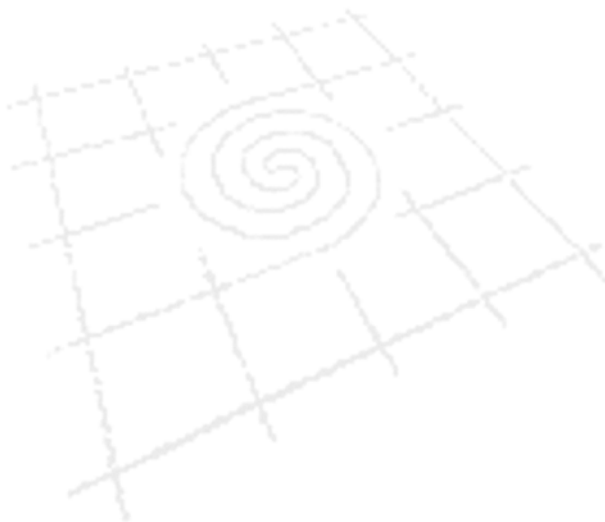


'It Was a Sorry Story ... Now We
 Can Think in Terms of Planning':
 The OECD Dimension of Irish
 Education & Science Policy
 Innovation, 1958-68

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Peter Murray
Department of Sociology,
NUI Maynooth
&
NIRSA

ABSTRACT

Unsuccessful domestic attempts to raise the profile of science and technology in Irish policy debate can be traced back to the end of the 1940s. By the late 1950s a combination of Soviet space race achievement and Irish development strategy shift had created a more receptive environment internationally and nationally. Interaction with the Office for Scientific and Technical Personnel (OSTP) of the Organisation for European Economic Cooperation (OEEC) ended the isolation of the Irish Department of Education and the Second Programme for Economic Expansion did what OEEC experts had been urging Irish policymakers to do by integrating education into economic planning.

Both in the education field and that of science and technology the bridge between a general commitment to planning and a concrete programme of action was supplied by research studies. These studies were initiated in the early 1960s by the successor body to OEEC, the Organisation for Economic Cooperation and Development (OECD). They were carried out by multi-disciplinary Irish teams with a common core membership and produced the seminal *Investment in Education* and *Science and Irish Economic Development* reports.

The former legitimated a quickening pace of government action to increase access to an expanded and rationalised education system strongly reoriented in the direction of science and technology. In the case of the latter, however, a context of alliance between Finance and Education was replaced by one of struggle for control between the two departments, both of which were participating in OECD initiatives to promote the adoption of national science policies. Also relevant was a division between the science and technology interests of the education sector and those of research institutes like Institute for Industrial Research and Standards, whose sponsoring department, Industry and Commerce, backed the attachment of the National Science Council to Finance.

Introduction

Under its nineteenth century Union with Britain Ireland acquired an education system which combined a measure of state funding, strict religious segregation and a high degree of control by clergy of the Catholic or Protestant churches. In the early twentieth century Irish language revivalists began to exert significant pressure on this system. With partition and southern independence in the early 1920s, the new state channelled such educational activism as it displayed mainly into the enactment of compulsory Irish requirements. Apart from establishing a vocational education sector which was neither developed nor dismantled, independent Irish governments shied away from any interference with the Catholic Church's 'grip on education of unique strength' (Whyte 1980: 16-21). Unlike most other European states after the Second World War, Ireland did not actively pursue policies to expand educational participation while for much of the 1950s deflationary economic policies accentuated the problems of an under-resourced system. Irish Education ministers generally adopted a stance of deferential passivity famously encapsulated in a 1955 Dail speech by Richard Mulcahy:

You have your teachers, your managers and your churches and I regard the position as Minister in the Department of Education as that of a kind of dungaree man, the plumber who will make the satisfactory communications and streamline the forces and potentialities of the educational workers and educational management of this country. He will take the knock out of the pipes and link up everything (quoted in O'Connor 1986: 1)

During the 1960s a radical transformation of this system gathered pace. This transformation had two key features. The first was greatly expanded levels of participation in secondary and higher education. The second was an increasing emphasis on science and technology that diminished the predominant importance the Irish system attached to issues of denominational religious formation and language revival. Debate about the need for and organization of an Irish national science policy proceeded in tandem with these new educational departures.

The West is frequently presented as reacting to the launching of the first Sputnik satellite by the Soviet Union in October 1957 with a concerted drive to increase its own science and technology capacity that focused particularly on the availability of an adequate pool of qualified personnel (Geiger 1997, Krige 2000). In this vein the memoir of a key Irish educational policymaker of the period refers to Ireland experiencing 'the tremor that shook Western science when Sputnik One was hurled into space... and caused a feverish revision of the mathematic and science courses in Western education' and comments that 'it might well be claimed that the greatest single event in post-war education world-wide was the shooting into space of Sputnik One' (O'Connor 1986: 56 and 83).

As a condition of receiving Marshall Aid from the USA, Ireland had become a member of the Organisation for European Economic Co-operation (OEEC) in 1948. US policy

continued to utilize OEEC as a channel of influence throughout the 1950s. Offers of US funding, to be matched by an equivalent contribution from OEEC member states, secured the setting up within OEEC of the European Productivity Agency (EPA) in 1953 and of the Office for Scientific and Technical Personnel (OSTP) in 1958. OEEC was reinvented as the Organisation for Economic Co-operation and Development in 1961 with the USA shifting from external influence to membership. EPA did not survive the change but OSTP – with its mandate for measures to address the scientific and technical (S&T) manpower shortage in Europe – was carried over. It became incorporated into an OECD Directorate of Scientific Affairs headed by Alexander King, who had previously headed OSTP while also holding the post of Deputy Director of EPA.

How OSTP and its OECD successor contributed to the process of transforming the Irish education system and helped to initiate consideration of an Irish national science policy are the main subject matter of this working paper. It should, however, be noted that the supply of S&T personnel was an issue that OEEC had been addressing prior to the creation of OSTP through the work of its Manpower Committee. Significant attention had also been paid to the issue by individual Western states such as the USA, Canada and the UK (Godin 2002). Thus while the issue's profile was certainly greatly raised by Sputnik, it also had a significant history preceding that satellite's sensational debut. Moreover a debate about scientific manpower shortage in Ireland had taken place in the early 1950s apparently without either Eastern or Western external prompting. The working paper begins by examining these domestic exchanges.

Was there a shortage of scientific manpower in early 1950s Ireland?

