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Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments
The "POLICY MIX" Project

Country Review

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Introduction and Policy mix concept

The policy mix project

This report is one of the 31 country reviews produced as internal working papers for the research project "Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments" (Contract DG-RTD-2005-M-01-02, signed on 23 December 2005). This project is a research project conducted for DG Research, to serve as support for policy developments in Europe, notably in the framework of CREST activities. It does not form part of the ERAWATCH project, but the working documents are made available on ERAWATCH webpages for the purpose of steering a debate on the policy mix concept.

The "Policy Mix" project is run by a consortium of 7 partners:

- UNU-MERIT (The Netherlands), consortium leader
- Technopolis (The Netherlands)
- PREST – University of Manchester (United Kingdom)
- ZEW (Germany)
- Joanneum Research (Austria)
- Wiseguys Ltd. (United Kingdom)
- INTRASOFT International (Luxembourg).

Each country review is produced by an individual author, and provides expert's view on the policy mix in the country. This report is not approved by the Commission or national authorities, and is produced under the responsibility of its author.

The role of country reviews is to provide an exploratory analysis of the current policy mixes in place in all countries and detect the most important areas of interactions between instruments as well as new modes of policy governance that are particularly adapted (or detrimental) for the building of policy mixes. They provide analytical material for the analysis of the policy mix concept and its implementation in Europe. This material will be used as background for further reports of the project and for the construction of a tool for policy-makers (to be made available in late 2007 and 2008).

The policy mix concept

The country reviews are based on the methodological framework produced by the consortium to frame the "policy mix" concept. They have been implemented on the basis of expert assessments derived from the analysis of National Innovation Systems characteristics and policy mix settings, using key information sources such as Trendchart and ERAWATCH reports, OECD reviews, and national sources, among which the National Reform Programmes.

In this work, the "policy mix for R&D" is defined by the consortium as: **"the combination of policy instruments, which interact to influence the quantity and quality of R&D investments in public and private sectors."**

In this definition, policy instruments are: "all programmes, organisations, rules and regulations with an active involvement of the public sector, which intentionally or unintentionally affect R&D investments". This usually involves some public funding, but not always, as e.g. regulatory changes affect R&D investments without the intervention of public funds.

Interactions refer to: "the fact that the influence of one policy instrument is modified by the co-existence of other policy instruments in the policy mix".

Influences on R&D investments are: "influences on R&D investments are either direct (in this case we consider instruments from the field of R&D policy) or indirect (in that case we consider all policy instruments from any policy field which indirectly impact on R&D investments)".

Structure of the report

The report is structured along the following questions.

First, in section 1, and in order to place the policy mix in context, the general challenges faced by the National Innovation System (NIS) are analysed by the expert. The view is here not restricted to the challenges with regard to raising R&D investments, but rather encompasses all the conditions that directly or indirectly affect the functioning of the NIS and R&D expenditures. These context conditions are very important for the discussion of the relevance of the policy mix later on.

Second, the stated main objectives and priorities of R&D policy in the country are spelled out in section 2, as well as their evolution over the last ca. five years. This discussion is based on White Papers and official documents, i.e. on published policy statements. The reality of these objectives compared to actual working of policy instruments will appear in section 5.

The third section provides an expert assessment and critical analysis of a possible gap or convergence between the NIS challenges and the main policy objectives and priorities stated before.

Section 4 presents the policy mix in place, following the above definition, i.e. policy instruments affecting R&D activities in the private and in the public sector, either directly for instruments from the R&D policy domain, but also indirectly for instruments outside the R&D domain which are of particular relevance to R&D activities. A typology of instruments is used, to categorise the R&D-specific and non-R&D specific instruments. A short description of each instrument is provided: aim, nature, target group, budget.

Then, section 5 discusses whether there is a gap between the main policy objectives and priorities stated in section 2, and the instruments in place. This is done by

comparing the set of objectives with the set of instruments at work. When individual evaluations of programmes or policy instruments are available, their results are used if they shed light on contribution of these instruments towards the policy objectives.

Section 6 discusses the orientation of the policy mix, indicating priorities amongst various possible routes to increase R&D investments. Policy instruments are categorised under 6 different routes according to their relevance, and this categorisation is followed by a discussion on the range of instruments affecting each route, missing instruments, routes that are not addressed by instruments, possible redundancies or overlaps, etc.

Section 7 provides another view on the policy mix, focusing on the relative importance of each types of instruments. The aim is to get a picture of the policy mix, the balance between (sets of) instruments, and the relative weight between them.

From section 8 onwards, the review turns to the crucial question of policy governance. That section discusses the emergence of the policy mix through examination of the following question: how did the set of R&D policy instruments arrive ? What is the rationale behind them, what were the driving force behind their establishment, and how is this evolving recently. A crucial question relates to the existence of some consideration of possible interactions when establishing new or suppressing existing instruments. The section tries to establish whether the policy design process is incremental or radical, analytical or non-analytical. From this, that section discusses if the policy mix is a “construct” or an “ex post” reality.

The next section, section 9, focuses on the governance of the system of R&D policy instruments take place. It examines the key question of interactions, i.e. whether there is a form of co-ordination between R&D policy and policy instruments from outside the R&D domain, and the existing mechanisms that favour or hinder such interactions.

The final section, section 10, deals with the core question of the policy mix concept: it endeavours to discuss interactions between policy instruments to affect R&D expenditure. The section discusses possible positive, neutral and negative effects of R&D policy instruments; both within the R&D policy domain, but also with instruments from other policy domains. In most cases, this takes the form of hypotheses rather than hard evidence.

Feedback welcome

Feedback on this report is gladly received. Individual country reports will not be updated but discussion on policy mixes is welcome during the timeframe of the study (2006-2008). Please send your comments to:

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1. National Innovation Systems Challenges

In this section the main challenges to the Japanese NIS with respect of R&D intensity are outlined. On the basis of policy documents and external assessments, three areas can be viewed as challenges:

1) Return on Investment in R&D

2) Human Resources for R&D

3) Industrial R&D Performance

We will discuss each of these points and then relate these to the types of instruments outlined in the methodological report. We wil also outline how these issues have shifted into focus in the period since 2001.

Challenge 1: ***Human Resources in R&D***

Human resource related challenges are an important issue confronting the Japanese innovation system. These relate to the education system, the ability to transfer between different sectors of the economy, for instance from universities to industry or vice versa, managerial and administrative recruitment in Independent Administrative Institution (IAIs) and National Universities. The issue also touches upon key issues facing the Japanese economy, chief of which are demographic issues due to the declining population. The Ministry of Economy Trade and Industry (METI) have observed that by 2020 there will have been a 31% decrease in the young working population (METI 2006). Other issues relate to this, such as the ageing population and issues surrounding those able and fit to work, but who refuse to do so. Those not in employment, education or training, referred to as 'NEETs', are seen as a policy problem by many (see METI (2006b)).

In terms of human resources for science and technology related activities, challenges cover research training and managerial capabilities. At the research level, while funding support for doctoral and postdoctoral students has increased and targets have been set for the number of postdoctoral students over the course of the first (1996-2000) and second (2001-2005) Science and Technology Basic Plans (10,000

postdoctoral researchers). Commentary and surveys suggest that many doctoral and postdoctoral researchers are uninterested in pursuing careers outside of academia and working in industry. It is felt by many that a broader range of experiences are desirable for those in advanced education (NISTEP 2005a) enabling them to move between different employment sectors, where such movement is currently very small. In 2003, 1,172 researchers moved from industry to universities, 367 researchers moved from universities to industry (NISTEP 2005b: 57). Other survey findings suggest that many companies report a mismatch between skill requirements and skill supply for companies, where dissatisfaction exists by industry on the skills and knowledge of university graduates (see also IMD 2006).

Further challenges relate to the composition of the research base. In light of population decline, increasing participation by females and researchers from overseas is gaining prominence. This is applicable across all research sectors in the economy. For 2004, within the business enterprise sector 6.4% of researchers are female. In the government sector, 12.2% of researchers are female. In the higher education sector, 21.1% are female. Foreign researchers also comprise a small component of the Japanese research labour market and where the USA, UK and France have 35.7%, 28.5% and 21.1% of their researchers coming from overseas, Japan has 13.7% (NISTEP 2005).

At the managerial level, recent reforms to public research institutions and national universities through the Independent Administrative Institution Law (1999) and National University Incorporation Law (2003) respectively have seen former government agencies and national universities gain greater independence from government in order to set their own managerial policy and institutional strategy. Formerly classified as civil servants, personnel in IAIs and universities lacked experience of managerial skills, experience of financial management and decision making that has placed new pressures on how IAIs develop new managerial systems, develop strategy and financial practices in the new policy environment (Kobayashi and Okubo 2004). Furthermore, the recruitment of such talented personnel from other sectors of the economy has been limited by wider issues in the policy system such as regulations governing pension transferability (OECD 2006) and costs associated with transfer (CSTP 2006; ESRI 2006).

