment is not at all being neglected in our analysis. On the contrary, we are making sure that credit is taken only for a realistic estimate of the unemployment impact of job creation. Other measures (such as targeted training schemes, improvements in the structure of taxation, employment legislation and structural improvements in labour relations) are all relevant in that context, but not here.

Second, we are not saying that emigrants are indifferent between being at home and being abroad. What our approach does imply is that the marginal[27] emigrant is indifferent between the average package of benefits (employment and employment prospects, wages, etc.) at home and abroad. For example, the emigrant might be prepared to accept a big cut in wages to come home.

Third, we are not discriminating between emigrants and residents in counting benefits. The actual distinction that is being made is between the impact of a new job on the unemployment conditions at home and abroad. There is an impact on the domestic job market; but there is no impact on the foreign job market. So when an emigrant returns to take a job in Ireland, that does not improve the lot of the remaining emigrants.

Finally, our concrete quantified recommendation does not take the extreme view of instant adjustment through migration that is set out in the above equations. Clearly job creation does have a temporary effect on unemployment, and Annex 1 discusses the empirical evidence on how big this effect is. The recommendation to use a shadow wage of (v_1 = 0.8) is drawn from that discussion. It could also be consistent with a small permanent effect of job creation on unemployment.

4.5 External Benefits of Reduced Migration

What our approach does omit is any account of the external benefits of reduced emigration, i.e., the benefits that accrue to persons other than the migrants. One could imagine, for example, that parents and relatives might wish that their relatives were living in Ireland. Return migration would benefit

[27] As usual in economic analysis, it is the marginal that matters for optimal pricing: it is the marginal unit that establishes the equilibrium price.

these relatives even if it did not reduce unemployment.[28] Depopulation can generate external costs also – it is not frivolous to recall the sense of loss and inadequacy felt by some rural football clubs in the 1980s when they found they could not field a full team because of a heavy wave of emigration among the young men. Depopulation is the obverse of congestion costs. (Our method ignores the alleviation of congestion costs also.)

While these kinds of consideration could lead to looking at reduction in emigration or job creation *per se* as distinct objectives, and could be advanced as a justification for reducing the shadow wage, there are serious difficulties in quantifying such external benefits. The use of a questionnaire approach ("contingent valuation") is subject to the sorts of objections that have been raised in the context of attempts to place a value on ecological diversity through questionnaire methods (see above).

Furthermore, the policy importance of such external benefits may not be as large as is sometimes supposed. Because of the Government's budget constraint, additional public expenditure on job creation beyond the point where conventional benefits fell below cost would result in higher tax rates. This potential trade-off between higher employment and lower after-tax wages (Kennedy, 1992) may in turn be limited by the migration response. Resolving these large issues seems beyond the scope of the present study.

The labour market is often thought to be segmented, with most of the long-term unemployed unable to compete with other participants. For one thing, some of the new jobs created by FDI tend to make higher demands on skill levels than jobs in the so-called traditional sector. To the extent that these skill differentials are reflected in wage rates, the methodology does take account of them. A more important aspect of segregation relates to the long-term unemployed; the whole argument about migration does not really apply to job creation that is successfully targeted on the long-term unemployed, as this group shows much lower international mobility. A lower shadow wage would therefore be assigned to sheltered or ring-fenced employment schemes designed for this special group (cf. Snower, 1994).

Emigration has long reflected serious economic and social problems in Ireland. Involuntary emigration resulting from the failure of a malfunctioning economy to generate sufficient job opportunities is to be deplored. It is also an emotive issue, but that should not prevent a coherent analytical approach. An approach that implicitly treats every emigrant as an unemployed member of the Irish labour force is not coherent, and will not give the right answer to the relevant policy questions. As acknowledged, the present approach may take too simple and too sanguine a view of out-migration (as well as of in-migration) downplaying issues other than economic productivity. Our submission is that

[28] This could already be taken account of to the extent that migrants internalise the preferences of their relatives.

what is being neglected – chiefly the willingness of the *marginal* migrant to accept a lower real income in order to live in Ireland is certainly small.

Annex 1 draws on recent empirical work on labour mobility and the link between job creation and unemployment in an attempt to quantify what deviation from the theoretical benchmark of 100 per cent of the market wage rate implied by the simplest formal models above. We arrive at a figure of 80 per cent (v_1 = 0.8), which could accommodate some of the more subtle concerns discussed here.

Chapter 5

DISTORTING TAXATION AND THE MARGINAL SOCIAL VALUE OF PUBLIC FUNDS

Just how does taxation enter the picture? This is one of the trickiest aspects of policy evaluation in a tax-distorted economy, yet it is an important one. Indeed, neglect of the impact of distorting taxation seems to be the most serious conceptual gap in the appraisal framework used to date. In this chapter we develop an interpretation of the discriminatory nature of Irish tax-and-grant policy which provides a basis for arguing that tax receipts attributable to the project must be included as a benefit[29] and indeed that they should be assigned a high value reflecting the marginal cost of public funds. Thus this chapter is concerned with the terms in τ and ϕ in the formula of Chapter 3 above. This interpretation of policy will also be used in Chapter 6 below to resolve the deadweight issue.

5.1 Interpreting Existing Policy

If we have a good system of economic cost-benefit analysis, we should be able to give a ready answer to two commonly asked questions about Irish industrial policy:

> Q.1 "The grant-cost per job approved rarely exceeds £30,000; the 1994 average was only £17,100.But the tax revenue – income tax, PRSI, VAT and excises – paid by an average industrial worker over seven years would alone approach £30,000 – and that does not count savings on social welfare payments. Why aren't the agencies prepared to pay more if there is no net Exchequer cost?"[30]

[29] Hitherto, Exchequer flows were considered during project appraisal in a separate check, and were not integrated into the cost-benefit calculation.

[30] Note, however that cost-per-job approved began to increase again in the early 1990s. For indigenous companies it averaged £10,400 in 1989-91, but has increased steadily since then through £13,300 in 1992 and £15,000 in 1993. The cost-per-job sustained over the period 1987-94 was £11,400. (The cost per job concepts are as used by the agencies. Simplifying slightly, the *cost-per-job approved* is an *ex ante* concept: the total of grants approved for projects during the period stated divided by the total number of lasting jobs expected to be created by the time the approved projects are fully operational. The *cost-per-job sustained* is an *ex post* concept: the total grants paid during a seven year period divided by the total number of jobs created during that period and still in effect at the end of the period.)