The adequacy of Ireland's scientific manpower supply was first raised by the Institute of Industrial Research and Standards (IIRS) in 1949. IIRS grew out of an Industrial Research Committee set up in 1933 and supported by a modest amount of piecemeal government funding. By the end of the 1930s it was channeling about £6,000 annually to the three National University colleges for research that was mostly concerned with trying to identify industrial uses for Ireland's abundance of peat and seaweed. Moves to place the Committee on a more secure footing were under way in Industry and Commerce by the early 1940s when these were put to one side to create the Emergency Scientific Research Bureau, whose staff sought to improvise solutions to the problems thrown up by the wartime interruption of the flow of vital imports. With the end of the war the project of a permanent industrial research institute was revived and an Industrial Research and Standards Act was passed in 1946.¹

According to an IIRS memorandum sent to Industry and Commerce in June 1949 'there is a serious shortage of in this country of "scientific man-power", that is, in the number of University graduates in Science and Engineering' that 'hampers the satisfactory conduct of Government Services and the growth of industries here and which calls for the application of remedial measures'. Specifically there should be 'an early and thorough inquiry under Government auspices'. The urgency Industry and Commerce attached to the

matter can be gauged from the two years it took to make a response. A Departmental Conference in June 1951 considered a memorandum setting out the findings of an informal investigation into the subject. These were that a shortage was experienced only in the cases of mechanical and electrical engineers (by government departments, local authorities and state-sponsored bodies like Bord na Mona, ESB and the Sugar Company) and of pure scientists (by the Department of Education's inspectorate and by secondary schools). Industry and Commerce had no information on the number of graduates employed in private industry but deduced that no shortages existed as no complaints had been made to itself or to the Industrial Development Authority: 'the lack of complaint may be due to the fact that University graduates in science and engineering are not employed to any considerable extent in private industry in this country.'

This view of the situation was rejected by IIRS which reiterated its call for a full investigation. Industry and Commerce, however, took the view that any action required lay within the province of the Department of Education and the universities. Almost two further years had elapsed by the time Education, after several reminders, produced its response which largely consisted of detailing the funding it was providing for the expansion of engineering and science courses at UCD and UCC. Presented with this, IIRS again reiterated its inquiry call, citing initiatives being taken by OEEC (on whose Committee for Applied Research the IIRS Director was the Irish representative) to argue that it should encompass 'the whole field of Technological Manpower'. An Industry and Commerce memorandum countered that:

Apart from temporary fluctuations in the supply of and demand for scientific graduates, the real difficulty appears to be that there is not in this country either a tradition of industrial skill or the necessary reserve of skilled or semi-skilled labour. In the absence of this tradition of industrial skill and of reserve of skilled etc. labour no useful purpose would be served by the holding now of an inquiry or investigation on the lines of that suggested by the Institute.

Exchanges on the subject continued into 1956 with Industry and Commerce and Education united in emphasising ongoing expansion of university facilities and rejecting the need for a manpower shortage inquiry. Faced with this, IIRS finally gave up repeating its call.²

Early OEEC Scientific Manpower Inquiries

Seeking to bolster its case for an inquiry by citing OEEC initiatives in the area did the IIRS little good while Industry and Commerce was advising External Affairs that 'it had no information on the subject matter of the O.E.E.C. questionnaire' and subsequently producing a memorandum that recommended that no action be taken regarding the OEEC report based on the data collected. The Irish replies to questionnaires issued by the Manpower Committee in 1954 and 1956 concerning S&T manpower output, employment, shortages and surpluses were largely composed of data related to

Agriculture with the problems of recruiting and retaining engineers of Posts and Telegraphs - the one department that had supported the IIRS inquiry call - also featuring.³

In July 1957, several months before Sputnik One's launch, the OEEC Council approved the setting up of a Working Party on Scientific and Highly Qualified Manpower and the Irish Delegation was approached by Alexander King of EPA to nominate a member:

We should much appreciate the sending of a personality of authority in the scientific and education world. The type of person we envisage would be someone like Professor Wheeler [Dean of UCD's Faculty of Science] but you have many other people of merit. On a number of scientific topics we already have contact with Dr. Donal Flood of the National Standards and Research Organisation (sic) in Dublin who would, of course, be acceptable.

External Affairs circulated the request to Agriculture, Education, Industry and Commerce as well as the Taoiseach's Department. But, in line with Ireland's prevailing mode of minimal EPA/OEEC involvement (Murray 2005), it got no nominee for this working party. By early 1958, however the Interdepartmental European Recovery Programme (ERP) Committee had emerged as a forum within which positive engagement with OEEC on S&T issues was beginning to develop. This committee, set up ten years earlier to handle Marshall Aid business in a co-coordinated fashion, had External Affairs, Finance, Taoiseach, Agriculture and Industry and Commerce as its core departmental members.

In the interim the conditional US offer of funds had set in motion the process of setting up within OEEC a new office dedicated to S&T manpower issues and a proposal to institute annual reviews by this office of national S&T manpower policies had been approved. On 7 January 1958 the Interdepartmental ERP Committee agreed that Irish participation in the new S&T programme was desirable 'especially in the context of the Free Trade Area negotiations', initiated a process of gathering material in anticipation of an annual review and nominated Professor Wheeler as a member of the Working Party set up in July which had by then completed its work and been wound up. Reluctance to participate in matching the funds the USA had offered for the new office was expressed - 'the Minister for Industry and Commerce considers that, in accordance with our attitude in Working Party 23, we should take the line that Ireland, as an underdeveloped country, should not be asked to contribute' - but later withdrawn in the light of the Paris Ambassador's response that 'in my view it wouldn't look too good for a country in the course of development to opt out of an exercise of this nature'.⁴

A changing context prompted some movement in Industry and Commerce's attitude to S&T questions. It informed External Affairs in August 1957 that it was 'unable to attempt an assessment of the scientific and manpower position in Irish industry'⁵: but a year later its position was that:

At the present level of industrialisation the supply of scientific personnel is equal to the demand. It is not unlikely, however, that if the industrial development it is hoped to stimulate by measures designed to attract external investment etc. materialises, the supply of scientific and technical manpower will become a live issue.⁶

Industry and Commerce continued, however, to disclaim responsibility for S&T manpower questions and to maintain that these were a matter for Education. Irish representation on OSTP's Governing Committee was assigned to the latter department. This was to greatly increase the exposure to international influence of a department whose `approach to questions of interchange with other countries' had been characterized in 1955 by an External Affairs official as `cautious to the point of being negative' (quoted in Whelan 2000:309).