In sum, these issues place emphasis on policy issues related to fully exploiting current human resources, issues surrounding the recruitment of talent from overseas, and amending regulations and policies that currently limit personnel transfer between different sectors of the economy.

Challenge 2: Return on Investment in R&D

Following the introduction of the Science and Technology Basic Law in 1995 (Law 130) the Japanese government increased funding for science and technology to 24 trillion Yen to 2011 (160 Billion Euro[1]) (1% of GDP per year, of which the nominal growth rate is 3.5%). This has been implemented through three basic plans running from 1996-2001, 2001-5, and 2006-2010. The plans have prioritised nanotechnology and materials, the life sciences, information and communications and the environment. The funding has also seen investment in the public research infrastructure in Japan.

Despite increases in the budget for science and technology, studies have suggested that the return on investment hyas so far been quite weak. The Annual Report on the Japanese Economy and Public Finance published by the Cabinet Office (2005) suggested that the effectiveness of budget use was lower than that elsewhere. An OECD study performed in 2005 found similar results with respect of R&D outputs (OECD 2005). Furthermore, a recent paper by Hayashi and Tomizawa (2006) noted that the overall share of highly cited papers is low and concentrated in a select core of institutions.

It may be worthwhile observing that the investments made by the Japanese government have only been implemented within the period since 1995 and it may be too early to accurately assess the overall return on investment at this stage, where a longer term view may be more desirable. Nonetheless, there may be some dynamic underlying this issue, with the Council for Science and Technology Policy (CSTP) recently outlining efforts to improve efficiency in spending rather than focusing mostly upon spending targets (CSTP 2006).

In sum, this second challenge places emphasis on the means by which results can be generated, publicised and economically exploited.

[1] 1 Euro = 149.5 Yen (August 2006)

Challenge 3: Industrial R&D Performance

As of 2004, 74.8% of GERD is performed by industry in Japan. Considering this importance, industrial R&D activities are a key element of the innovation system. However, where BERD is considered, 98.1% is financed by industry, with 1.1% financed by government. Over the course of the 1980s and 1990s, where the Japanese economy was beset by slow economic growth and high levels of corporate debt, a number of studies suggested that total factor productivity (TFP) at the macro level had decreased, particularly in the manufacturing sector. Differences in TFP growth were observed between firms that embarked upon internationalisation of activities and those that focused principally upon the domestic market (Fukao and Kwon 2005). While TFP growth has increased over recent years across most sectors of the economy due to greater product market competition, openness, and R&D (IMF 2006), concern remains surrounding the idea of a 'dual Japan' where some industries are internationally competitive, such as electrical machinery, automobiles and instruments, while others are more domestic oriented and less competitive, such as those in the food, lumber and fabricated materials sectors (Motohashi 2006). Competitive pressures in key sectors such as electronics, manufacturing, with competitors from other countries, particularly in Asia is a key challenge facing Japanese industry and the national innovation system, with policy makers citing the importance of an economy driven by the 'twin-motors': manufacturing and services (METI 2006). In particular, innovation in services have been seen as an area requiring greater effort.

In sum, the main challenges relate to maintaining or increasing productivity and competitiveness across all sectors of the economy. How the government can influence this is a major issue however. The proportion of BERD financed by government in 2003 was 0.8% in 2003, having declined from 1.1% in 1996. This places emphasis on framework conditions in terms of regulatory frameworks, human resources and other factors, rather than governmental expenditures and incentives, which are constrained by levels of public debt held by the Japanese government (Ministry of Finance 2006).

Range of Instruments in Relation to the Challenges Facing the Japanese NIS

What is clear from the above is that many of the factors shaping the challenges confronting the Japanese NIS span domains outside of the traditional R&D Policy

Domain identified in the Methodological report. For instance, the Finance Domain, Human Capital Domain and Innovation Domain were all prominent in our above discussion (2006: 16).

With regard to **Human Resources in R&D**, the main relevant instruments would appear to be:

- R&D Specific Education Policy
- R&D Specific Employment Policy
- Education Policy
- Employment Policy
- Immigration Policy
- Sexual Equality/Age Discrimination Policy

With regard to **Return on Investment in R&D**, the main instruments cover:

- R&D Policy (Public and Private Sectors)
- Sectoral Policies
- R&D Specific Fianance Measures
- IPR Policies
- Innovation Policy

Regarding **Industrial R&D Performance**:

- R&D Policy (Private Sector)
- R&D Specific Finance Policy
- Sectoral R&D Policy
- Linkage Policy
- Industry Policy
- Trade Policy
- Macroeconomic Policy
- Finance and Fiscal Policy

Indirect areas relate in particular with Challenge 1. With Challenge 2, the range of relevant instruments are more R&D specific; this can also be argued with respect of Challenge 3, which relates more closely to standard R&D policy and concerns with industrial innovation.

Development of the Challenges since 2001

In terms of changes since 2000/1, Challenge 1, **Human Resources in R&D**, has been a longstanding issue, but has particularly come into prominence as the scale of demographic challenges facing Japan have begun to be realised, as investments in R&D have sought to promote postdoctoral careers, and as the links and scale of transfer between different sectors of the economy have been realised (NISTEP 2005). Challege 2, concerning the **Return on Investment in R&D,** expenditure has only recently gained prominence in the policy community as analysts have began to look at the investments made since the introduction of the science and technology basic plans, since 1995. Challenges surrounding **Industrial R&D Performance** prevailed throughout the 1990s. Since the beginning of the economic recovery, in tandem with issues surrounding human resources, productivity across the economy has become more important.

2. Objectives and priorities of R&D policy

Here the main objectives and priorities of R&D policy in Japan are reviewed. Similar to Section 1, these objectives and priorities are derived from discussion in policy forums, such as the CSTP, and various policy reports and documents. The priorities and objectives can be identified as: 1) Enhancement of the Research System; 2) Seeking a Return on R&D Investments; 3) Human Resource Development; 4) Globalisation and Internationalisation; 4) Protection of and Security from Natural, Social, Environmental and Economic Issues. In some respects the objectives and priorities listed below are overlapping. We will note that many of these objectives predate 2001 and that there is some stability in the existence of these priorities.

- *Developing Measures for Economic Exploitation of the Research Infrastructure*

  This includes seeking to enhance the protection of intellectual assets and the efficiency of allocating rights; developing deeper and wider linkages between

the public and private research sectors; and using deregulation zones to test-bed regulatory reforms and set targets for the number of spin-out companies.

- *Enhancement of the Research System*

  This includes expanding public financing of science and technology, allowing greater institutional autonomy to allow responsiveness to organisational needs and prioritising funding allocations to certain research areas.

- Developing Human Resources

  Objectives have recently broadened to personnel involved in intellectual property; broadening the range of experience for those in graduate school. Current discussion at the policy level relates to expanding opportunities for female researchers and extending the permissible length of stay for researchers from overseas.

- Responding to Globalisation and Internationalising the Research System

  Here there are two main issues such as responding to competitive pressures from other parts of Asia, and changing the structure of the Japanese research system to make it more international in terms of research personnel and engagement with overseas research institutes.

- Protection of and Security from the Natural Environment

  Key issues that call on the uses of science and technology can be summarised as addressing environmental problems such as global warming and ozone depletion; energy and resource use and efficiency, aging of the population, decreasing population, social infrastructure and protection from extreme weather such as typhoons, and earthquakes, all of which regularly affect Japan.

Changes in Priorities and Objectives since 2001

The Enhancement of the Research System, Globalisation and Internationalisation of the Research Environment and Protection and Security from the Natural Environment have all featured as long term priorities of Japanese innovation policy. Only more recently has discussion surrounding the Basic Law began to place more emphasis on the types of economic returns occurring from the investments in science and technology.

3. Coherence between NIS challenges and R&D objectives and priorities

Table 1 summarises the main challenges and the main priorities for the Japanese NIS.

Table 1: Summary Overview of Challenges and Priorities	
Challenges	**Priorities**
• Return on Investment in R&D • Human Resources for R&D • Corporate R&D Activities	• Measures for Economic Exploitation of the Research System • Enhancement of the Research System • Developing Human Resources • Globalisation and Internationalisation • Natural, Social, Environmental and Economic Support

The objectives and priorities outlined are broadly compatible. Many of the challenges appear to have been acknowledged by policy makers and are in the process of being addressed or are awaiting implementation, as we will observe in Section 4, Section 5 and Section 6.

4. Composition of the policy mix for R&D

Here we will look at the range of policy instruments that are in place aiming at affecting R&D activities in the private and the public sector. Instruments which impact upon the public sector are first presented. Instruments that influence both public and private sectors are then outlined. Finally, instruments that influence the private sector are then reviewed. We will take into account instruments outside the R&D domain.

R&D Policy Instruments for the Public Sector Only

Public sector relevant instruments are: institutional reform policies, human resource policies, and, R&D evaluation policies.