Q.2 "Why can't a job-creating initiative in the non-traded sector get grants on the same scale as manufacturing?"

These are not easy questions to answer and, in attempting to do so, one must beware of the temptation to rationalise elements of existing policy which may be the matter of legitimate debate. But it is a serious weakness of the existing methodology that it cannot provide a satisfactory answer to either question.

The key to answering such questions is to take account of the fact that Government has revenue requirements for purposes outside the scope of industrial policy. These include covering the cost of various public and social services – health, education, roads and so on – and servicing its debt. As a result, distorting taxation is imposed on various forms of economic activity – and the higher the tax rates, the more severe the distortion.[31] In large part, the puzzles implied by questions Q.1 and Q.2 above simply reflect the tax distortion.

5.2 The Shadow Price of Public Funds

So, in order to raise its basic revenue needs, the Government has to impose taxes which drive a wedge between cost and benefit at the margin. This in turn means that the Government should not finance all projects that yield a net benefit. It has to take account of the damaging side-effect of the extra tax that will be entailed. Taxation of factors of production discourages economic activity and its distorting effects are clear, especially where unemployment prevails.

This provides a possible answer to the question Q.1. Economic activity must yield tax revenue. If the Government and its agencies reduce taxes or increase grants to the point where the "net Exchequer cost" is zero, the revenue needed to fund public and social services for the economy will not be forthcoming.

A standard way of taking account of this revenue need is to build in to cost-benefit calculations a "shadow price or marginal cost of public funds". This is a factor (in this context greater than unity) by which grant and tax funds are multiplied in order to make them commensurate with private flows in the calculation. The purpose of the factor is to take account of the distortions that would be created (at the margin) by the extra taxation that would have to be imposed elsewhere in the economy in order to make good any loss of revenue arising from the project being evaluated (cf. Heady, 1988).

[31] The scale of the distortion is often thought to rise with the square of the tax rate. Note also, however, that some sources of taxation – such as some energy taxes, tobacco and alcohol taxes – both raise revenue and correct pre-existing distortions. But the revenue from such corrective taxes is insufficient to meet the revenue needs of the economy.

5.3 The Government as a Discriminating Monopolist

There is another twist to the story, and this is more specific to the case of Irish industrial policy. What we have observed over the past two decades (and in somewhat different form for much longer) is a sharp differentiation between the tax-and-grant treatment of certain broad categories of productive activity. The precise structure of this differentiation is quite complex, but an important feature is that manufacturing and certain internationally traded services have been eligible for a low corporation profits tax and for grant-aid.

We all know of example where monopolists charge different prices in different locations. Every microeconomics textbook provides the simple calculation that shows how such price discrimination can increase the monopolist's profits if the elasticity of demand in the two segments of her market are different. As long as the two segments of the market can be segregated, she simply raises the price for the low-elasticity group, and lowers it for the high-elasticity group. The discriminating monopolist will then typically increase production, and thereby increasing overall economic benefit (as well as profits).

The interpretation which we would like to propose for this policy structure is that the Government (directly and through its agencies) is acting in just the same manner. It is offering a two-tier regime in order benefit from a higher elasticity in the preferred sector. Indeed, this higher elasticity will see not only greater employment generated, but will also be effective in clawing back through volume much of the revenue lost through the more generous regime. That is why the tax receipts must be included in the cost-benefit formula if we are not to overstate the cost of the policy.

If every economic activity were to be eligible not only for the low corporation tax rate, but also for a grant of £17,100 per job, the impact on the Exchequer would be catastrophic.[32] Instead, such a regime is open only to a limited segment of the economy. Effectively, the preferred category is offered a more favourable environment than the rest of the economy. Provided the elasticity of activity (with respect to the tax-and-grant rate) in the favoured sector is sufficiently greater than that in the other, the decline in the less favoured sector will be less than the expansion in the favoured sector. Sufficient Exchequer revenue will thereby be generated to pay for needed Government services, while at the same time a greater level of economic activity will be induced.

By discriminating between categories of enterprise then, the Government is acting in a manner analogous to that of the textbook discriminating monopolist. Substitute "mobile or footloose investors" for "high elasticity group", picture the Government, including its industrial promotion agencies, as the monopolist

[32] The announced unification of the corporation tax rate is at 12½ per cent rather than 10 per cent, significantly mitigating the tax loss.

and we have a plausible first approximation to the design of industrial incentives.

Even if all other shadow prices were equal to market prices, this new approach could provide a possible reason for discriminating between categories in terms of tax rates and grants. Provided a sector or category of enterprises can be identified that has a more elastic response of economic activity with respect to the tax regime, and provided it can be ring-fenced away from other categories[33] for the purposes of tax (and grant), then the total tax revenue required can be raised with lower distortion and lower social costs by presenting the high elasticity category with a more favourable tax regime.[34]

We thus also have a possible answer for the second question (Q.2) in so far as the non-traded sector may on average have a lower elasticity of response to tax-and-grant rates than does manufacturing. The discriminatory policy could be rationalised in this manner.[35] In order to verify the logical consistency of this argument, we have worked out a very simple algebraic model of tax policy displaying this discrimination feature (Annex 2).[36]

Has the Government chosen the right dividing line between favoured sectors and the rest? At present, manufacturing and certain internationally traded services have a lower corporation tax rate, and may be eligible for grants; within this group, small firms appear to be separated by administrative practice and receive a lower rate of grant.[37] This ranking does seem to accord with *a priori* views as to the mobility or elasticity of these categories. But there are many other possibilities: for example one could divide between large and small firms. An even more natural distinction would be between foreign-owned *vs.* Irish-owned, or between foreign-owned and traded *vs.* the rest, but such classifications would surely fall foul of EU law. As discussed in Chapter 6 below, in assessing whether the classifications could be improved, one would need to consider not only issues of elasticity, but also the inevitable leakages and other distortions caused at the margins of the identified categories.

[33] Sometimes, as occurred with tax breaks for leasing, the intended ring-fence breaks down.

[34] This can be seen as a simple application of optimal Ramsey taxation, where taxes are imposed at rates that are inversely proportional to the elasticity of demand.