The Wilgress Visit and the first OSTP Annual Review

The first concrete manifestation of the new international influence came when a former Canadian Ambassador to OEEC, L.D. Wilgress, was commissioned by the organization in 1959 to review the state of scientific co-operation in Europe. Prior to visiting Ireland in June, he discussed his mission with M.T. O'Flanagan, Education's nominee to the Governing Committee of OSTP. O'Flanagan subsequently noted that:

Mr. Wilgress will wish... in particular to find out if there is a proper understanding at the highest level of the link between scientific training and economic growth... he will wish to stir up interest at the highest policy level and stress the importance of scientific training and research to any national development programme.

Ireland would be `the first of the "non-industrial countries" of O.E.E.C. which Mr. Wilgress will visit'. In the industrialised ones he had `had conversations at highest Government level', meeting in the United Kingdom with `the Chancellor of the Exchequer, the Lord President of the Council, the Minister for Education and the Heads of Applied and Pure Research in Government and University institutions'. In his two days in Dublin Wilgress was to meet the Ministers of Education, Agriculture, Industry and Commerce, Lands (which had responsibility for fisheries) and External Affairs. He also saw the Secretary of Finance, the Directors of the Agricultural Institute and of the IIRS as well representatives of Trinity College and UCD.

An interim report Wilgress submitted to OEEC in July described Ireland as `not so much an underdeveloped country as one seeking to arrest further underdevelopment'. The loss of a large proportion of science graduates to emigration was noted as were the inadequate and overcrowded facilities in which they received their education. `There is not', the report noted `a widespread realization in Ireland of the role of scientific research in the development of industry'. Ireland had sought - `like so many other underdeveloped

countries' - to develop industry by replacing imports. Little attention had been paid to developing industrial exports, where the requirement of high quality gave industrial research especial relevance. The response to the report from Irish departments was broadly positive – as an External Affairs minute put it, 'considering Mr. Wilgress was able to spend such a short time here, his report strikes me as remarkably sound'.⁷

Later in 1959 Ireland experienced for the first time the process of review by OSTP-nominated educational experts:

The technique which was applied was to send to each country a small group of independent experts to discuss...with government officials and competent representatives of other interested circles. On the basis of these interviews they prepared a report which was then discussed at a "confrontation meeting" at the headquarters of the Organisation, at which high ranking representatives of the examined country answered the various questions put to them by the "examiners", and members of the Governing Committee (Papadopoulus 1994:25)

The examiners who came to Ireland in October were H.W. Stowe, the President of Queen's College, New York and a professor of thermodynamics from the University of Grenoble's Institut Fourier, Louis Weil. Their report highlighted the issue of low educational participation rates and the lack of integration between economic planning and educational development:

This rate of progression from the primary grades to the secondary schools and to the level of the "Leaving Certificate" appears to be unusually low. By modern standards of interpretation it must surely mean that a large proportion of the brain-power of the Irish people is not receiving its full potential development... It seems particularly unfortunate that in the new outline of plans for the economic development of Ireland, no provisions have been outlined for the part education must play

In the scientific field, they noted 'extreme overcrowding of the laboratory accommodation' in the universities, while at secondary level:

Our study reveals a reasonably good mathematical training, at least for boys, but much less satisfactory training in physics or chemistry. Only a small proportion of secondary school pupils are so prepared as to be able to present themselves to a University science faculty for further training in physics, chemistry and engineering after leaving secondary school. The principal origin of this deficiency seems to be a lack of adequately prepared teachers of science.

One of the 'inquiries for further review at the confrontation meeting' contained in an appendix to the report posed the question: 'so far as teaching personnel are concerned, is

the load of secondary education becoming too heavy for the church and private organisations to bear?’

When the confrontation meeting took place on 17 November the Irish delegation consisted of Education’s Secretary, its nominee on the OSTP Governing Committee (O’Flanagan) as well as Professor Wheeler and the Director of IIRS (Flood). The meeting itself threw up questions the Irish group would hardly have found themselves addressing in policy discussions at home. For example, ‘one examiner said he had been told that there is no proper career structure for lay teachers in clerical schools – no promotion to headships or other positions of responsibility – and asked whether this hampers the supply of science teachers’. One of the Irish representatives sought to provide reassurance on this issue by arguing that ‘Irish graduates go in for teaching as a last resort and once having fallen back on it are not much deterred by lack of promotion prospects’.

The ban imposed by the Church hierarchy on Catholic students attending Trinity College (Burke 1990: Lydon 1992) was an issue subject to delicate and euphemistic handling in Dublin (Bowman 1993). In Paris, however, it was raised in a direct and critical way at the confrontation meeting:

If the universities are crowded, why not with Irishmen? Why does Trinity College, Dublin, take one-third of its students from abroad? This college, replied the Irish representatives, is a special case. There is an ecclesiastical sanction upon it for Irish Catholics so heretofore it has not been filled to capacity, but in the current year owing to the British “bulge”, it has a full complement.

Among their ‘inquiries for further review at the confrontation meeting’ the examiners had asked: ‘what complexities emerge from the requirement that all students in Irish schools must learn the Irish language, and from requiring that much of the instruction in other subjects shall be given in that language?’ Here the representatives responded with an assertion of the language’s importance - ‘one of the few surviving indications of our national identity’ - and the argument that emphasis on its use in schools was not at science’s expense - ‘the schools that teach science through Irish are among the best at both science and Irish – and get the teachers they want’.

The confrontation meeting ended with the examiners saying ‘they had the impression things are stirring educationally in Ireland’ while Alexander King observed from the chair that ‘the relationship between education and economic growth is particularly important in Ireland and there are also problems arising from religion and history.’⁸

OEEC, OECD and the Quickening Pace of Irish Educational Change, 1959-61

Two years later one of the Irish representatives at the confrontation meeting – Education’s Secretary – wrote a letter providing his Finance counterpart with an account of the extent of Education’s interaction with OEEC/OECD to date.⁹ This was done in the context of an agreement in principle between the departments that ‘a study, conducted with expert assistance, would enable us to work out with reasonable accuracy the educational targets and requirements which, as already agreed, are to figure prominently

in the next five years' economic plan'. According to this letter 'perhaps the most useful item in the O.S.T.P. programme has proved to be the "Country Review":

These meetings have served three valuable purposes. Special national problems can be given international attention; the international "confrontation" provides a strong stimulus for increased effort on the part of the national authorities concerned; and, finally, the comparison of various national situations is the best possible means for discovering those areas in which international action is needed, and in which O.E.C.D. can be of greatest help.