Institutional Reform

Organs that were previously part of the government have been granted greater autonomy on the basis of the Independent Administrative Institution (IAI) Law

(1999) and the National University Incorporation Law (2003). 109 IAIs exist (2005) and each organisation now has its own financial management, strategic control which is set out in medium-term-plans (6 Year statements of Objectives and Plans), and organisational flexibility through ability to reform internal administrative structures without prior governmental approval. The incorporation of the National Universities has followed a similar policy framework to that of IAIs (Yamamoto 2004) with the use of medium term plans, financial autonomy, outsider participation in management and the ability to undertake organisational reform without governmental approval. The national universities will face a 1% annual cut in their operating grants, to stimulate managerial and organisational efficiency. The significance of these reforms relate to the likelihood of promoting greater institutional diversity, where institutions will respond to their particular strengths or market niches. Commentary surrounding the incorporation of the national universities has also suggested that the reform may introduce a more competitive environment to the Japanese higher education system where institutions compete for competitive research grants, students and faculty.

This process has been supported by the expansion of competitive research funds through such programmes as Grants in Aid for Scientific Research, Strategic Creation Research Promotion Programmes operated by the Japan Science and Technology Agency, Science and Technology Promotion Coordination Fund and 21st Century Center of Excellence Programme. There are also a range of other smaller programmes outlined in Table 3 below.

Human Resources

A number of policies have been introduced to support the development of human resources. These include PRESTO, ERATO, and CREST, provided by the JST. Other schemes are also in place by the Japan Society for the Promotion of Science (JSPS) which include prizes for younger researchers, doctoral and postdoctoral fellowships. The increased use of competitive research funds such as Grant-in-Aid provide wider opportunities for researchers to establish their research reputations. Other programmes are being introduced to provide internships, develop transferable skills or skills for managing technologies through the Management of Technology Programme. With regard to internationalisation, Postdoctoral Fellowships for Foreign Researchers, short-term, invitation fellowships, summer programmes, fellowships for young researchers operated by the Japan Society for the Promotion of Science (JSPS) are all

in place. Other research programmes are open to foreign candidates or specifically try to link up with and form relations with other research groups overseas, such as the Core-to-

Evaluation Systems

Universities, IAIs and Governmental ministries are now obliged to participate in evaluation of programmes and projects, as well as policy evaluation. The evaluation system has developed over the 1990s and the early part of this decade through developments at the Ministry of Internal Affairs and Communications (SOUMU) and through Cabinet Office decisions as means of complementing objectives set out in the Science and Technology Basic Law and Basic Plans. Universities are also subject to evaluation by specific evaluation organisations such as the National Institution for Academic Degrees and University Evaluation (NIAD-UE) and third party committees that evaluate teaching and managerial aspects.

R&D Policy Instruments affecting the Public and Private Sectors

Policy measures here are university-industry links, research programmes, intellectual property policy, human resources, policies to promote international competitiveness, and venture companies.

University-Industry Linkage Policy

Over the late 1990s, the government began to introduce policies to promote university-industry links. In 1998, the Technology Transfer Law (Law Number 52) allowed Technology Licensing Offices to License University technologies to industry.The 1999 Industrial Revitalisation Plan introduced the Japanese version of the Bayh-Dole Law whereby ownership of intellectual property could rest with the university. The major change in the process was not until the passage of the National University Incorporation Law however. A raft of other reforms have introduced procedures for managing collaborative research, creating wider incentives to participate in such activities, and allowing university professors to serve on company boards, amongst other initiatives (NISTEP 2005c: 48-49).

A number of research initiatives emphasize university-industry collaboration, such as the Creative Research Strategic Research Promotion Initiative operated by the Japan Science and Technology Agency (JST), including the CREST, PRESTO and ICORP

initiatives. Other Ministries and Agencies also maintain special programmes that support such interaction, for example the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Fire and Disaster Management Agency, and the Okinawa Development Corporation (see Cabinet Office 2006). Funding support for industry has been developed to support industrial collaboration with universities in areas such as collaborative and contract research, but also staffing, training and some institutional costs (see: METI 2005; MEXT 2006).

The influence of these various instruments appears to be influencing joint activities. The number of joint collaborative contracts between national universities and industry has increased from around 3000 cases in 1999 to over 9000 cases in 2003. Contract research cases have increased from around 6000 cases in 1999 to around 7000 cases in 2003. The number of domestic patents held by universities has increased from 200 in 1999 to around 900 in 2003 (all data: MEXT 2004b). Debate continues in some circles over the desirability of the formalized processes introduced by government vis-à-vis the more informal system that used to characterise relationships between universities and industry, and this is discussed at greater length in Section 8.

Research Programmes

The Science and Technology Basic Law prescribes the basic policy requirements for the promotion of science and technology (excluding the humanities) and for comprehensively and systematically promoting policies for the progress of science and technology. The Science and Technology Basic Plans, implemented on the basis of the Law, have prioritized four main areas for research funding. Major elements of this funding are implemented by various research agencies such as the JST or the JSPS through open calls for participation. Research programmes include Grants-in-Aid for scientific research, programmes such as ERATO, PRESTO, SORST, operated by the JST; the Strategic Information and Communications R&D Promotion Programme (SCOPE), operated by SOUMU. METI has promoted 7 sectors that include: fuel cells; information electronics; robotics; contents; health and welfare instruments services; the environment and energy instruments services; business services. Other research programmes relevant to the public and private sectors include the Research and Technologies for the Evaluation of Foodstuffs and their Health Benefits (Food Safety Commission); Fire and Disaster Management Agency Science and Technology Promotion System (FDMA) or schemes operated by the Ministries of

Health, Labour and Welfare (MHLW); the National Agriculture and Food Research Organization (NARO), amongst other agencies (see CSTP 2006). The proportion of competitive funds has increased to around 10% of the science and technology budget. By international standards, however, this level is still quite low, with the suggestion made by some that the overall level increase.

Intellectual Property Related Instruments

The Basic Law on Intellectual Property (2002, Law 122) has seen the Japan Patent Office (JPO) establish various strategy groups for measures to accelerate the patent application process, to assist in the establishment of developing organisational capacity for managing intellectual property in universities, and through adopting various amendments in relevant patent laws. Major activities surrounding patent law can be summarized seen as the Creation of Intellectual Property Strategy Headquarters (2003), amendments of the Patent Law and other laws in 2003, leading to a review of the patent fee system, unification of oppositions and trials for invalidation, review of the unity requirements, deletion of provision on the designated nations in the Patent Cooperation Treaty (PCT). Law Amendment to Expedite Patent Examination for increasing the use of outsourcing for prior art searches, increasing the attractiveness of the utility model system, revision of the employee invention system. The Intellectual Property Strategic Programme (2004) set out to reduce the waiting time for patent examination to within 30 months by 2008 and 11 months by 2013. To achieve these aims the JPO has been expanding the number of examiners and seeking to develop human resource capacity through training programmes. The JPO has also begun to increase the use of outsourcing patent searches to make the patent application process more efficient. The *Comprehensive Strategy for Personnel with Intellectual Property Skills* published by the Cabinet Office in January 2006 has developed three relevant objectives. These cover: 1) increasing the number and quality of those involved with intellectual property; 2) nurturing and enhancing the quality of IP management; and, 3) raising consciousness surrounding IP issues amongst the general population (Cabinet Office 2006:8).

Human Resources

Some steps for promoting greater mobility have been taken through the Fixed Term Employment System for researchers introduced in 1997. The JST has also launched

the Japan Research Career Information Network (JREC-IN) service which provides information on recruitment opportunities in the research field. This is intended to reduce laboratory 'in-breeding'. Attention is also focused upon developing opportunities for skill replenishment through the provision of external courses (CSTP 2006; METI 2006). Measures to broaden the skill base of researchers and broaden career opportunities beyond academia are proposed by business representative organisations (Keidanren 2005) and have featured in government analysis (CSTP 2006) in particular with reference to the removal of the economic costs faced by researchers moving between different organisations.There has been steady movement towards developing opportunities for students to develop wider skills and experiences outside of academia through the development of internship programmes. These began to be developed from 1996 and have increased where the majority of universities now provide such opportunities (MEXT 2004). More recently these measures have been extended to the postgraduate levels

Industrial R&D and Competitiveness

In 2006, the METI launched the New Economic Growth Strategy which, amongst other things, covers this issue and sets out strategies to develop personnel, regional issues, competitiveness, productive capacity.

Venture Capital Financing

A dearth of capital funds to support venture companies have been acknowledged. Venture capital funds are amongst the lowest in the OECD, especially in areas related to health and biotechnology (OECD 2005: 128). The Japanese government has sought to expand the available funding for such initiatives over concern with the 'valley of death' which characterises the period between the initiation of the company and the launch of products. Such programmes include the Industrial Technology Research Support Fund operated by NEDO; Business Development Fund; New Industry Creation Subsidy for Regional Research Activities, amongst other programmes. Where the policy mix for this may be of relevance is in the privatisation of the Japan Post Office, which was vigorously proposed by the Koizumi Administration. Reform of the post office could be replaced by a more diverse range of providers, provide better services, pay corporate taxes, from which it is currently exempt, and introduce

more efficient government. Privatisation of the post office may also provide greater fluidity in credit markets through promoting private banking institutions.