[35] It must be pointed out that, because it distorts the productive sector's input decisions, such a policy is not the optimal policy in the standard framework as proposed by Diamond and Mirrlees (1971). Only if the menu of taxes available to the government is restricted should taxes that distort production decisions be used. For present purposes we are taking it that some such restriction applies.

[36] This model can be seen as evolving from the approach proposed by Ruane (1979), though the emphasis here is rather different. In designing the model, we have had particular reference to the framework presented in Marchand *et al.* (1984).

[37] New foreign industry typically used to receive the highest rates of grant, but in recent years the gap between the average grant-cost-per-job approved for foreign and indigenous industry has effectively been eliminated.

5.4 Is Ireland's Two-tier Industrial Policy Optimal?

Here we are trying to interpret the two-tier policy, not to provide an apologia for it. To make this point consider the following:

First, there may be better policy instruments that could supersede the mainly tax-and-grant based policy regime that is being used at present.

Second, no account is taken of some overall negative consequences of the policy regime. For example, the very existence of a degree of discretion may lead to the rent-seeking behaviour and what the Culliton group (1992) referred to as the "hand-out mentality". This provides a powerful argument against the whole policy approach, at least so far as the relatively immobile indigenous firms are concerned.[38]

Third, (on the other hand), no account is taken of some positive effects of the regime: including such aspects as the dynamising role of the steady stream of new foreign investment on management quality, the signalling or band-wagon effect of the arrival of new foreign industry on the likelihood of other potential investors in the same sector reassessing Ireland as a possible location, and so on.

Fourth, the question of factor bias: has the low rate of corporation tax and the way in which grants are structured tended to discriminate against labour usage? This is a knotty question which has never been wholly resolved. Even when the statutory ceiling on grants is expressed in terms of a fraction of fixed capital investment, it is clear that this ceiling tends to be reached only for job-rich projects. Besides, in terms of inward direct investment, the main concern is the overall volume of jobs, not the capital-labour ratio. The influence of the low rate of corporation tax has not been labour-saving in any simple way.[39] The tax-bias against labour comes as much or more from the structure of income tax and social insurance contributions as from the low rate of corporation tax.

It is beyond the scope of the paper to assess whether the overall approach to industrial policy is the best possible one. Our objective has been rather to formalise the logic of the present policy framework, and to provide a tool which will lead to correct grant-decisions within that framework.[40]

[38] Other adverse consequences of discriminating between categories have recently been assessed by O'Rourke (1994) and by Barry and Hannan (1995).

[39] It favours firms who have paid tax at a high rate in another country. There is no presumption that the Irish operations of such firms would be capital intensive, though they need to be able to show profits to make the most of the tax break. For an account of the characteristics of some of the most dynamic sectors of inward FDI in Ireland, see Honohan, Maître and Conroy (1998).

[40] Other sectors, including building, tourism, sheltered professional services, and so on also benefit from privileges under other elements of the tax and legislative code; we

This chapter has argued that taxes indirectly clawed back as a result of the grant-aided activities should be included as a benefit. And that all government revenue flows should be valued at premium reflecting the marginal cost of social funds. This appropriate premium (the ϕ of Chapter 3) is lower than it would have been when marginal tax rates were somewhat higher, but a rate of 1.5 would be in line with the literature.[41]

would not wish to argue that all of these privileges form part of a consistent strategy along the lines here discussed for industrial incentive policy.

[41] Honohan and Irvine (1987, 1990) provide estimates for this parameter appropriate to Ireland in the mid-1980s. They ranged from 1.75 to 2.44. Since 1984 top marginal tax rates have been falling, and bearing in mind the rule-of-thumb that deadweight costs of taxation are roughly proportional to the square of the tax rate, it would be necessary to revise the marginal cost of social funds estimate to, perhaps as low as 1.5.

Chapter 6

DEADWEIGHT AND BARGAINING

Nobody likes to come out of a bargaining situation with the sense that the other party might have conceded more. Yet this will normally have been the case. If there is a surplus to be divided, one or both parties must have got at least some of it. Here is where the issue of deadweight arises. If it were just a question of setting a tax rate to apply to a large class of investors, the rate that is chosen results inmost investors coming away with some surplus. Likewise some who would have invested had there been no tax will be priced out.

But a discretionary grant is different. With full information, the agencies could offer to each applicant the minimum grant sufficient to induce all to invest. With imperfect information the crucial question is: what grant rate to offer. It would be too generous to accept all applicants whose proposals generated social benefits greater than the proposed grant cost. After all, a small lowering of the grant rate would likely still see the project go ahead, and there would have been a definite saving of public funds. The situation is similar to the so-called winner's curse in auctions. Not knowing the reservation price of others, it makes sense to bid below one's own reservation price. And the appropriate policy here is to shade the maximum grant rate below what a naive cost-benefit calculation would indicate. Or in other words to discount the estimated benefits by a special factor (1-θ in the formula of Chapter 3).

This chapter presents a method for arriving at the appropriate deadweight factor to ensure that excessive grants are not paid.

6.1 The Issue of Deadweight

Confining ourselves therefore to the question of how to evaluate individual grant applications within the context of an existing policy structure, we must now consider how to take account of the problem of deadweight in the grant system (taking the tax system as a given).

The purpose of pre-multiplying the total project benefits (net-of-grant) by a deadweight factor (given in the formula of Chapter 3 as 1-θ) is to ensure that the grant-level for the marginal project, i.e., the project which has a benefit-cost ratio of one, is pitched at the correct level. Increasing this maximum allowable grant-to-benefit ratio will induce further projects, but at a cost in additional aggregate grant outlay. The correct setting of the maximum allowable grant-to-benefit ratio will be such that any increase would yield benefits lower than the aggregate increase in grant outlay; any reduction would cut back benefits more than grant aggregate grants.

In order to estimate the correct value θ by which the benefits should be discounted (or equivalently the maximum grant-to-benefit ratio 1-θ) we need to know how responsive aggregate project benefits are to grant levels, and also by how much aggregate grant costs increase with an increase in the maximum allowable grant-to-benefit ratio. If every project were to receive the maximum grant, then the second part of this calculation would be relatively simple, and we could focus on the first, namely the degree to which higher grants will induce a certain additional volume of projects and of jobs created. Given an estimate of the elasticity – the proportional response of these benefits with respect to the level of grant – it would then be possible to calculate the maximal grant-to-benefit ratio (1-θ), i.e., the ratio beyond which the increase in benefits secured is less than the increase in the grant paid.