OEEC/OECD action in the first instance 'focused on science and mathematics teaching at the secondary school level' and 'developed into a veritable campaign for the comprehensive reform of school science whose effects, in varying degrees, were felt throughout the OECD area' (Papadopoulos 1994: 28). By November 1961 the effects in the case of Ireland were that:

This country has received assistance from O.E.C.D. in organising a number of seminars for teachers of Science. A number of the suggestions in regard to Mathematics and Science which arose from the Confrontation would have already been adopted were it not for the fact that the final examination of them had to await consideration of the report of the Council of Education on the secondary school curriculum generally.¹⁰

The Council of Education was 'a body satisfied with the system as it then operated and unwilling to consider almost any amendment' (O'Connor 1986: 69). Published in 1962, its report on the secondary school curriculum recommended strongly that all secondary school pupils be given some science education but concluded that existing subject syllabuses, with the exception of that in music, were suitable, subject to minor alteration. The prevalence of a different view was stated by the Second Programme for Economic Expansion in August 1963: 'a beginning has been made with the revision of the curricula in the primary and secondary schools so that they will accord more closely with present requirements, particularly in relation to mathematics, science and languages. This revision will continue until it is fully completed' (Department of Finance 1963: 14).

Penetration of the Irish university education by OSTP's perspectives encountered a more effective domestic obstacle. Inadequate university facilities had, as we have seen, forcibly struck the earliest OEEC scientific and educational experts to visit Ireland. A limited inquiry into the accommodation needs of the National University of Ireland in 1957 and a scandal concerning the illegal manner in which academic appointments were being made in UCD were followed by the setting up in October 1960 of a Commission on Higher Education with very wide terms of reference (O'Connor 1986: 45-51 and 55). In December the Irish body set up in 1959 to liaise with EPA - the Irish National Productivity Committee (INPC) - was informed by its Chairman, Dennis Hegarty:

The Committee had an interest in improving scientific and technical education. He [The Chairman] thought the Committee could help the new Commission in its

study of this matter. The Organisation for Scientific and Technical Personnel (O.S.T.P.) a sub-ordinate body of the OEEC, had at its service educationalists of the highest repute. He had discussed with Dr. King of this Organisation the possibility that a team of experts of the highest level might be made available to the Irish Commission and Dr. King had agreed with this proposal in principle. The idea was that an economist might be sent by the O.S.T.P. to study our educational system from the economic angle and collect data. He would then make a report and advise the Commission on the shape which the new efforts might take in education of a scientific and technical character.¹¹

But, although Hegarty told the INPC that he had `discussed this idea with the Chairman and other members of the Education Commission who had expressed interest and approval', the Commission's discussion of the proposal produced an acceptance of the offer so qualified as to amount to a rejection - `the experts would not act, or be designated, as agents of the Commission; the proceedings of the Commission could not be disclosed to the experts and the Commission would not be in any way bound by the report of the experts'.¹² Within Education the initial response to OSTP expert involvement was also unenthusiastic but this later changed with the Minister telling the Commission's Chairman in July that `he would be disposed to withdraw his previous reservations' if certain conditions were satisfied. These conditions were:

- `That, as we have already been assured, the examination will be at OEEC's expense
- That it be an instrument of the Commission, working within the terms of reference, constitutional and otherwise, of the Commission
- That it reports only to the Commission
- That the assent of the University Colleges to being inspected be assured in advance. This could be done either by the Commission or by the Department, but preferably and more properly by the Commission
- That there be no assumption that the educational system of this country is in some way backward in its standards or in the standard of its products
- That the likely future of industry in relation to skilled man-power be also examined'

The Commission discussed the question again in September but rejected the idea that `the experts should act as agents of the Commission' or that it should have any association with a survey of the universities. An expression of willingness to consider evidence submitted to it from any source was as supportive as it was prepared to be and the proposed involvement of OSTP got no further.¹³

Vocational education proved far more open to OSTP influence. The suggestion by Wilgress that OECC take up the question of technician education was favourably viewed in Ireland while the report of the November 1959 confrontation meeting noted that:

The Irish representatives agreed that the system of technical education is weak in the middle – in the training of medium level and high level technicians. Yet it is these types that industry most wants and at present it has to import many of them, especially in the textile industries. (There was some disagreement among the representatives on the extent of this import.)¹⁴

In September 1961 Education, prompted by Industry and Commerce, appointed a committee to inquire into the need for and training of technicians in Irish industry. In 1962 an OECD country review specifically focussed on technicians got under way at Ireland's request with its confrontation meeting - attended by both the Minister for Education and the Department Secretary – being held in January 1963. Four months later a major initiative to expand Ireland's underdeveloped vocational education provision by inaugurating a technical schools leaving certificate and establishing a network of regional technical colleges was announced (White 2001: 33-35).

The Economics of Education

The major impact of OSTP on Irish education was to arise not out of the pursuit of the specific concerns that its title referred to but from a broadening out of its focus from scientific and technical education to embrace education as a whole:

The concentration of the initial OSTP programme... stemmed from the conviction that the rate of growth of the economy would be increasingly determined by the provision of education in science. But it was equally accepted from the beginning that the problem of producing an adequate supply of well qualified scientists, engineers and technicians was not one which could be examined independently from the output of the educational system as a whole, since such technical personnel represented only part of the apex of the educational structure. It was only logical, therefore, that a central objective of the programme would be to stimulate policies in Member countries for increased allocations of resources to education as part of their efforts to maintain an adequate rate of economic growth. Out of this simple idea emerged the "Economics of Education" which was to play such a prominent part in the work of the Organisation and, more generally, in providing political support for the massive expansion of education over the next ten years (Papadopoulos 1994: 32)

Here the key developments were OSTP's parentage of the Study Group in the Economics of Education formed in 1960 and the conference on Economic Growth and Investment in Education held in Washington in October 1961. The study group developed a theoretical rationale for educational expansion while the Washington conference was a key moment in the dissemination of these ideas to a wider audience of senior policy-makers ((Papadopoulos 1994: 32-42; O'Connor 1986: 62-63; White 2001: 29-31).