R&D Policy Instruments for the Private Sector Only

Regarding policy instruments relevant to the Private Sector, the following instruments are presented: the R&D Tax credit; subsidies and research grants; and, SME policies.

R&D Tax Credit

A proportional R&D Tax Credit was introduced by the Ministry of Finance in 2003 as an alternative to the existing R&D tax credit scheme. It comprised a proportional R&D tax credit of 8% (applicable only for FY 2003 to FY2005), plus 2% for corporations with a higher proportion of R&D expenses. For R&D activities conducted by SMEs, a proportional tax credit of 12% plus 3% was introduced (applicable only for FY 2003 to FY 2005). For R&D activities conducted jointly by academic, business and government circles, or R&D commissioned by the government in order to promote basic studies or innovative studies, a proportional tax credit of 12% plus 3% was introduced (again applicable only for FY 2003 to 2005). The scope of qualified R&D expenses included such expenses as labour, non-personnel expenses, depreciation for machinery and buildings, and expenses of R&D activities conducted overseas. The amount of the R&D tax credit is not allowed to exceed 20% of the amount of corporation tax. The amount of the R&D tax credit exceeding this ceiling may be carried-over for one year under certain conditions.

Research Programmes

Various programmes have been developed by Ministries to support private sector research activities. In 1999, a Japanese version of the US Small Business Innovation Research (SBIR) Programme was established for supporting R&D activities by SMEs through contract research grants and subsidies. Seven Ministries are involved in the programme which also includes IAIs. Low interest loans are available as well as a loan guarantee programme. Other programmes include the Advanced Technology Research Support programme, operated by the National Institute of Information and Communications Technology. Funding expansion for environment and life science fields, and industrial R&D activities has increased through the science and technology basic plans, and corporate research appears to be expanding into areas related to

energy saving electrical equipment, use of alternative power sources in automobiles or domestic use, as well as innovative food products that utilize bio properties.

Small and Medium Sized Enterprises

METI supports the development of SMEs based on measures in the following four areas: (1) support for start-ups and SMEs entering new business, (2) development and use of human resources at SMEs, (3) diversification and facilitation of SME finance and support for revitalization of SMEs, through the use of research grants such as the Small Business Innovation Research Programme and other programmes (4) revitalization of shopping districts and city centers (METI 2005). A special SME Revitalization Council has also been established. Various measures have been established to support regional activities, as well as the initiation of Special Zones for Structural Reform. These include industrial clusters targeted at specific areas (e.g. environment, manufacturing, health) in the Industrial Cluster programme (19 projects supported by (METI) since 2001); joint regional projects that include universities and industry (48 projects supported by (MEXT) since 2000); and knowledge clusters (initiated by MEXT in 18 regions since the inception of the programme in 2002). Other programmes are supported by the Ministry of Agriculture, Fisheries and Food (MAFF) (54 projects selected since 2001), the Ministry of Environment (which has supported regional projects since 1993), and the Ministry of Internal Affairs and Communications (SOUMU). Many of these programmes are implemented through regional offices for the Ministries in collaboration with local government and industry.

One aim of the Second Science and Technology Basic Plan was to promote science and technology in each geographic region. The Third Science and Technology Basic Plan continues this theme, stating that “the promotion of S&T in regions contributes to building regional innovation”. The main means through which these activities are implemented is through the promotion of regional clusters and S&T policies in the regions.

Table 2: Policy mix for R&D in Japan

Policy categories	Policy instruments: short description and target group
R&D Domain	
R&D policy generic	• **Science and Technology Basic Law** Allowed for the introduction of the Science and Technology Basic Laws (1996-2000; 2001-5; 2006-2010) • **Third Science and Technology Basic Plan (2006-2010)** *Prioritisation of four primary and four secondary fields: Nanotechnology and materials, life sciences, energy and environment, information and communications.* • **Grants in Aid for Scientific Research (JSPS/MEXT)** *Competitive grants for scientific research for national universities, private universities, industry, national research institutes* • **Strategic Creative Research Promotion Programmes (JST)** *Includes programmes operated by the Japan Science and Technology Agency such as ERATO, PRESTO, ICORP, CREST, SORST aimed national universities, public research institution, companies, independent research institutions* Targets: Universities, IAIs, Companies • **Science and Technology Promotion Coordination Fund (MEXT)** *Comprehensive research budget for use by universities, national research institutes, independent administrative institutions, companies*
R&D policy sectoral	• **Technology Strategy Map (METI)** • **21st Century Centre of Excellence Programme (METI)** *To support centres of research excellence in universities for a period of five years.* • **Technology Research Promotion Activities (MEXT)** Nanotechnology, life sciences based on societal needs, next generation IT. Target Groups: University-industry Collaboration • **Earth Observation Satellite Construction Plan (MEXT)** Technological promotion activities targeted to universities, IAIs, companies. • **Advanced Measurement Analysis Techniques Development (JST)** *Targetted to universities, IAIs, companies.* • **Creative Reform for Technological Development (JST)** Targeted to companies; it is possible for research teams to comprise members from universities, IAIS.
R&D / Innovation policy – Linkage	• **Technology Transfer Law (1998)** Allowed Licensing Offices to license technology to Technology • **Industry Revitalisation Special Measures Law (1999) (METI)** • **Okinawa Industrial Promotion Fund** Promotion of University-Industry Links in Okinawa (Okinawa Industrial Promotion Public Corporation) • **University Venture Business Creation Application Research Development Programme (NEDO)** Transfer of technologies from university to industry through TLOs. • **Hiranuma Plan** 1000 venture companies. • **Budgetary support for University Linkage Infrastructures (METI and MEXT)** ***Subsidies to support TLOs, Intellectual Property Headquarters, personnel and other UI relevant factors***

R&D / Innovation policy – IPR	• **Industry Revitalization Special Measures Law (1999)** • **Basic Law on Intellectual Property (2002)** • **Plan for Promoting Intellectual Property (2003)** Strengthening of Intellectual Property Protection
R&D specific financial and fiscal policy	• **R&D Tax Credits** • **Expansion of Angel Taxation System for SMEs (METI)**
R&D specific education policy	• **Internships (Various Ministries, mostly MEXT)** University and Graduate Students. University-Indsutry Links • **Comprehensive Strategy for Personnel with Intellectual Property Skills (2006) (Cabinet Office)** *Set out strategy to 2014 for quantitative increase in personnel with IP related skills.* • **JSPS Award to Eminent Scientists (JSPS)** *For Inviting Prominent Scientists to Japan* • **JSPS Research Fellowships for Young Scientists (JSPS)** *Provision of fellowships for doctoral students.* • **JSPS Postdoctoral Fellowships for Foreign Scientists (JSPS)** *Invitation fellowships for postdoctoral foreign researchers.* • **New Economic Growth Strategy (METI)** *Greater flexibility in course provision and learning opportunities; improvement in human resources*
R&D specific employment policy	• **Fixed Term Employment System for Researchers (JST)** • **Japan Research Career Information Network (JST)**
Finance Domain	
Financial and fiscal policy	• **Special Tax Credit for R&D Expenses (MOF)** • **Tax Incentive on Depreciation for Corporations acquiring equipment and information infrastructure**
Macroeconomic policy	• **Global Economic Strategy for Forging New Growth** • **Promotion of Foreign Direct Investment in Japan (METI)** Target of 5% of GDP by 2010
Human Capital Domain	
Education policy	• **School of Independence for Youth (MHLW) (2.1 Billion Yen)** *To tackle problems associated with NEETs and Freeters* • **Promotion of Nation Founded on Manufacturing** (MHLW) (670 million Yen) *Training in Manufacturing skills* • **Education Reform Plan** (2001 and 2004) (MEXT) *Improvement of Academic Ability; improvement in the quality of teachers.* • **Human Capital Promotion Tax System (METI)** Allowed companies to deduct training expenses from taxation Target: Companies and SMEs.
Employment policy	• **System for Promoting Investment in Personnel (METI 2005)** *Allowed companies to deduct tax on training courses above a certain level.*
Innovation Domain	
Innovation policy generic	
Innovation policy sectoral	• **Small Business Innovation Research (SBIR)** • **Application of Research Activities Fund (1 Year Fund)** • **Business Development Fund (1 Year Fund)** • **New Industry Creation Subsidy for Regional Research Activities (within 2 years)** • **Business Development of Research Results for New Technologies** • **Strategic Information and Communications R&D Promotion Programme (SOUMU)**