In an ideal world of full information, infra-marginal projects – those that do not require the maximal grant in order to go ahead – would not be given the maximal grant. For such projects there is a "rent" – the gap between the maximum grant that would still result in a net social benefit and the minimum grant required to ensure that the project goes ahead. The minimum grant is welfare maximising, and should be the preferred option for the State. Legislation provides for this, and the agencies make their best efforts to capture as much of the "rent" as possible, given their information and given competition from foreign agencies. Nevertheless there will undoubtedly be some leakage and an increase in the maximal grant rate will tend to increase grants provided generally.

The two major components of the deadweight factor are thus (i) the elasticity of response and (ii) the degree of leakage to infra-marginal projects. We deal with these separately by first considering the case where there is full leakage: an increase in the maximal grant/benefit ratio is passed to all projects. This case is analysed in Section 6.2. We then proceed in Section 6.3 to model the leakage, arriving at a modified deadweight factor leading to higher grants. Section 6.4 considers the issue of whether it is desirable to vary the deadweight by category of project. The discussion is necessarily somewhat technical.

6.2 Simple Case

In order to place a value on the parameter θ then, we need to use information concerning the response of additional projects, or larger projects, to a less onerous grant regime. A generally higher grant will induce more benefits, chiefly through direct and indirect employment, as more projects are implemented. Quantification of this effect relies on macroeconometric models.

The most successful models of Irish economic growth have employed a two-stage decision process by firms (e.g., Bradley and Fitz Gerald, 1988). In the first stage, the location decision is taken on the basis of overall factor-price competitiveness. In a second stage, the capital-labour ratio is chosen on the basis of relative factor prices. When the consequential capital stock is put in

place, actual labour will vary below full-capacity demand depending on demand conditions.

Within this framework, the role of grants may be two-fold. First, they improve aggregate factor price competitiveness by lowering the cost of locating in Ireland. Second, they may influence the capital-labour ratio. The second effect is controversial: early critiques that suggested a pro-capital bias have become muted (see Ruane, 1979, for references). More recently, operational ceilings on grant-cost-per-job have had the effect of making grants closer to wage subsidies, though this bias may not be large.[42]

In order to estimate the magnitude of the employment response then, it is reasonable to begin with econometric estimates of the wage-sensitivity of the demand for labour. One useful source of such information is the table of elasticities of demand for labour estimated by Bradley, Fitz Gerald and Kearney (1993). For instance, we can use their estimate of -0.55 as the long-term elasticity of demand for labour in high-tech manufacturing with respect to the real (tax-inclusive) wage cost.

In terms of the location decision, the grant can be treated as fungible: only its total value matters, and not whether it is based on labour or other costs. When it comes to the factor intensity decision, it does matter whether the basis for awarding grants makes them more like labour subsidies or more like capital subsidies. But it only matters to the extent to which labour and capital are substitutable in each project – not likely to be high in most cases. If grants were simply a labour subsidy, and if all the economic benefits were proportional to employment, we could apply the labour demand elasticity directly to the purpose at hand. Neither assumption is exactly correct, but they should be adequate to give the correct order of magnitude. Any alternative assumptions would hardly command more credibility. Accordingly we will proceed on the basis of these two assumptions.

In the "simple case", where an increase in the grant rate applies uniformly across all projects, the corresponding value of maximum grant/benefit ratio $1-\theta$ is calculated as the ratio at which the marginal impact of grant-rate on benefits is equal to its marginal impact on costs. It is based, as explained above, on a simplified model of the grant process in which both benefits and grants are proportional to jobs.

Assume, then, that (instead of the more elaborate model of Chapter 3) the social benefit B of the project is simply proportional to the employment created L.

$$B = \psi L.$$

[42] As mentioned above, even when statutory ceilings on grant-levels are expressed as a fraction of fixed capital formation, the ceilings are not often reached, and the grants paid do vary in accordance with many other conditions. It is no longer clear in what direction grants influence relative factor prices: the influence may be in different directions for different projects.

The cost C is taken as equal to the product of the grant-cost per job g and the employment L. We write the net-of-grant wage as:

$$w=w_0 - g.$$

and deduce that the response of overall benefits and grant costs to a change in the grant rate g is:

$$\frac{dB}{dg} = \psi \frac{dL}{dg} = \psi \frac{L}{w}\frac{w}{L}\frac{dL}{dw}\frac{dw}{dg} = \psi \frac{L}{w}\eta \qquad (7)$$

and

$$\frac{dC}{dg} = L + g\frac{dL}{dw}\frac{dw}{dg} = L\left(1+\frac{g}{w}\eta\right) \qquad (8)$$

where η is the elasticity of demand for labour with respect to the wage.

At the maximal grant level $\hat{g}$, (i.e. the grant-level which is optimal for the category ignoring the possibility of improving on it through project-level negotiations) $dB/dC = 1$. Therefore,

$$1 = \frac{dB}{dC} = \frac{dB}{dg}\frac{dg}{dC} = \frac{\psi\eta}{w+\hat{g}\eta} \qquad (9)$$

From which we deduce that, at the maximal grant level, the benefit to cost ratio is:

$$\frac{1}{1-\theta} = \frac{B}{C} = \frac{\psi}{\hat{g}} = 1+\frac{w}{\hat{g}\eta}. \qquad (10)$$

Substituting the value of the elasticity 0.55, and an average grant-to-wage ratio of 0.15[43] yields an estimate of 1-θ of 0.076. That is the factor the measured benefits would have to be reduced by in the formula of Chapter 3 – a very considerable reduction.

Using the labour demand elasticity estimated by the same authors for traditional manufacturing, namely 0.15, 1-θ falls to 0.022. Thus low labour

[43] This is approximately the present average ratio in practice. Using this figure therefore implicitly assumes that the present grant levels are about right *on average*. If application of the new method led to greatly altered average grant levels, then (strictly speaking) this figure would have to be revised in the same direction leading to a slightly larger adjustment in average grant levels.

demand elasticities lead to very substantial reductions to benefit for deadweight and thus to low figures for the maximum grant.[44]

6.3 Partial Leakage: Dividing the Surplus

In order to take account of the fact that the agencies are in a bargaining position with project promoters, and will try to secure the project for the minimum grant, we need to modify the simple formula obtained above to take account of the fact that an increase in the maximum grant level is not fully passed on to infra-marginal projects.