No Irish economist was a member of the Study Group but it did include an Englishman who had significant Irish connections and a Dane who was to acquire such connections at a later date. John Vaizey began his career in industrial economics with a study of the British brewing industry. At Peterhouse College Cambridge in the mid-1950s he became friendly with Patrick Lynch, a fellow of the college who had previously acted as economic adviser to the Taoiseach and would subsequently combine an academic career at UCD with extensive external commitments. Vaizey's involvement with the brewing industry led to his co-authoring with Lynch of one of the volumes of the history of Guinness's brewery that were to mark its Dublin bicentenary (Lynch and Vaizey 1960). Time spent 'working with uncatalogued and unsorted archives' in Dublin meant that 'through the Irish book I got to know Ireland well' (Vaizey 1986: 123-124). Economic history had replaced industrial economics as Vaizey's main theoretical interest but it too was displaced when, prompted by the work of Richard Titmuss and Brian Abel-Smith on the National Health Service, he began to focus on the economics of education: 'I became an Expert on that somewhat esoteric but increasingly fashionable subject... [and] was drawn increasingly to Paris to work with international organisations' (Vaizey 1986: 123). The Study Group, to which Vaizey was a leading contributor, was chaired by Henning Friis, the Director of Denmark's National Institute of Economic and Social Research, who also chaired OSTP's Governing Committee. Friis was to come to Ireland in 1965 as a UN consultant to study the country's social research needs. Moves to bring Friis to Ireland for this purpose were initiated Patrick Lynch.

While great significance was later to be routinely attributed to Irish participation at the 1961 Washington conference, Irish preparations for it were disorganised to say the least. OEEC documentation had been circulated in the Spring, with June 15 set as the deadline for nominations, but External Affairs seems only to have passed the information on to Education. Finance, whose participation was also sought by OEEC/OECD, did not become aware of the upcoming conference until mid-July. However on 30 June the Cabinet had approved the proposals of a Finance Memorandum for the preparation of a successor to the programme for economic expansion which had now reached its mid-point. One sentence in this memorandum - 'Education will be covered in the new programme, special arrangements being made with the Department of Education for the preparation of material' - signalled a significant extension to the existing scope of the planning process and paved the way for Finance representation in Washington. On 8 August the US Embassy sent External Affairs a minute stating that 'the United States Government attaches considerable importance to this conference and hopes that the delegation of each OECD member will include representatives of the departments of finance and education', before listing the members of the high-powered delegation that would represent the USA. At the end of August a US Embassy official told T.K. Whitaker that one of these delegates, Assistant Secretary of State for Educational and Cultural Affairs Philip H. Coombs 'hoped that Dr. Hillery, Minister for Education, and myself [Whitaker] would be present at this conference and that he would meet us there'.¹⁵

The Irish "Investment in Education" Report

Irish policy-makers had accepted the significance of education for economic development prior to the Washington conference but a significant move to give this acceptance

concrete and specific content was initiated at this event. In Washington Kjell Eide of OECD's Directorate of Scientific Affairs handed the Irish delegates – an Assistant Secretary from Finance and another from Education – a document entitled “Pilot Studies on Long-Term Needs for Educational Resources in Economically Developed Country”. During the closing months of 1961 discussion on carrying out in Ireland the kind of pilot study OECD envisaged got under way involving the departments of the Taoiseach, Agriculture, Industry and Commerce, External Affairs as well as the CSO. Support for the proposal was unanimous and planning for the study got under way in January 1962 with a meeting in Education which Alexander King came from Paris to attend.

At the next meeting on 7 March, with only Irish officials present, philosophical doubt made a brief appearance with the CSO Director asking whether ‘the question was perhaps being approached from the wrong point of view’:

We were asked to begin by saying what was needed in terms of manpower, etc., instead of taking as our point of departure the human resources available and what we can afford to give them. That is, the question was not being considered from the humanistic point of view.

To this Education's Secretary riposted that ‘he was sure the human element would not be overlooked, but he felt that if we did in fact approach the question from the purely humanistic point of view, then little financial support would be forthcoming either from the Government or from O.E.C.D.’. Irish perspectives were if anything more instrumental than those of OECD. One of the terms of reference suggested by OECD envisaged the making of ‘alternative assessments of future social demand for educational facilities at different levels based on present trends and international experience’. At the March 7 meeting there were expressions of ‘some disquiet about the implications of the word ‘social’’. By May Finance had succeeded in getting ‘social’ removed and ‘essential’ inserted in its place. That the making of policy recommendations would not fall within the study team's terms of reference was also successfully stipulated by Finance.

Most discussion at the planning meetings centred on the question of the expertise needed to carry out the envisaged study. Initially a necessity to source this from outside the country was perceived. The CSO Director told the 7 March meeting that ‘the chances of finding in Ireland a suitable economist and statisticians for the study team were very slim indeed’. His suggested means by which the project leader might be recruited ranged from advertisements in *The Economist* and similar publications through his own contacts with the National Science Foundation in Washington to recommendations from John Vaizey or the OECD. Later at the same meeting, when the creation a Steering Committee to work in tandem with the study team was being discussed, one of the participants remarked ‘that as the members of the study team would be foreigners, it was desirable that the Steering Committee should consist of people who could give informed guidance to them’.

By mid-April this perception was changing. At a meeting on 17 April with C.H. Murray of Finance, John Vaizey was unable to suggest anyone who might be available to fill the

team leader position - 'economists were very scarce and economists qualified to undertake a study of educational needs and resources were doubly scarce'. The 'possibilities of a part-time assignment' were then turned to - 'for this to be at all workable the man in question would have to be resident in this country...he [Vaizey] suggested that we might consider the question of securing the release of a university academic from his university work'. A further project planning meeting took place on the same day at which Irish officials were briefed on developments within OECD by Kjell Eide who stated that 'the Organisation would consider it vital that the project leader be a national of the country carrying out the study'.

At the next meeting of Irish officials only on 23 May 'it was agreed that, both from the national and the OECD viewpoints, it would be preferable that the team leader should be an Irishman with a suitable academic background'. Patrick Lynch was identified as the preferred candidate for this role while an Irish statistician working for the United Nations in New York - W.J. Hyland - was to be sounded out on returning to join the study team by M.D. McCarthy. By 25 June Lynch's agreement had been secured, arrangements for Hyland's return were well advanced and - although a British candidate for a junior economist position within the team had been suggested by Vaizey - it was decided to seek the release of another Irish university lecturer, Martin O'Donoghue of Trinity College, to fill this role. A civil servant from Education - Pdraig O'Nuallain, 'a secondary [school] inspector with a degree in mathematics' - completed the team.

With a purely Irish team taking shape, and 'informed guidance' for foreigners no longer required, the composition of the Steering Committee became a less salient issue. The letter of 8 November 1961 from Education's Secretary to his Finance counterpart that initiated broader inter-departmental discussion of the pilot study had noted that:

In the case of other countries that are carrying out such surveys it is the practice to have organised labour and employers' associations represented on the national team. Perhaps that position could be met here by including two representatives of the National Productivity Committee, one from the Labour and the other from the Employers' side of that Committee.