	• **Information and Communications Research Facilities (National Insitute of Information and Communications Technology)** *Subsidy support for Venture Businesses for the promotion of advanced technologies* • **Transportation Basic Research Promotion System (JRTT)** *Domestic Universities, national research institutes, IAIs* • **Engineering Technology Research and Development Promotion Scheme (JRTT)** *Targeted to universities and other research organisations*
Other policies - industry	• **Industrial Research Technology Basis Promotion Fund (National Institute of Information of Information and Communications Technology)** *Support for the technological basis of firms in communications and broadcasting* • **Industrial Technology Research Support Fund (NEDO)** Nurturing of technological seeds and personnel skills. Target: Universities, young researchers • **Innovative Use Atomic Energy Technological Development Programme (METI)** Safety and economical technological production promotion. Target: Universities, IAIs, Research Institutes, Industry) •
Other policies - trade	• **Development of Measurement Standards for Advanced Materials (METI)**
Other policies – health and safety	• **Creative Food Industry Agglomeration Research Support Fund (BRAIN)** *Promotion of university-industry-government links for collaborative research and promotion of industrialisation.* • **Promotion of Basic Research in Healthcare Programme (BRAIN)** *New and creative technologies. Target Group: Domestic research facilities, young researchers* • **Ministry of Health, Labour, and Welfare Grant in Aid for Scientific Research Assistance Payment (MHLW)** *Advanced and creative Technologies* • **Food and Health Nutrition Evaluation Technologies (Food Safety Commission)** Target Groups: Universities, National Research Institutes • **Mandatory Requirement for Safety Assessment of Foods and Food Additives Produced by Recombinant DNA Techniques** (MHLW) • **Labelling System for Genetically Modified Foods (MHLW) (2001)** • **System for Promoting Technological Research for Fire Fighting and Disaster Prevention (Fire and Disaster Management Agency)** ***University Industry Links, NGOs an other Organisations***
Other policies - environment	• **New National Energy Strategy (METI 2006)** • **Environmental Technology Development Promotion Fund (MOE)** Basic technologies for future environmental problems. Targetted at research organisations, universities, companies. • **Advanced Technology Applications Research Upgrading (MAFF)** Promotion of university-industry-government links • **Nuclear Energy Research Activities (MEXT)** Basic Technologies related to nuclear systems. Targeted to national universities, companies, IAIs • **Oil and Natural Gas Development Benefit Promotion Programme (JOGMEC)** *Creative Technologies for application.* Target: Domestic research performers • **Waste Treatment and Disposal Grant in Aid for Scientific Research Subsidy (MOE)**

	Targeted at universities, IAIs, companies, non-profit organisations.
Other policies – regional development	• **New Regional Consortium Research Activity Support Fund (Various Timescales) (SME Agency)** • **New Regional Consortium Research Development Programme (METI)** Creation of new business, collaborative research consortium. Promotion of University Industry Links. • **Promotion of Practical Vocational Training in Outlying Regions (MHLW)** • **Regional Concentrated Collaborative Research Development (JST)** Promotion of high level fields for university-industry-government links. **Regional Environment Comprehensive Research Promotion Fund (MOE)** Targeted at domestic research organisations • **Technological Development Measures to cope with Global Warming Programme (MOE)** Targeted at domestic research institutions • **Special Deregulation Zones ()METI)** To testbed regulatory reform intitiatives in partitucular regions.
Other policies - competition	
Other policies – social security	

5. Coherence between main policy objectives and priorities, and policy instruments

In this section we will explore whether there is a gap between the main policy objectives and priorities, and the instruments that have been put in place. This section builds on earlier sections. To recap, we outlined the objectives as:

1. Enhancement of the Research System

2. Seeking a Return on Investments in R&D

3. Human Resource Development

4. Globalisation and Internationalisation

5. Protection of and Security from the Environment

We will link each of these objectives with the instruments outlined in Section 4.

1) Enhancement of the Research System

At a general level the Japanese government has sought to promote the level and performance of science and technology in Japan. The most important policy measure to achieve this objective has been the Science and Technology Basic Law, On the basis of this Law, government funding for science and technology through the implementation of Science and Technology Basic Plans that have increased and paid for the enhancement of research infrastructures in universities and IAIs, human resources in science and technology and research programmes.

The use of Science and Technology Basic Plans which have been implemented over three stages covering 1996-2001, 2001-5, and 2006-2010 have prioritised resources towards four priority and four secondary areas of science and technology activities. These areas are: the Life Sciences; Information and Communications; Environment; Nanotechnology and Materials. The secondary priorities are: Energy; Production Technologies; the Social Base; Frontier Sciences. There are also 62 sub-priorities within these 4 primary and 4 secondary areas. Universities have been encouraged compete for research grants through the expansion of competitive programmes such as Grants in Aid for Scientific

Research (MEXT); Strategic Creative Research Promotion Programmes (JST); Science and Technology Promotion Coordination Fund (MEXT), 21st Century Center of Excellence Programme.

The development and exploitation of advanced technologies is also a priority and is actively pursued by the Ministry of Economy, Trade and Industry (METI) and IAIs such as the Institute of Physical and Chemical Research (RIKEN), the National Institute of Advanced Science and Technology (AIST), or the New Energy and Industrial Technology Development Corporation (NEDO). A Strategic Technological Roadmap by METI includes twenty technologies, distributed between the four priority and secondary fields set out in the Basic Plan. These strategic technologies include semiconductors, medical devices, robotics, and nanotechnologies, amidst other technnologi Advanced technologies include fuel cells; information electronics; robotics; contents; health and welfare instruments services; the environment and energy instruments services; technologies for business services. Other programmes also emphasise key technologies, such as the Technology Research Promotion Activities Programme (MEXT), Advanced Measurement Analysis Techniques Development (JST), amongst other programmes.

2) Seeking a Return on Investments in R&D

Following passage of the National University Incorporation Law (2003; Law 112) the incorporation of the National Universities in 2004 has allowed the universities to introduce a range of policies and strategies to collaborate with industry. METI has begun ranking universities by their performance in UI activities and there is a high degree of attention focused on learning of policies and systems from overseas, and how to develop stronger relations with industry. The universities now have a number of organisations for managing relations with industry that include Technology Licensing Organisations (TLOs), Intellectual Property Headquarters, Incubation centres, collaborative research centres or venture support laboratories. Many universities also have a vice president in charge of university-industry links. Support for these activities is provided by METI and MEXT through annual budget allocations.. In particular, Technology Research Promotion Activities (MEXT), or some of the Strategic Creative Research Promotion Programmes operated by the JST.

Various policy initiatives and legal reforms have sought to create a 'nation founded on intellectual property'. Such measures have related to increasing Japan Patent Office (JPO) recruitment to accelerate the patent examination process, introduce intellectual property headquarters in universities, and other reforms relating to the patent system through various laws such as such as the Technology Transfer Law (1998: Law 52), the Industry Revitalization Special Measures Law (1999) and the Basic Law on Intellectual Property (2002: Law 122).

Universities have been encouraged to develop Venture Business Laboratories where start-ups can use office space below market rates. Government has provided seed funds to support such schemes. There is prolific attention to spin-off companies within the mass media. The Hiranuma Plan published in 2001 set a target for the creation of 1000 start-up companies, which the government has now met.

The return on investment has also been targetted to regional economic benefits through regional collaborative research centres established at universities, and regional cluster policies feature as part of economic growth strategy by METI. There are also special Deregulation Zones which serve to operate as areas to assess the impact of regulatory change. Regional innovation policies have featured as part of the Science and Technology Basic Plans. Specific programmes such as the New Regional Consortium Research Development Programme (METI), or Regional Concentrated Collaborative Research Development operated by the JST, are also in existence.

3) Human Resource Development

Human Resource development has featured heavily in the science and technology basic plans, witnessing increased budget for doctoral and postdoctoral researchers. Recent discussion in the CSTP has outlined measures for increasing the number of overseas researchers through amending immigration regulations. The CSTP is also keen to expand opportunities for female researchers, and extending the duration of employment. Promoting interchange between different sectors of the economy has also become important (CSTP 2006). Concrete policy proposals have not yet been forthcoming however.

These initiatives have been combined with various strategies relevant to personnel issues. Chapter Five of the Plan for Promoting Intellectual Property (2003) stresses the importance of promoting intellectual property personnel, the Management of Technology (MOT) Masters programme and relevant tuition in universities. In January 2006, the Cabinet Office also published Comprehensive Strategy for Personnel with Intellectual Property Skills. These three objectives cover: 1) increasing the number and quality of those involved with intellectual property; 2) nurturing and enhancing the quality of IP management; and, 3) raising consciousness surrounding IP issues within the general population (Cabinet Office 2006:8).