Our approach to this problem is to recognise that each infra-marginal project involves a surplus which is shared in some proportion λ between the agencies and the promoter. The classic solution to how the surplus is divided is known as Nash's bargaining solution (Nash, 1953). According to this solution, the share will depend on the relative degree of risk aversion of the bargainers. Extensions to the Nash bargaining solution (Osborne and Rubinstein, 1990) also take into account possible differences in time preferences of the bargainers, or in the cost to them of a delay in arriving at a bargain.

An implication of this standard theory is that, if the bargainers are identical in the relevant respects (risk aversion, time preference), then they will split the surplus equally, λ=0.5.

As will be shown below, the sharing of benefits in the proportion λ (for the promoter), 1-λ (for the agencies) results in a reduction in the leakage by a factor of

$$\frac{2}{(1+\mu)\lambda}$$

where μ is the fraction of employment that would exist even if grants were zero. If λ were zero, leakage would be zero and 1-θ would converge to unity: in that case the full benefit of the specific project could be paid out in grants. Taking both μ and λ to be one-half gives a reduction in the leakage by a factor of 2.67, thereby raising 1-θ from 0.076 to 0.202. This figure, implying θ = 0.798, we take as our basic recommendation for normal circumstances.

In order to explain the reduction in leakage, we refer to Figures A, B and C. The sloped line in Figure A illustrates the dependence of jobs on the grant rate *g*. At zero grants, the number of jobs is *x_* ; if grants are paid up to the level *g'*, the number of jobs is *x'*. If the same per-job grant *g'* is paid for all projects, there is (for all but the marginal job at *x'*), what we may think of as a potential surplus to the promoter. This is the source of the deadweight. For the jobs corresponding to the part of the figure to the left of *x_* the surplus is equal to the full amount of the grant *g'*, as these jobs would exist even if no grants were offered. For jobs to the right of *x_* , the surplus is lower by the height of the line *x_A*. The shaded area in Figure B shows the increase in the surplus if the

[44] The parallel with the model of Annex 2 will be evident.

common grant is increased from g' to $g'' = g' + \Delta g$. Writing $x_1 = 0.5(x' + x'')$, this increase in surplus equals $x_1 \Delta g$. But if the agencies attempt to claw back some of this surplus by varying the grant where they believe that they are dealing with an infra-marginal project, the promoters' surplus is lower. Figure C assumes, in line with the algebraic development above, that the promoter obtains a constant fraction λ of the surplus for each job. The area between the two kinked lines represents the increased promoters' surplus in this case. It is a straightforward calculation to show that this area is approximately equal to:

$$\frac{\lambda}{2}(x_0 + x_1)\Delta g$$

And if the number of jobs that would exist even in the absence of grants, $x\_$ is a fraction μ of x_1, then the above formula is established, considering that in the full leakage case, all of the surplus goes to the promoter.

6.4 Different Deadweights for Different Categories of Project

Even though the reasoning here relies on rather abstract theory, there seems to be no better approach to the key problem of deadweight. It is certainly more acceptable than the naive assumption that the agencies capture all of the surplus. The parameters μ and λ have to be settled. They both lie between zero and one. Since there is no reason to think that the agencies or the government differ from large corporations in risk aversion, one-half seems appropriate for λ in that case. The more risk-averse the promoter, the lower her share of the surplus, so if one believed that small entrepreneurs were more risk averse (or more impatient) than the government, then one would have a lower value of λ, thus lower leakage and allowing higher grants.[45]

[45] The discussion is in terms of a simple negotiation in a zero-sum game. We neglect the complications that may be caused by the fact that negotiations on a grant involve additional correlated aspects, and may not be zero sum.

