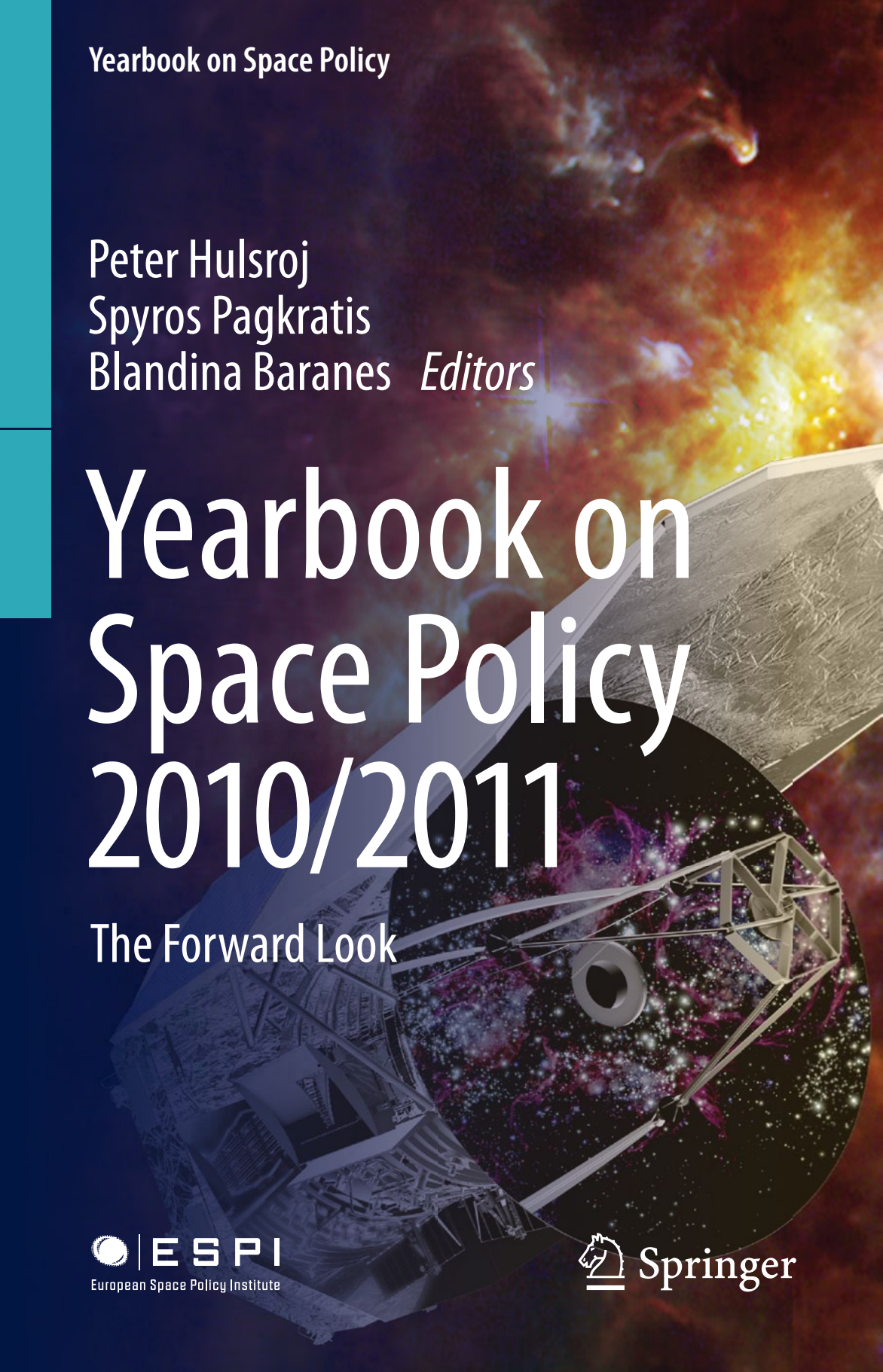
Yearbook on Space Policy

Peter Hulsroj
Spyros Pagkratis
Blandina Baranes *Editors*

Yearbook on Space Policy 2010/2011

The Forward Look



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Director: Peter Hulsroj

Peter Hulsroj • Spyros Pagkratis
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Editors

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Editors
Peter Hulsroj
Spyros Pagkratis
Blandina Baranes
European Space Policy Institute
Vienna, Austria

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Preface Yearbook

Space, the Global Endeavour

The forces that shape and drive human activities in outer space have been changing since the dawn of spaceflight. Where it initially started out as a bipolar and geopolitical competition, space utilisation over time expanded both its scope and the players involved, embracing space exploration, space science and applications that constantly benefit millions of users worldwide.