Considering the reduced expenditure towards personnel training in Japan (OECD 2006), in 2005 the Japanese government introduced special tax measures for companies to deduct part of their training expenditure from tax liabilities (METI 2005[2]) . The Ministry of Health, Labour and Welfare has introduced a series of Basic Plans for Human Resources Development. Major components of this include:

- The Promotion of Projects to Reinforce the Capacities of Young People
- Promotion of Human Resources Development by Employers
- Promotion of Human Resources Development through Workers' Self Initiative

These programmes have led to the development of various support infrastructures and programmes throughout Japan. 'Jobshops' have also been developed to help overcome the problems identified concerning 'NEETs' and 'FREETERS'. More specific to R&D, programmes have been developed to entice overseas researchers to Japan. For instance, JSPS Award to Eminent Scientists (JSPS); JSPS Research Fellowships for Young Scientists (JSPS); JSPS Postdoctoral Fellowships for Foreign Scientists (JSPS) and the New Economic Growth Strategy (METI), which emphasizes greater flexibility in course provision and learning opportunities; improvement in human resources.

4) Globalisation and Internationalisation

[2] http://www.meti.go.jp/policy/jinzai_seisaku/jinzaitoushi_zeisei.htm

The two dimensions, globalisation and internationalisation relate to engagement with the global community, and in internationalising the Japanese research environment. Economic growth in Asia has emerged as a policy issue over recent years due to increased levels of competition and wider regional economic opportunities. The New Economic Growth Strategy by the Ministry of Economy, Trade and Industry (METI) has suggested that as the rise of East Asia intensifies global competition, Japan should effectively utilize intellectual assets to ensure competitiveness. Other programmes emphasise corporate research abitlities, such as the Industrial Research Technology Basis Promotion Fund. There are also strategies and policies in place to generate greater FDI into Japan, such as the objective for 5% of GDP as set out by METI.

Internationalizing the Japanese research system relates to encouraging Japanese researchers to collaborate and work with researchers based overseas. This features as a priority in Chapter 4 of the Science and Technology Basic Law. Operating within this structure, programmes are implemented through the Science and Technology Basic Plans for promoting international exchange and the hosting of researchers. This includes extending invitations to prominent researchers overseas or inviting postdoctoral researchers to spend time in Japan through research programmes such as, for example, the JSPS Award to Eminent Scientists; the Postdoctoral Fellowship Awarded to Foreign Researchers or the Core to Core Programme.

5) *Protection of and Security from the Natural Environment*

Issues surrounding the natural and social environment of Japan feature prominently in the Science and Technology Basic Plans (CSTP 2005) and the annual Science and Technology White Paper (MEXT 2006). Key issues that call on the uses of science and technology can be summarised as: 1) addressing environmental problems such as global warming and ozone depletion; 2) energy and resource use and efficiency; 3) aging of the population; 4) decreasing population; 5) social infrastructure and protection from extreme weather such as typhoons, and earthquakes, all of which regularly affect Japan. Research programmes have also been observed. For instance,

Overview

The challenges that have been observed in studies and assessment appear to be acknowledged at the policy setting level by the CSTP. Where gaps do exist, particularly in relation to human resources, it appears that policy instruments are in the process of adjustment. The main factor to consider is the issue of time-lags between policy introduction and realisable change. Many of the reforms in Japan have been occurring since 1995 which is a relatively short time-scale in which to evaluate policy effects. However, we can observe that where policy problems do arise, policy makers seem flexible to respond to the issue. In macro-economic issues, entrenched interests can stall policy implementation that may be beneficial for wider innovation policy, and this has been seen with attempts at privatisation of the post office. We have also seen that Employment Policy, Regulatory Policy, Competition Policy and Female Equality issues are also having some bearing upon the Japanese innovation system. Table 3 seeks to summarize the main challenges and objectives with the types of instruments currently in play.

Table 3		
Challenges	**Objectives/priorities**	**Main Measures responding to the challenge**
a) Enhancement of the Research System	• Develop greater diversity in professional training, utilization of skill base and population	• Science and Technology Basic Plans • Independent Administrative Institution Law • National University Incorporation Law • Grants in Aid for Scientific Research • Strategic Creative Research Promotion Programme • Science and Technology Promotion Coordination Fund • 21st Center of Excellence Programme
b) Return on Investment in R&D	• Economic Exploitation of Research Infrastructure	• National University Incorporation Law • Technology Promotion Research Activities Strategic Creative Research Activities • Technology Transfer Law • Industry Revitalisation Special Measures Law • Basic Law on Intellectual Property • Hiranuma Plan • Regional Programmes
c) Human Resource Development	• Develop greater diversity in research personnel, utilise current labour force more effectively	• Doctoral and Postdoctoral Scholarships • Plan for Promoting Intellectual Property • Comprehensive Strategy for Personnel with IP Skills • New Economic Strategy
d) Globalisation and Internationalisation	• Internationalise the Japanese research system; respond to challenges of globalization	• New Economic Growth Strategy • Science and Technology Basic Law and Plans • Scholarships and invitation programmes
e) Protection and Security from Natural Environment	• Utilize energy efficiently, protect Japan from extreme weather systems	• Science and Technology Basic Plan • New National Energy Strategy • Various research programmes

6. Policy mix instruments and target groups

In this section we will outline how the different instruments outlined above may influence R&D investments. Table 4 seeks to identify the specific routes addressed by the various policy instruments. In Table 4, where "XX" is indicated, this signifies that

the instrument is very relevant to one of the particular 6 routes by which R&D Investments are increased. “X” signifies that the measure is of relevance.

Table 4: Policy instruments and broad routes to increase R&D investments

Policy categories	Policy instruments	ROUTE 1: promote establishment of new indigenous R&D-performing firms	ROUTE 2: stimulate greater R&D investment in R&D-performing firms	ROUTE 3: stimulate R&D investments in firms non-performing R&D	ROUTE 4: attract R&D-performing firms from abroad	ROUTE 5: increasing extramural R&D carried out in cooperation with public sector	ROUTE 6: increase R&D in public sector
R&D Domain							
R&D policy generic	Science and Technology Basic Law	X	X		X		XX
	Third Science and Technology Basic Plan (2006-2010)	X	X		X	XX	XX
	Grants in Aid for Scientific Research (JSPS/MEXT					X	XX
	Strategic Creative Research Promotion Programmes (JST)					X	XX
	Science and Technology Promotion Coordination Fund (MEXT)					X	XX
R&D policy sectoral	Technology Strategy Map (METI)		XX			X	
	21st Century Centre of Excellence Programme (METI)					X	XX
	Technology Research Promotion Activities (MEXT)					X	XX
	Earth Observation Satellite Construction Plan (MEXT)		X			X	X
	Advanced Measurement Analysis Techniques Development (JST)		X			X	X
	Creative Reform for Technological Development (JST)		X	X		X	X

R&D / Innovation policy – Linkage	Technology Transfer Law (1998)						
	Industry Revitalisation Special Measures Law (1999) (METI)	X				XX	X
	Okinawa Industrial Promotion Fund						
	University Venture Business Creation Application Research Development Programme	X					
	Hiranuma Plan	XX					
	Budgetary support for University Linkage Infrastructures	XX	X	X		XX	X
R&D / Innovation policy – IPR	Technology Transfer Law					XX	
	Basic Law on Intellectual Property		XX	X			
	Plan for Promoting Intellectual Property		X	X		X	X
R&D specific financial and fiscal policy	R&D Tax Credits	X	XX	XX		X	
	Expansion of Angel Taxation System for SMEs	XX	X	X			
R&D specific education policy	Internships (Various Ministries, mostly MEXT)	X	X	X	X	X	X
	JSPS Award to Eminent Scientists (JSPS)						XX
	JSPS Research Fellowships for Young Scientists (JSPS)	X	X	X	X	X	XX
	JSPS Postdoctoral Fellowships for Foreign Scientists (JSPS)						XX
	New Economic Growth Strategy (METI)		XX	X	X	XX	X
	Comprehensive Strategy for Personnel with Intellectual Property Skills (2006) (Cabinet	X	XX	X	X	X	X