Figure A: Grant level and jobs: base case

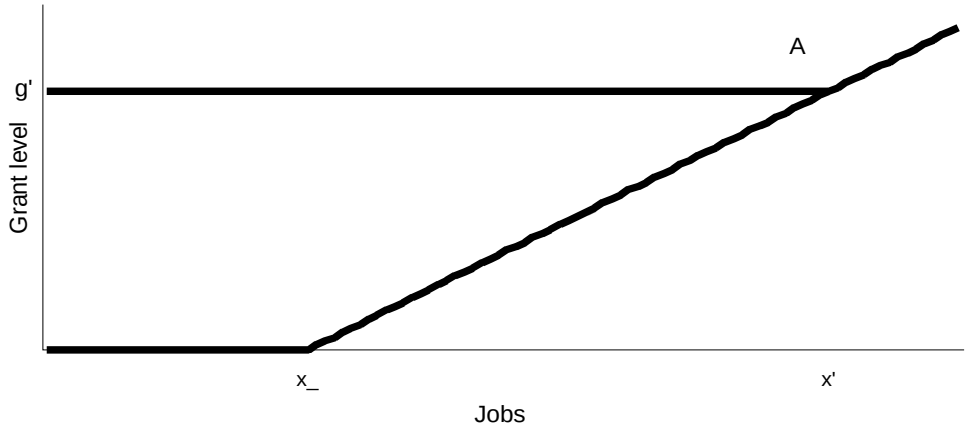


Figure B: Surplus when a uniform grant is changed

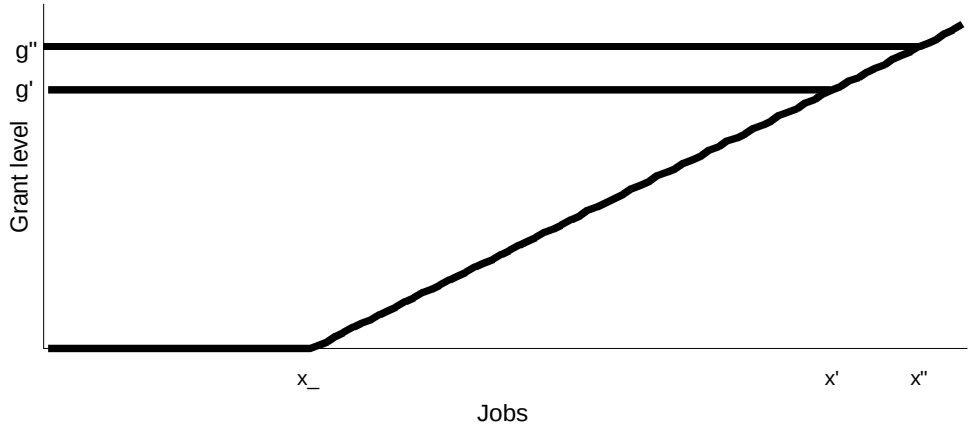
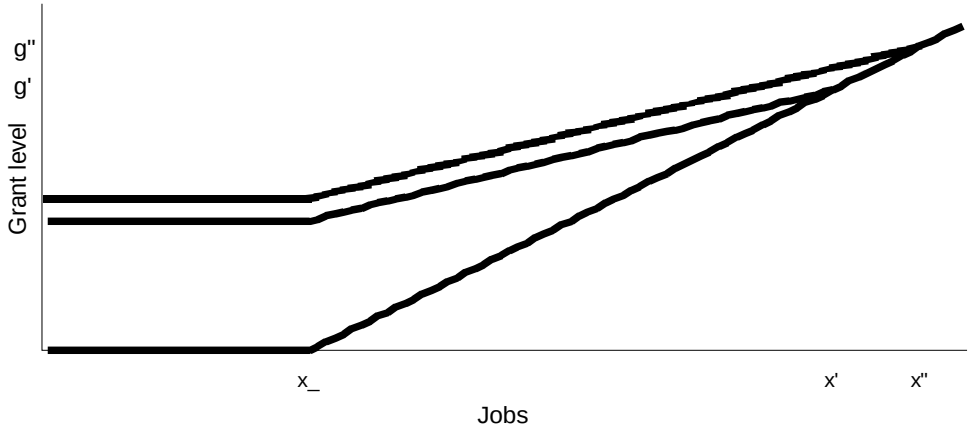


Figure C: Agencies claw back a fraction of surplus



Since about three in every four manufacturing start-ups are actually grant-aided, it might seem difficult to argue for a very high value of μ (i.e., the fraction of employment that would exist if grant were zero). On the other hand, applying the elasticity of 0.55 (hardly valid over such a wide range) would give a value of μ at around 0.9 even if the ratio of grant to net-of-grant wages was as high as 20 per cent. Lower values of μ lead to lower leakage and thus allow higher grants.

There may be a negative correlation between the value of λ and of the elasticity of labour demand proxied by μ. For example, low values of λ for small indigenous entrepreneurs may correspond to a relatively low grant-sensitivity of their labour demand, and hence a low absolute value of μ. Ideally, we would have robust estimates of the labour demand elasticities for different categories of project (by size, ownership or product sector). This is not the case. In the absence of such information, and considering the supposed negative correlation between λ and μ, there could be an argument for not varying the deduced parameter θ as between different categories of project.

It may be noted that this discussion of leakage and deadweight is very relevant to the question of which sectors should be eligible for grant-aid (and other preferential treatment). If a sector has a low labour demand elasticity, or if its inclusion would worsen the leakage parameter μ, then it should not be added to the existing list.

The question of rescue and other forms of double-dipping must also be raised in this context. The threat of closure can be used by enterprises to lever a second round of grant-aid. There is a strong argument for dealing with firms that make such applications by applying a higher discount θ to the benefits. The reasoning here is that grants provided in a rescue situation are very prone to leakage, in the sense that conceding a rescue-type grant is likely to precipitate a number of “me too” claims.

This chapter has presented a new approach to taking account of deadweight in discretionary grant schemes. We propose that a discount factor θ be applied to project benefits to ensure that the level of grants does not generate too much deadweight. The method points to the empirical quantities that are needed for implementation: the aggregate sensitivity of projects to grant-aid, and the relative bargaining strength of the grant agency and the entrepreneur. We show how this information can be appropriately combined to yield the deadweight factor θ used in the formula of Chapter 3. It is suggested that a reasonable value for θ for standard industrial grants in Ireland is about 0.8. The method is new, and the quantification acknowledgedly tentative, but it is offered at least as a more solid basis for thinking about these issues.

Chapter 7

CONCLUDING REMARKS

The purpose of a formal appraisal system is to rank projects, and to identify a cut-off point in the ranking. The approach adopted in this paper is that these decisions should be based primarily on factors which are reasonably measurable: employment and taxation flows. Both of these have been incorporated in previous appraisal systems, but we propose a significant change in the weights to be attached to them, basing our proposal on a deeper interpretation of Irish economic structure and of the internal logic of Irish economic policy.

The importance of unemployment is recognised in our proposed calculation, but is tempered by a recognition that migration flows can substantially frustrate efforts to eliminate involuntary unemployment through job creation. Since it is unemployment reduction rather than job creation that contributes to the net socio-economic gains, that implies a much higher shadow wage than has been used in the past.

The central role of tax and grant incentives in Irish industrial policy is also built in to our proposed formula, which both includes tax revenue indirectly clawed back from the project, and also takes account of the Government's budget constraint and the economic cost of raising the needed revenue (marginal cost of social funds).

Also provided is a new way of taking explicit account of deadweight, with the intention of ensuring that the grant regime is no more generous than needed to induce the investors' response.

In some ways, the approach suggested may seem old-fashioned, since it does not take account of positive externalities, clustering, increasing returns, dynamic learning effects and the like. Nor does it take account of negative externalities, such as the environmental and congestion side-effects that have become evident in recent years. That does not mean that we do not consider these to be important. But for the present, no generally accepted quantifiable framework exists for placing a value on such spin-offs. For that reason we have refrained from suggesting a formal procedure which would not command general acceptance, and whose inclusion would cast doubt on the whole procedure.

Instead, we propose what will appear to be a much more rigorous approach to the appropriate quantification of the important elements of benefit that are included.

Together with a large number of more detailed revisions, the new approach has been tried out on a sample of actual projects. The results are encouraging. The new formula does make a difference, but it does not drastically reorder most projects. It can therefore credibly contribute to a worthwhile incremental policy change.