This suggestion was not, however, to be acted upon during the pilot study planning process and the INPC - despite its 'interest in improving scientific and technical education' - was not to be institutionally incorporated into the developing coalition for wider education change. More successfully suggested for inclusion - 'though his experience of statistical exercises is limited, his presence on the Committee might be valuable' - was the Reverend Professor of Sociology at Maynooth, Jeremiah Newman. From Finance this suggestion drew the comment that:

The idea of a church rep. may not be a bad one considering the traditional humanistic moral etc. bias of education here. A cleric might well be "educated" thro' membership of the Ctee. about the more materialistic manpower aspects.¹⁶

How the new initiatives were viewed by clerics is not clear. In 1959 the OSTP examiners had 'learned from the Ministry of Education that the ecclesiastical authorities are no less concerned than state officials' about the shortcomings of Irish mathematical and scientific education. During the period in which the educational study team was at work the state of Irish education was one of the subjects considered by the priests on a Dublin Diocesan Committee to examine the Public Image of the Church set up by Archbishop McQuaid. The section dealing with education in the report the Committee presented to the Archbishop in June 1964 depicted a system coming under severe criticism from the laity. Its suggestions included regular consultation between teachers and priests within parishes, encouragement of parents' committees or associations and the appointment of a chaplain for Catholic students in Trinity College. It also observed that 'if fees in secondary schools continue to rise, as many have recently, there is likely to be a growing body of articulate parents anxious for radical changes in our system of education'.¹⁷

Such recommendations were hardly congenial to McQuaid's authoritarian conservatism and were not implemented. A few years later the extent to which state-initiated educational change was gathering pace following the December 1965 publication of the study team's *Investment in Education* report confronted the Archbishop. In July 1968 he received from the Jesuit editor of *Studies* an article written by Sean O'Connor, the Education Assistant Secretary heading the planning unit whose establishment had been called for in that report's one foray into policy recommendation. The editor's covering letter placed O'Connor at the centre of 'the sweeping changes introduced by the Department of Education', pointed out that it was unusual for a civil servant to write an article of this kind but that O'Connor - who 'is obviously deliberately provocative in some parts of his long article' - did so with his Minister's approval and asked the Archbishop to nominate a contributor to a symposium on its contents in *Studies*. Entitled 'Post-Primary Education: Now and in the Future', O'Connor's article concluded with a call for 'a dialogue at the highest level between church and state on the problems in education now surfacing':

A change must be made: otherwise there will be an explosion, maybe sooner than later. No one wants to push the religious out of education; that would be disastrous in my opinion. But I want them in it as partners, not always as masters.

O'Connor was not 'provocative', the Archbishop wrote in his marginal comment, 'he is erroneous - which is much more grave - on a moral issue.' While the note continued: 'I shall consider naming someone to comment', McQuaid was later to write to the Jesuit provincial seeking to prevent publication of the article by *Studies*. In this he was to be unsuccessful. The Autumn 1968 *Studies* symposium led off by O'Connor's article clearly underlined the coming to an end of the 'dungaree man' state presence in Irish education.¹⁸

The "Science and Irish Economic Development" Report

OECD's highlighting of the relationship between economic growth and education was a supplement to, rather than a substitute for, its continuing emphasis on the relationship between economic growth and science. In May 1962, as the Irish education study team

and Steering Committee were taking concrete shape, the Directorate of Scientific Affairs circulated a document entitled “Pilot Teams to Study the Needs for Scientific Research and Technology in relation to Economic Growth”. Irish participation was favoured by Industry and Commerce as well as by the recently revamped IIRS under its new Director, Martin Cranley. Finance was concerned about duplication of the work being done by the education study while Education took the position that the project should be deferred until the education study was completed (‘in about two years hence’).

Before two OECD officials came to Dublin in February 1963 an External Affairs official noted that ‘the real purpose of the visit may be to have it confirmed in discussions with all concerned that a pilot scheme on scientific research may be a little premature’.¹⁹ But, with Patrick Lynch expressing the views that the statistical work required by the two projects could be dovetailed and indicating the availability of some of the personnel of the education team (including himself) to contribute to the second study, these meetings produced the opposite effect to this predicted long-fingering. By the end of 1963, with ‘hard’ science expertise drafted in from the Agricultural Institute, Bord na Mona and UCC to join Lynch, Hyland and O’Donoghue, the new study’s team had been formed. With a study team core in place at an early stage, the study’s terms of reference was opened up to their input. In this instance these terms included within their scope the making of policy recommendations.

Organising meetings of the Ministers of Science of its member countries was another means adopted by OECD to advance its S&T agenda. Irish representation at these meetings, which began in 1963, was supplied by Education which set up an informal committee drawing in some other departments, IIRS and the Agricultural Institute to carry out preparatory work for these meetings. In 1964 this committee was expanded to bring in engineering and science academics from the four universities. In addition to its original role in relation to OECD ministerial meetings, the committee thereafter became a forum in which the case for state provision of post-graduate and post-doctoral university research funding was pressed.²⁰

These two parallel OECD initiatives to raise the salience of science policy issues were to have the unintended effect of bringing the Irish interests involved into head-on collision. In January 1965 the S&T Survey Team presented to a meeting of its National Advisory Committee a document entitled “Proposals for A National Coordinating Body for Scientific Research and Development”.²¹ The following month Education circulated for observations a draft Memorandum for the Government - “Formulation of a National Science Policy”.²² After redrafting the former emerged as an interim report arguing for a National Science Council working to Finance’s Development Division: the latter sought to formalise Education’s control over science policy issues and enhance the status of the ad hoc advisory committee it had created. Objections by Finance and by Industry and Commerce forced Education to defer the submission of its Memorandum until the Survey Team’s report was available to be considered at the same time by the Government.²³

By the end of 1965 publication of the two volumes of the Survey Team’s report had been rushed through government procedures by Industry and Commerce. Finance then moved

immediately to invite other departments to submit their views on the recommended attachment to it of a National Science Council.²⁴ A Memorandum for the Government proposing that this be done issued from Finance in April 1967. This time Education was placed in the position of arguing for deferral.²⁵

One Education argument was the need to consider alternative proposals for scientific and technological development structures that the Commission on Higher Education had produced. Coming nearly six years after it had turned away the offer of OSTP assistance, and more than two years after the reporting date indicated in the Second Programme for Economic Expansion had passed, the Commission's report was undermined by the inordinate delay in its completion. A multiplicity of reservations weakened its recommendations and its overall approach was out of tune with the policy thrust that had been generated by Irish state interaction with OEEC and OECD (White 2001: 42-50). In competition with the creation of a National Science Council linked to Finance were the Commission's proposals for a Technological Authority and of a National College of Veterinary Sciences which would integrate teaching and research activity within their respective fields. However the Commission's report was to Education and 'institutions connected with other state departments to which the Commission made reference' - such as the Agricultural Institute and IIRS - 'did not feel any constraint on them to accept the recommendations, particularly when the proposals about education itself were a cause of dismay to many' (O'Connor 1986: 173).