	Office)						
R&D specific employment policy	Fixed Term Employment System for Researchers (JST)						XX
	Japan Research Career Information Network (JST)						XX
Finance Domain							
Financial and fiscal policy	Special Tax Credit for R&D Enterprises	X	XX	X			
	Tax Incentive on Depreciation for Corporations Acquiring Equipment and Information Infrastructure	X	XX	X	X		
Macroeconomic policy	Global Economic Strategy for Forgning New Growth	X	X	X	X	X	
	Promotion of Foreign Direct Investment in Japan	X	X	X	XX	X	
Human Capital Domain							
Education policy	School of Independence for Youth (MHLW) (2.1 Billion Yen)	X	X	X		X	X
	Promotion of Nation Founded on Manufacturing		X	XX			
	Education Reform Plan						X
	Human Capital Promotion Tax System (METI)	X	XX	X	X		
Employment policy							
Innovation Domain							
Innovation policy generic	Small Business Innovation Research (SBIR)	X		X		X	
Innovation policy	Application of Research Activities Fund (1 Year Fund)	X		X		X	

sectoral	Business Development Fund (1 Year Fund)	XX	X	X		X	X
	New Industry Creation Subsidy for Regional Research Activities (within 2 years)	XX				X	X
	Business Development of Research Results for New Technologies	X	X	X		X	X
	Strategic Information and Communications R&D Promotion Programme	X	X	X			X
	Information and Communications Research Facilities	XX					X
	Transportation Basic Research Promotion System	X	X	X		X	X
	Engineering Technology Research and Development Promotion Scheme						X
Other policies - industry	Industrial Research Technology Basis Promotion Fund	X	X	X	X	X	
	Industrial Technology Research Support Fund (NEDO)					X	XX
	Innovative Use Atomic Energy Technological Development Programme (METI)		X			X	X
Other policies - trade	Development of Measurement Standards for Advanced Materials		X			X	X
Other policies - defence							
Other							

policies – consumer protection							
Other policies – health and safety	Creative Food Industry Agglomeration Research Support Fund (BRAIN)		X			XX	X
	Promotion of Basic Research in Healthcare Programme (BRAIN)						X
	Ministry of Health, Labour, and Welfare Grant in Aid for Scientific Research Assistance Payment (MHLW)	X	X			X	X
	Food and Health Nutrition Evaluation Technologies (Food Safety Commission)						X
	Mandatory Requirement for Safety Assessment of Foods and Food Additives Produced by Recombinant DNA Techniques						
	Labelling System for Genetically Modified Foods						
	System for Promoting Technological Research for Fire Fighting and Disaster Prevention					X	
Other policies - environment	New National Energy Strategy (METI 2006)	. X		X			
	Environmental Technology Development Promotion Fund (MOE)		X	X		X	X
	Advanced Technology Applications Research Upgrading (MAFF)					XX	
	Nuclear Energy Research		X				X

	Activities (MEXT)						
	Oil and Natural Gas Development Benefit Promotion Programme	X	X	X			
	Waste Treatment and Disposal Grant in Aid for Scientific Research Subsidy	X	X	X		X	X
Other policies – regional development	New Regional Consortium Research Activity Support Fund	X	X	X		X	X
	Promotion of Practical Vocational Training in Outlying Regions		X	X			
	New Regional Consortium Research Development Programme					X	
	Regional Concentrated Collaborative Research Development					XX	
	Regional Environment Comprehensive Research Promotion Fund	X	X	X			X
	Technological Development Measures to cope with Global Warming Programme	X	X	X			X
	Special Deregulation Zones ()METI)						
Other policies - competition							
Other policies – social security							

Route 1: Promote Establishment of New Indigenous R&D Performing Firms

The most prominent instrument in Route 1 is the Hiranuma Plan introduced in 2001. This set the objective of 1000 venture companies from universities. This has now been achieved (NISTEP 2001) and has been supported by public finance through funds that have been opened to support university-industry links (METI 2005; MEXT 2005). Other funds have also arisen such as the University Venture Busines Creation Application Research Development Programme. The main rationale underlying interventions in this area is through concern with the "Valley of Death", which characterises the period between the initiation of the company and the launch of products on the market. There is also a regional dimension to support for this route with programmes such as the New Regional Consortium Research Development Programme operated by the Ministry of Economy, Trade and Industry. It could be argued that the sustainability of these companies remains a key issue.

Route 2: Stimulate Gerate R&D Investment in R&D Performing Firms

As noted earlier, most R&D performing firms in Japan are already R&D intensive at international levels, with high R&D expenditure and efficient total factor productivity. There are, however, various measures that exist to support R&D performing firms. Although there are financing measures such as programmes in specific technological fields, as well as R&D Tax Credits, many interventions flag up areas, such as the Technology Strategy Map operated by the METI, or the New Economic Growth Strategy. There are also key measures which seek to allow R&D investing firms to appropriate the returns on their R&D investments through patent policy reform and through measures that seek to accelerate the patent application process through the training of relevant personnel. In particular, the Basic Law on Intellectual Property, the Plan for Promoting Intellectual Property. Measures in the Human Resource domain here are also important, such as opening opportunities for training.

Route 3: Stimulate R&D Investments in Firms in Non-R&D Performing Sectors

We noted from our discussion of the challenges facing the Japanese economy that TFP in some economic sectors was unsatisfactory. This is then a key issue for where the policy mix issue will be of relevance. The most appropriate measure we could locate in this study was the R&D tax credits. Without more detailed case study of particular industrial sectors, it was difficult to outline issues relevant to the policy mix

concept were influencing such companies. From this study, there were few other programmes of significant relevance that could be located although other measures are supportive in terms of human resources (for instance, manufacturing training programmes). This could be located as an area where there are gaps in the policy mix.

Route 4: Attract R&D Performing Firms from Abroad

Within the G7, Japan has one of the lowest proportions of inward FDI. Above it was observed that METI has a target to attract 5% of GDP by 2010. The main types of policies introduced thus far appear to be the distribution of information through promotion seminars, and support for local governments (METI 2006). While the location of only one measure may suggest that the government is not sufficiently prioritising inward R&D FDI, research on FDI suggests that a host of complex factors influence country selection including the market structure, regulatory environment and research environment. This latter point however, has featured prominently in the literature on overseas R&D (for instance, Odagiri and Yasuda 1997) and as UNCTAD have noted, policy frameworks have shifted from 'providing an enabling environment to stronger pro-innovation (technology seller) regimes, while continuing to encourage technology transfer' (UNCTAD 2003: 129). Current policies that emphasise the public R&D base and the regimes which structure technology transfer may therefore be sufficient.

Route 5: Increasing Extramural R&D Carried out in the Public Sector

Business expenditure in HERD is currently quite low in Japan, at around 2.8% (2003).We noted a range of measures that seek to promote Route 5. These include the Science and Technology Basic Plan, Industry Revitalisation Special Measures Law, Budgetary support for University-Industry Linkage structures, as well as IP related measures such as the Technology Transfer Law. Following the incorporation of the National Universities in 2004, however, policy action by government may be constrained by the autonomy vested in the universities. It is now for the universities to decide how they raise finance. Many have now developed strategies for promotion with industry. Issues here may surround motivating interest in university-industry links by academic faculty through incentive systems which are currently relatively undeveloped.

Route 6: Increase R&D in Public Sector

The public sector research system in Japan was always seen in many studies as the weak point of the Japanese innovation system. This issue was also recognised in Japan, where policy makers observed Japanese companies establishing R&D relationships with American and British universities. According to our analysis in this report, we see that the bulk of policy interventions are targeted principally at the Public Sector R&D system. This includes the Science and Technology Basic Plan, Grants in Aid for Scientific Research as well as other funding programmes, many of which are competitive. Improvements in the Public research system, in combination with transfer mechanisms are then the major area where government activity is occurring.

7. Balance within R&D policy mix

In terms of the most "important" policy instruments that affect R&D expenditures, Table 5 seeks to analyse the relationships. The importance of policy instruments are indicated according to the following dimensions:

a) overall contribution to increase of private R&D expenditures
b) impact on specific aspects of the NIS or R&D performers
c) public attention/attention by policy makers
d) volume of public funding involved
e) beneficiary of a shift in public funding

Table 5: Assessment of 'importance' of R&D policy instruments

Instruments	Funding	Criteria				
		a	b	c	d	e
Science and Technology Basic Plan	25 Trillion Yen			XX	XX	
Grants in Aid for Scientific Research	188 Billion Yen			X	XX	
Strategic Creative Research Promotion Programmes				X	XX	
Science and Technology Promotion Coordination Fund	39.8 Billion Yen				XX	
21st Century Center of Excellence Fund	37.8 Billion Yen				X	
Technology Research Promotion Activities		X				
Budgetary Support for University-Industry Linkage	641 Million Yen		X	X		
R&D Tax Credits		X	XX	X		

8. Emergence of R&D policy mix

Here we will look at the emergence of Policy Mix in Japan, the Nature of the Policy Mix Design, and the relationship between the policy mix and other stakeholders.

Emergence of the R&D Policy Mix in Japan

The significance of the Science and Technology Basic Law, which first gave responsibility for the promotion of science to the government, cannot be overstated. This has provided the implementation framework and objectives for the Basic Plans, which are more responsive to circumstances and adjustable in the light of new policy developments. Within this framework, the Plans may be viewed as more adaptable than traditional legislative or policy instruments which can take longer to reform or amend. The development of the Science and Technology Basic Law has had knock on effects on other policy instruments in respect of the following.

- Increased expenditure on R&D led to greater efforts to enhance the means through which university research results could be transferred to the private sector. In particular, the development of the Technology Transfer Law (1998) and the Japanese Version of the Bayh-Dole Law (1999), amidst other reforms to further stimulate university-industry activity.
- The use of prioritisation of research fields in the Basic Plans and the use of competitive allocation procedures, has led to greater concentration of resources within a core set of institutions, greater inter-institutional competition for resources
- Implementation of the Basic Law also saw the development of new measures for the evaluation of research results. Specifically, the passage of the *National Guideline on the Method of Government R&D* (1997) and other evaluation outlines (see Cabinet Office 2001).
- The target set in the first and second Basic Plans for 10,000 postdoctoral researchers led to issues surrounding the nature of graduate education and its applicability beyond academia. Policy makers and some universities are now in the process of seeking to broaden this through the introduction of internships and possibly alternative scholarships. The issue has also led attention to focus on regulatory conditions surrounding transferability between government, universities and industry as well as the transferability of pension arrangements.