The proposed appraisal method does not represent an overall evaluation of industrial development policy. That is not its intention: it is, as explained, intended as a tool of decision-making on a project-by-project basis. Nevertheless, there may be a tendency to assume that, if only projects with benefit-to-cost ratios in excess of one are funded, then industrial policy is optimal. This is not the case.

Our discussion has highlighted important features of recent Irish economic policy: the central role played by the fight against unemployment; the widespread public awareness of the burden of taxation and the need to use public funds effectively; and the professional demands on public servants in dealing with the many foreign investors, balancing the desire to encourage their investment with the need to strike a good bargain.

ANNEX 1

CHOOSING A NUMBER FOR THE IRISH SHADOW WAGE

The Issue

In deciding the shadow-price of labour, we need to balance simplicity with credibility. This is potentially an extremely complex area, and theoretical arguments could be provided for assessing shadow-wages separately for each major project. In practice we need a much more straightforward approach.

As discussed in Chapter 4, the shadow-price of labour which has hitherto been used is extremely low by international standards. On the other hand Irish unemployment is very high, and that might seem to justify a low shadow wage. For various reasons, including the relatively high labour mobility between Ireland and abroad, job creation in Ireland does not reduce unemployment one-for-one. Our conclusion is that, despite high rates of unemployment, it is inadmissible to use as low a shadow-wage as has been used up to now.

From this perspective, the crucial empirical quantity needed to determine the shadow wage rate is the sensitivity of unemployment to job creation. Basically the point is that if unemployment does not change (for example because as many migrants return as there are new jobs) then the conventional argument for lowering the shadow wage below the market wage, namely that some of the labour used was idle, fails.

In our main approach, we use the results of macroeconometric models to estimate the reduction in unemployment resulting from expansion in industrial employment. Most models predict that such an effect would vary in the first years following the job creation, with a higher initial impact of job creation on unemployment being eroded by subsequent migration. But in the interests of simplicity it is recommended that this dynamic feature should be largely ignored for the purposes of shadow pricing.

What we do is to compute the average reduction in unemployment over a seven-year period resulting from a sustained increase in industrial employment. As a refinement, future values are discounted at the rate of 5 per cent per annum before averaging in order to arrive at present values.

Calculating the Response of Unemployment to Job Creation

What reduction in unemployment can be expected to result from an expansion in industrial employment? In choosing a new figure, we recommend

reliance on the results of econometric analysis of unemployment dynamics, using sub-annual data.

Several econometric models of the Irish economy allow calculation of the response of unemployment to job creation. They all predict that the initial impact of job creation on unemployment is fully eroded by subsequent migration. Indeed, the long-term effect on unemployment is predicted to be negative in simulations where the initial job creation has come from an expansion of government expenditure; while this feature might superficially appear to be perverse, it results from the subsequent increase in taxation which is needed to re-balance the fiscal accounts. Despite general agreement on these qualitative features, recent econometric work does not provide an unambiguous guide to the speed of the adjustment of unemployment to the initial shock.

The reason for this ambiguity lies partly in the variety of model designs used, reflecting different approaches to the modelling of migration, and different degrees of complexity in the degree to which other relevant factors, such as taxation and wage determination, are taken into account explicitly. Another important distinction is between annual and quarterly models. There are more data series available at annual frequency, and this allows for a more elaborate modelling of the various linkage mechanisms in the economy. On the other hand, it is hard to capture the dynamic path of relatively quick responses in an analysis which is based on annual data only.

Evidence from Quarterly Data

The model in Honohan (1992) focuses directly on the link between Irish and UK unemployment,[46] thereby avoiding the need to employ unreliable migration data. It uses the assumption that the *long-term* sensitivity of the unemployment rate to job creation in Ireland is zero (an assumption which is not contradicted by the data).That model predicts a gradual convergence of unemployment rates in Ireland back to their equilibrium relation with those in the UK. The quarterly data employed allows a fairly precise estimate of the speed of convergence. There is an estimated transition period of about two years following a shock, during which unemployment, having been disturbed to a level below the equilibrium, is still in the process of converging back. Using the estimated model (for males),[47] and assuming that job creation had an initial one-for-one effect on the level of unemployment, we calculated the average

[46] Most of the analysis is based on registered male unemployment, adjusted for changes in data definition.

[47] Variations in registered female unemployment in recent years have not been as explained with the same degree of confidence.

impact on unemployment over thirty quarters. Taking account of time discounting, the result is that the reduction in unemployment averages only about 20 per cent of a sustained jump in the number of jobs.[48]

Evidence from Annual Data

Bradley, Whelan and Wright (1993), represents a recent version of the HERMIN econometric model of the macro-economy, based on annual data. Its approach is quite different, in that it assumes that migration flows (as opposed to the stock of unemployment) respond to relative employment conditions at home and abroad. Once migration gets under way, this model assumes that it will have its own momentum. As a result, it predicts a relatively slow build-up of migration which eventually leads to unemployment over-shooting its final equilibrium. The model shows unemployment approaching its ultimate equilibrium through an oscillating path. In a simulation carried out on the effects of a sustained jump in the level of public employment, this model predicts net immigration over seven years of 2.6 times the increase in public employment. Although this includes immigrants who are not labour force participants, it confirms that the unemployment impact of job creation is severely eroded by immigration. The simulation report does not calculate the unemployment impact directly. If two-thirds of the net immigration represent labour force participants, and even if there were no change in the labour force participation rate, the reduction in unemployment would again be no more than 20 per cent of the overall job increase.[49]

[48] The exact number depends on the approximating assumptions made about the rate of job loss after creation (e.g., 0.10 per annum), the rate of discount (e.g., 0.05 per annum, Department of Finance, 1994), and the rate of convergence of unemployment rates (e.g., 0.2 per quarter, Honohan, 1992). If we know these parameters we can calculate the present value of the reduction in unemployment, and express it as a fraction of the present value of the increase in employment. One minus this fraction is then taken as the shadow wage, if the unemployed are assigned a zero opportunity cost. The indicated parameters yields a figure of 81 per cent; lower rates of job loss give higher figures. If we assume zero job loss and truncate the present value calculation at seven years, we obtain 79 per cent. (If the initial impact of job creation on unemployment is lower, then the percentage is higher.)