Remarkable in the light of the praise heaped upon the team headed by Lynch for its analysis of the education system, a second argument adduced by Education against implementing the S&T Survey Team's National Science Council recommendation was that 'in scientific circles the Report is held in very low esteem'. Although not explicitly identified, the 'scientific circles' referred to here seem to have been the science and engineering academics brought onto Education's ad hoc advisory committee.²⁶

In spite of this opposition the proposal to create a National Science Council secured Government approval. Later in 1967, when Finance circulated a further memorandum dealing with the Council's terms of reference and membership, Education returned to the fray seeking without success to split technology from science and keep the former outside the Council's remit. To this Finance responded that 'it is through increasing the level and application of technology that the Council can best contribute to national development.'²⁷

Conclusion

Unsuccessful domestic attempts to raise the profile of science and technology in Irish policy debate can be traced back to the end of the 1940s. By the late 1950s a combination of Soviet space race achievement and Irish development strategy shift had created a more receptive environment internationally and nationally. Interaction with OSTP ended the isolation of the Irish Department of Education and the Second Programme for Economic Expansion did what international experts had been urging Irish policymakers to do by integrating education into economic planning. Writing privately to his Finance counterpart in 1962 Education's Secretary described the resultant change of context:

It is only during the last four or five years that we have managed to struggle to our feet here and look around us at all. It was a sorry story – 25% of our primary teachers untrained, and that position getting steadily worse, the school building problem also getting steadily worse, no push forward in science teaching in the secondary schools, the universities neglected and losing heart, continual recriminations on all sides about salaries and what not... this situation is well on the way out and... now we can think in terms of planning.²⁸

Both in education and in science and technology the bridge between a general commitment to planning and a concrete programme of action was supplied by OECD-initiated pilot studies drawing upon Irish resources of expertise across a range of disciplines. With regard to its conception, its execution and its catalytic effects, the work of the OECD-linked education study team is a much celebrated episode of Ireland's modernisation (Mulcahy 1992). A remarkably broad consensus supported the initiative. Bureaucratic caution and ministerial self-preservation were set aside to allow a 'warts and all' portrait of Irish education to be painted by the study team (O'Connor 1986: 63; Walsh 2005: 150). Special efforts were made to focus public attention on the findings of a damning report that legitimated a quickening pace of government action to increase access to an expanded, rationalised and reoriented education system (Walsh 2005: 158). In the case of the science and technology study the context of alliance between Finance and Education was replaced by that of a struggle for control between the two departments, both of which were participating in OECD initiatives to promote the adoption of national science policies. Also relevant was a division between the S&T interests of the education sector and those of research institutes like IIRS, whose sponsoring department, Industry and Commerce, backed the attachment of the National Science Council to Finance.

To the regret of policymakers seeking to adapt the Irish economy to conditions of freer trade in the 1960s, educational expansion got under way in Ireland about two decades later than it might have done (O'Buachalla 1996: 13-14). Once under way it consolidated a fundamental change in social structure with the acquisition of educational credentials replacing the familial inheritance of property as the key determinant of life chances in Ireland. An expanding supply of educated labour, with business and technical skills featuring strongly, simultaneously increased Ireland's attractiveness as a location for mobile capital investment. Yet, even in the very recent period when miracle status has come to be attributed to the resultant economic growth, nagging doubts have continued to centre on the country's extreme dependence on a flow of foreign high technology investment and its ongoing failure to develop a vibrant indigenous S&T capacity (Yearley 1995). This indigenous weakness was first systematically examined at much the same time, by many of the same people and within the same context of interaction with the OECD Directorate of Scientific Affairs as the much more famous education analysis.

NOTES

Abbreviations used in Notes:

DDA	Dublin Diocesan Archives
DETE	Department of Enterprise, Trade and Employment
DF	Department of Finance
DFA	Department of Foreign Affairs
DIC	Department of Industry and Commerce
DT	Department of the Taoiseach
NAI	National Archives of Ireland
TCD	Trinity College Dublin

¹ NAI DIC TIC 33339 Industrial Research Council: proposed establishment of a separate research institute. Proposed establishment of Institute for Industrial Research and Standards: preparation necessary legislation: Industrial Research and Standards Act 1946. Industrial Research and Standards Bill 1946

² NAI DIC TIC 33345/21 Institute for Industrial Research and Standards Request by Industrial Research Committee for enquiry into shortage of scientific manpower in Ireland

³ NAI DI&C TIC 33345/21; NAI DFA 305/57/67/19/1 part 1 O.E.E.C. Scientific and Technical Manpower Programme

⁴ NAI DFA 305/57/67/19/1 part 1: O.E.E.C. Scientific and Technical Manpower Programme. Exploration by OEEC of the possibility of setting up a free trade area that would encompass both the customs union of the European Economic Community (EEC) and the organisation's eleven other member states had spawned three OEEC working parties by the time the Treaty of Rome was signed in the Spring of 1957. One of these – Working Party 23 - dealt with countries in the process of economic development. Irish efforts during 1957-58 focused on establishing a claim to come within this category and on formulating a common position with Greece and Turkey. The OEEC free trade area negotiations broke down at the end of 1958 (see Maher 1986: 51-88)

⁵ NAI DFA 305/57/67/19/1 part 1 O.E.E.C. Scientific and Technical Manpower Programme

⁶ NAI DFA 305/57/67/19/7 Annual Review - Scientific and Technical Personnel

⁷ NAI DFA 305/57/67/19/10 OEEC Scientific Cooperation Visit to Europe of Mr. L.D. Wilgress 1959

⁸ NAI DFA 305/57/67/19/7 Annual Review - Scientific and Technical Personnel

⁹ T. O'Raiheartaigh to T.K. Whitaker, 8 November 1961, NAI DF 2001/3/775 Proposed pilot study of future educational needs with Organisation for Economic Cooperation and Development assistance

¹⁰ Ibid.