Stenberg (2004) observed that there has been much policy learning from America in terms of the policy designs adopted for the Japanese innovation system. This is particularly so in relation to policy designs for university-industry links. Amongst specialists within the field there has recently been some scepticism voiced towards the overall policy design adopted. Japanese university-industry links previously operated along informal lines (Pechter 2001; Hicks 1993). From 1998, more formal systems began to be adopted. The incorporation of the national universities cemented this process whereby formal legal structures were adopted in universities and any technology transfer would proceed through licensing organisations in accordance with university guidelines. Most organisations responsible for managing this process have been dependent upon government subsidies however, and these will cease in 2008. There is therefore some concern over how the organisational structure may develop. Many see TLOs or University Intellectual Property Headquarters either merging or going bankrupt.

Nature of the Policy Mix Design

With regards to whether the design process for the policy mix is incremental or radical, or whether it is analytical or non-analytical. There is an element by which the design process of the Japanese R&D system is both radical and incremental. The Science and Technology Basic Law clearly sets out to

> achieve a higher standard of science and technology (hereinafter referred to as "S&T"), to contribute to the development of the economy and society in Japan and to the improvement of the welfare of the nation, as well as to contribute to the progress of S&T in the world and the sustainable development of human society, through prescribing the basic policy requirements for the promotion of S&T (Article 1).

The Science and Technology Basic Plans, which are implemented on the basis of the Law, set out the means to achieve these objectives over a five year period. The CSTP, which the government is obliged to consult with regard to the Basic Plans, meets regularly and monitors and analyses policy performance over the course of the plan's cycle. As we have just seen however, there is an incremental spill-over between different policy domains as policy learning occurs.

Whether the policy mix is a "construct" or an "ex post" reality, then again there are elements by which both are applicable, in that the government has deliberately sought to improve the conditions surrounding science and technology. The overall nature of

the instruments in use however has developed incrementally and therefore the policy design may also be seen as having an ad hoc nature.

Relationship with other Stakeholders

It can be suggested that there is considerable support amongst policy elites, the business and educational communities for supporting science and technology. During the recent election in late 2005, the main opposition party suggested only minor reforms with respect of science and technology. For instance, the DPJ highlighted the importance of science and technology for international competitiveness and the role that intellectual property and technological capacity can play. It was proposed that university-industry links and the role of technology licensing offices be strengthened. The main business representative organisation, KEIDANREN, is a vocal supporter of science and technology and has its own 'Innovate Japan' slogan.

Following the retirement of Junichiro Koizumi as Prime Minister in September 2006, new Prime Minister Shinzo Abe made a speech in the Japanese Parliament which mentioned innovation policy over period until 2025. The details of this policy have not been set out clearly, but can be seen as endorsement and continuation of current policy.

9. Governance of the policy mix

Here we will review the governance of the R&D system, and the levels of co-ordination between different policy actors and R&D policy and policy instruments.

The Japanese innovation system has been characterised by a high degree of centralization and top-down authority. Although this is still largely accurate, there is now a greater degree of fragmentation arising from reforms that have been undertaken over recent years, and the growth of regional policy initiatives. At the same time as greater autonomy has been granted to different research performing institutions, there have also been efforts to enhance the oversight of R&D policy through strengthening the Council for Science and Technology Policy (CSTP), which occurred following wide spread reform of governmental structures in January 2001. The CSTP is the top governmental council for science and technology based on the Law for Establishing the Cabinet Office (2001, Law No. 89) and sees itself as a "Watchtower" over the science and technology policy landscape. The CSTP is composed of the Prime

Minister, ministers from the Cabinet Office, the Science and Technology Minister, the Minister for the Ministry of Internal Affairs and Communications (SOUMU), the Minister for the Ministry of Finance, the Minister for MEXT, the minister for METI. The CSTP also comprises members drawn from universities and industrial research institutions; with one science and technology policy expert with an economics background. The CSTP discusses basic concepts for science and technology policy on a monthly basis and prioritises all national science and technology policies which are then implemented by the various Ministries and Agencies. The involvement of different ministries is to enhance cooperation across government and avoid duplication of research programmes and projects.

A further key role of the CSTP in governing the research system is in allocating funding through allocating importance to different types of research. This is implemented through the prioritisation of fields established in 2004, where [S] is accorded the highest priority and importance and is highly likely to lead to positive outcomes, [A] where there are important policies and it is likely that there will be sound results put into practice; [B] where there are problems that require comprehension, and where outcomes and efficiences can be located; [C] where the research outline, plan, means of proceeding results may require review. Using extenal experts, Ministries use these criteria for assigning budgetary allocations.

Although IAIs and National Universities now develop their own plans and policies due to their autonomy from government, their medium term plans require approval by the relevant Minister of State and much of their funding is from government in the form of institutional funding and from competitive research funds (2.5% is from industrial sources). The obligation to submit a medium term outline, the dependence upon governmental funding provides a common link that maintains a connection between the central government and these other research performing institutions. There is also an increasing regional dimension to Japanese innovation policy.

Considering the cross-cuting nature of many of these policy initiatives, the CSTP has included relevant experts in its analysis of the issues facing the Japanese NIS. For instance, discussion of the sex, nationality and recruitment of researchers included participants from relevant ministries not typically active in CSTP activities. In this respect the CSTP performs a key organisational function allowing for policy mix issues to be addressed. One further issue worthy of increased attention over the

medium term will be the interaction of different elements of the science and technology governance system. In particular the introduction of the Innovation 25 policy in September 2006 has led to the emergence of a new Cabinet Level Strategic Council responsible for innovation policy until 2025. How relations will emerge with the CSTP is of some interest.

10. Interactions between policy objectives and instruments

First, there has been no rigorous academic statistical analysis of the types of factors influencing R&D performance at a macro-level specific to the range of instruments noted in this report. In that respect, the interactions noted in this report are assumed interactions based on the existence of funding or in commentary in governmental, or other organisational reports.

Secondly, Japan apportions 3.53% of GDP for expenditure on R&D (SOUMU 2006). This compares against 2.68% for the United States (2004); 1.81% for the EU25 (2003), 1.9% for the EU15 (2003) and 2.26% for the OECD (2004). Not only is Japan unique in apportioning more finance as a proportion of GDP towards R&D than other advanced countries, but it is also unusual for major economies to apportion any more than this percentage in the period since 1980. In that respect, Japan is at the frontier in terms of R&D funding allocations. Whether budget allocations should increase beyond this level before there are diminishing returns or wastage is open to question, however we have also observed that returns on investment since 1995 may have so far been unsatisfactory utilised according to a number of reports. In that respect Japan faces the problem of maximising the efficiency of investments and targetting the investments to promising areas. We have seen that the system for achieving this has been developed through the SABC prioritisation system. Other policies that seek to maximise these investments may take time to become more firmly embedded in the system.

Third, there has been considerable policy change in Japan since 1995, and the implementation of one Science and Technology Basic Plan leads to a fresh round of policy making as policy makers adjust instruments in the light of new policy needs and issues. The Japanese innovation system should therefore be seen as one

undergoing significant change and adaptation or as a dynamic changeable system. Furthermore, many of the reforms in Japan have been occurring since 1995 which is a relatively short time-scale in which to evaluate policy effects. Many of the challenges identified in this report may have been ameliorated if a longer timeframe were adopted by which to measure the success of the instruments outlined in this report.

In terms of Direct Effects, there are few of these that significantly influence the current R&D system in Japan. There are issues surrounding IP policy and processes of acquisition of patenting. However, these problems are acknowledged by policy makers and efforts are underway to accelerate the patent approval process. We have also seen that there are issues surrounding university-industry relations. But as we observed, the universities are now the major actors responsible for policy action in this area with little that government can now do, other than maintain subsidies to support UI organisations. Whether this will continue beyond the current funding horizon remains to be seen. There are also issues surrounding employment policy. Again, however, efforts are underway to ameliorate this situation. Studies have recognized the problems involved and we have seen that CSTP discussion has outlined the importance of future activity in this area.

Where problems do exist is in effective use of the human resources, especially where women researchers are concerned. This argument may also be extended to foreign researchers. Further issues may relate to the elderly, though this features less in current policy discussion. There may be gaps in policy provision over these areas at the moment. Where there is low R&D performance as indicated by TFP analysis, there may be specific policies that negatively influence these sectors. For instance, trade policy or competition policy. This would require a more in-depth study than what was realisable for the current report.

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