[49] To arrive at this estimate we used the estimated net migration resulting from the creation of 1000 public service jobs. We subtracted 67 per cent of cumulative net migration from the 1000 jobs to arrive at an estimate of the unemployment change. While unemployment was estimated to fall by 892 in the first year, this fell below zero after four years and, with continuing immigration, the unemployment impact was actually minus 642 persons after seven years. The net discounted sum of the unemployment effect over seven years comes to just 15 per cent of the jobs created. This ignores spin-off jobs resulting from the public service job creation (to be consistent with our proposed cost-benefit methodology, which treats such spin-offs separately).

The overshooting of migration predicted by this 1993 model has been regarded as an unrealistic and unsatisfactory feature. As a result of further econometric analysis, the migration equation has been revised in more recent versions of the HERMIN model (cf; Bradley, Whelan and Wright, 1995).For example, in one recent implementation (unpublished) the momentum in the migration equation (Koyck lag) has been removed. This means that the simulated speed of convergence is much slower. Indeed, in a special simulation carried out for this study,[50] although the creation of 1000 permanent public sector jobs was projected to increase unemployment after 15 years, the early effects were favourable: reducing average unemployment over seven years by about 600.

While the annual model of the whole economy thus agreed with the quarterly unemployment model as recently as 1993, the latest overhaul of the former model has inconveniently introduced an element of disagreement. There is scope for further analysis here, including use of the larger Medium Term Model.

In applying the results of any annual model's simulations to the effects of industrial employment creation, one must remain aware of the fact that the location and skill composition of public sector employment is quite different, and the unemployment response may also differ. Also, the migration data which it is designed to fit are generally considered unreliable. Finally, as mentioned, annual data is not the most suitable for capturing a response which is thought to be reasonably fast.

Accordingly, our judgement is that primary reliance should be placed on the results of the quarterly model.

Although it is clear that a considerable margin of error inevitably surrounds these estimates, they confirm that it is not possible to support shadow prices as low as 15 per cent. Even if the social cost of employing an unemployed person were zero, the estimated impact of job creation on unemployment from the male quarterly data would not justify shadow prices much below 80 per cent.[51]

[50] Thanks to John Bradley and Frank Barry for these special simulations and for helpful discussions.

[51] Even if the magnitude of the migration effect were not accepted, there are other factors pointing to a large shadow wage, including taking account of the utility of leisure.

ANNEX 2

A FORMAL MODEL OF DISCRIMINATORY TAXATION

To ensure the logical consistency of the argument of Chapter 5, it is worth setting out a formal model, the simplest which captures the features which we seek to describe.

Thus we assume that the economy is open, and that goods prices are fixed, and may thus be normalised at unity. There is a representative household maximising an utility function $u(x,l)$, based on its consumption x and its labour supply l. The constraints faced by the household are that it can supply no more than a fixed ration of labour l^* and must stay within its budget constraint:

$$x \leq a + wl \,, \tag{A.1}$$

where w is the wage rate and a is lump-sum income (defined later).

Writing,

$$\begin{aligned} w(x,l) &= u(x,l) - \lambda(a + wl - x) - \mu(l^* - l) \\ \frac{\delta w}{\delta x} &= 0 \Rightarrow u_1 = \lambda \\ \frac{\delta w}{\delta l} &= 0 \Rightarrow u_2 - \lambda w = \mu \,. \end{aligned} \tag{A.2}$$

This defines the household optimum.

Two sectors of private production exist, each producing output y_i . Firms in each sector choose labour inputs l_i to maximise profits π_i subject to that sector's technology. Each sector's labour input is taxed at a sector-specific rate π_i .Thus profits for sector i are:

$$\pi_i = y_i - (w + \tau_i) l_i \,. \tag{A.3}$$

Profit maximising choices of y_I and l_I depend only on the technology and on π_i and may be written:

$$y_i = y_i(\tau_i)$$
$$l_i = l_i(\tau_i)$$

Let the semi-elasticity of demand for labour with respect to the tax in each sector be written as η_i, i.e.,

$$\frac{1}{l_i}\frac{\delta l_i}{\delta \tau_i} = \eta_i$$

The government uses the tax revenue from the tax on production inputs (these are the only taxes available) to purchase goods, and requires a total of T for essential public spending. Its budget constraint is:

$$T \leq \tau_1 l_1(\tau_1) + \tau_2 l_2(\tau_2). \qquad \text{(A.4)}$$

A fraction θ_i of firm i is owned by non-residents and this fraction of profits is repatriated abroad. The resource constraints (taking into account the fixed prices and open capital market which allows the goods to be treated as if they were perfect substitutes) are:

$$x_1 \leq y_1 + y_2 - T - \theta_1\pi_1(\tau_1) - \theta_2\pi_2(\tau_2)$$
$$l^* \leq l_1(\tau_1) + l_2(\tau_2) \qquad \text{(A.5)}$$

The household's lump sum income is that fraction of profits which are owned by the household:

$$a = (1-\theta_1)\pi_1(\tau_1) + (1-\theta_2)\pi_2(\tau_2).$$

If we write the indirect utility function of the household as $V(a,l)$, then at the optimal (shadow) values of the tax rates, the Lagrangian L is at a stationary point with respect to the market adjustment variables a and l^* and the policy variables τ_i, where

$$L = V(a,l^*) - \rho_1[x(a,l^*) - y_1(\tau_1) - y_2(\tau_2) + \theta_1\pi_1(\tau_1) + \theta_2\pi_2(\tau_2) + T] \\ - \rho_2[T - \tau_1 l_1(\tau_1) - \tau_2 l_2(\tau_2)] - \rho_3[l^* - l_1(\tau_1) - l_2(\tau_2)] . \quad \text{(A.6)}$$

with non-negative multipliers ρ. After some substitution, first order conditions give:

$$\rho_1 = -\lambda$$
$$\rho_3 = \mu \quad \text{(A.7)}$$
$$\frac{\tau_i(\rho_2 + \lambda) + (\mu + \lambda w)}{(\rho_2 + \theta_i\lambda)} = -\frac{1}{\eta_i} .$$

In the case where all profits are domestically owned, the last of these simplifies to:

$$(\tau_1 - \tau_2)(\lambda/\rho_2 + 1) = \frac{1}{\eta_2} - \frac{1}{\eta_1} .$$

In words, the difference in optimal tax rates is proportional to the difference between the reciprocal of the semi-elasticity of demand for labour in the two sectors.

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