¹¹ NAI DIC R303/8/4 Irish National Productivity Committee, Minutes of Meeting No. 19, 16 December 1960

¹² TCD Library, T.W. Moody Papers Ms. 7121 Commission on Higher Education, Minutes of Plenary Meetings, Vol. 1, Second Meeting, 13 January 1961

¹³ TCD Library, T.W. Moody Papers Ms. 7121 Commission on Higher Education, Minutes of Plenary Meetings, Vol. 1, Tenth Meeting, 4 September 1961

¹⁴ NAI DFA 305/57/67/19/7 Annual Review - Scientific and Technical Personnel

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- ¹⁵ NAI DF 2001/3/546 Organisation for Economic Cooperation and Development policy conference at Washington October 1961 on economic growth and investment in education: Irish representation
- ¹⁶ NAI DF 2001/3/775 Proposed pilot study of future educational needs with Organisation for Economic Cooperation and Development assistance
- ¹⁷ DDA, Archbishop John Charles McQuaid Papers AB8/B/XXXX/d Committee on the Public Image of the Church
- ¹⁸ DDA, Archbishop John Charles McQuaid Papers AB8/B/XXXX/d Studies
- ¹⁹ NAI DFA 99/3/178 Pilot teams to study the needs for scientific research and technology in relation to economic growth
- ²⁰ NAI DF 2001/3/417 OECD conference of Ministers for Science: Inter-departmental science group
- ²¹ NAI DF 2001/3/415 Organisation for Economic Cooperation and Development Committee for Scientific Research: Pilot study of scientific research and technology needs in relation to economic growth
- ²² NAI DF 2001/3/417 OECD conference of Ministers for Science: Inter-departmental science group
- ²³ NAI DF 2001/3/417 OECD conference of Ministers for Science: Inter-departmental science group: NAI DETE 2000/13/26 Minutes of Industry and Commerce departmental conferences, No. 806, 15 March 1965
- ²⁴ NAI DT 96/6/80 O.E.C.D. Scientific Research: National Science Council: Establishment
- ²⁵ NAI DFA 99/3/178 Pilot teams to study the needs for scientific research and technology in relation to economic growth
- ²⁶ Ibid.
- ²⁷ NAI DT 98/6/682 O.E.C.D. Scientific Research: National Science Council: Establishment
- ²⁸ T. O’Raifeartaigh to T.K. Whitaker, 4 Bealtaine 1962, NAI DF 2001/3/775 Proposed Pilot Study of Future Educational Needs with Organisation for Economic Cooperation and Development Assistance

REFERENCES

- BOWMAN, J. (1993) “‘The Wolf in Sheep’s Clothing’: Richard Hayes’s Proposal for a new National Library of Ireland, 1959-60” pp. 44-61 in R. Hill and M. Marsh (eds.) *Modern Irish Democracy: Essays in Honour of Basil Chubb* Dublin: Irish Academic Press
- BURKE, A. (1990) “Trinity College and the Religious Problem in Irish Education” pp. 95-126 in J. Kelly and U. MacGearailt (eds.) *Dublin and Dubliners* Dublin: Helicon
- DEPARTMENT OF EDUCATION (1965) *Investment in Education* Dublin: Stationery Office
- DEPARTMENT OF FINANCE (1963) *The Second Programme for Economic Expansion* Dublin: Stationery Office
- DEPARTMENT OF INDUSTRY AND COMMERCE (1966) *Science and Irish Economic Development* Dublin: Stationery Office
- GEIGER, R.L. (1997) “What Happened After Sputnik? Shaping University Research in the United States” *Minerva* Vol. 35, pp. 349-367

-
- GODIN, B. (2002) "The Numbers Makers: Fifty Years of Science and Technology Official Statistics" *Minerva* Vol. 40, pp. 375-397
- KRIGE, J. (2000) "NATO and the Strengthening of Western Science in the post-Sputnik Era" *Minerva* Vol. 38, pp. 81-108
- LYDON, J. (1992) "The Silent Sister: Trinity College and Catholic Ireland" pp. 29-53 in C.H. Holland (ed.) *Trinity College Dublin and the Idea of a University* Dublin: Trinity College Dublin Press
- LYNCH, P., And J. VAIZEY (1960) *Guinness's Brewery in the Irish Economy 1759-1876* Cambridge: Cambridge University Press
- MAHER, D.J. (1986) *The Tortuous Path: The Course of Ireland's Entry Into the EEC, 1948-73* Dublin: Institute of Public Administration
- MULCAHY, D. (1992) "Cultural Strangers and Educational Change: The OECD Report Investment in Education and Irish Education Policy" *Journal of Education Policy*, Vol. 7, No. 5, pp. 445-469
- MURRAY, P. (2005) "Ireland and the Productivity Drive of Post-War Europe" pp. 66-81 in B. Girvin and G. Murphy (eds.) *The Lemass Era: Politics and Society in the Ireland of Sean Lemass* Dublin: UCD Press
- O'BUACHALLA, S. (1996) "Investment in Education: Context, Content and Impact" *Administration* Vol. 44, No. 3, pp. 10-20
- O'CONNOR, S. (1968) "Post-Primary Education: Now and in the Future" *Studies*, Autumn 1968 pp. 233-249
- O'CONNOR, S. (1986) *A Troubled Sky: Reflections on the Irish Educational Scene 1957-1968* Dublin: St. Patrick's College Education Research Centre
- PAPADOPOULOS, G. (1994) *Education 1960-1990: The OECD Perspective* Paris: OECD
- VAIZEY, J. (1986) *Scenes from Institutional Life and Other Writings* London: Weidenfeld and Nicholson
- WALSH, J. (2005) "The Politics of Educational Expansion" pp. 146-165 in B. Girvin and G. Murphy (eds.) *The Lemass Era: Politics and Society in the Ireland of Sean Lemass* Dublin: UCD Press
- WHELAN, B. (2000) *Ireland and the Marshall Plan, 1947-57* Dublin: Four Courts Press
- WHITE, T. (2001) *Investing in People: Higher Education in Ireland from 1960 to 2000* Dublin: Institute of Public Administration
- WHYTE, J.H. (1980) *Church and State in Modern Ireland 1923-1979* Dublin: Gill and Macmillan
- YEARLEY, S. (1995) "From One Dependency to Another: The Political Economy of Science Policy in the Irish Republic in the Second Half of the Twentieth Century" *Science, Technology and Human Values* Vol. 20, No. 2, pp. 171-196