Recently, we have entered a new phase where the opportunities ahead are great, but the challenges to live up to them equally so. A gradual but steady geopolitical shift – amplified by a financial and economic crisis – points towards a different balance of capabilities and power. This evolution has far-reaching influences on the different dimensions of outer space utilisation. As society requires evermore integrated technology application in a wide array of fields, it triggers the civil side to establish more cooperation to meet these demands. From a military perspective, the geopolitical shift introduces the challenge of a widening multi-actor system and more global interdependencies. In addition, existing issues, like the sustainable use of outer space, require ever more attention in order to be addressed in a timely and efficient manner. These processes sometimes push the current operation mode of the system to its limits, and – what is more – they will necessitate and drive substantial change in the medium to long term. It is for these reasons that the thematic title of this Yearbook highlights the global dimension of the space endeavour.

As in previous editions, this yearbook is comprised of three parts. The first part seeks to set out a comprehensive overview of the economic, political, technological and institutional trends that affect space activities. It was prepared in-house at ESPI and while its perspective is European, it also provides a comparative analysis of space efforts around the world.

The second part of the Yearbook brings together the views of nine distinguished experts in the space field. These experts touch topics or events which stirred the space sector in 2010, thus reflecting on the establishment of the UK Space Agency

and the formulation of a new German space strategy, but also on the usability of space data, intergovernmental cooperation and issues of sustainability such as balanced development and space debris.

An important milestone in the preparation of the Yearbook was again ESPI's Autumn Conference, where authors met for an exchange on the drafts of their contributions. Having taken place in Vienna in September 2011, it provided a forum for constructive exchange and coordination of the contributions.

The third part of the Yearbook carries forward the character of the Yearbook as an archive of space activities. Again prepared in-house by ESPI, a bibliography, chronology and data about institutions is provided where readers of the now five volumes of the Yearbook can identify statistical development and evolutions.

In closing, I would like to thank the contributors of the articles in Part II for their engagement in this publication, as well as the ESPI staff that has been instrumental in the Yearbook's production.

Peter Hulsroj

Contents

List of Figures

List of Tables

Acronyms

A

ABS	Asia Broadcast Satellite
ACE	Advanced Composition Explorer
ACES	Atomic Clock Ensemble in Space
ACLS	Advanced Closed-Loop System
AEB	Agência Espacial Barasileira (Brazilian Space Agency)
AIA	Atmospheric Imaging Assembly
AIS	Automatic Identification System
ALHAT	Automated Landing and Hazard Avoidance Technology
ALOS	Advanced Land Observing Satellite system
AMS	Alpha Magnetic Spectrometer
APL	John Hopkins University Applied Physics laboratory
APSCO	Asia-Pacific Space Corporation Organisation
APRSAF	Asia-Pacific Regional Space Agency Forum
ARV	Advanced Re-entry Vehicle
ASAT	Anti Satellite
ASI	Agenzia Spatiale Italiana (Italian Space Agency)
ATV	Automated Transfer Vehicle

B

BAA	Broad Area Announcement
BGAN	Broadband Global Area Network
BIS	UK's Department for Business, Innovation and Skills
BNSC	British National Space Centre
BSS	Boeing Satellite Systems

C

CAGR	Compound Annual Growth Rate
CASC	China Aerospace Corporation
CBERS	China-Brazil Earth Resources Satellite
CCD	Charged Couple Device
CD	Conference on Disarmament
CDTI	Centre for the Development of Industrial Technology
CEOS	Committee on Earth Observation Satellites
CESPO	Centre d'Etudes Spatiales de la BIOsphère
CFAS	Federal Commission for Space Affairs
CFSP	Common Foreign and Security Policy
CGWIC	Chinese Great Wall Industry Corporation
CIS	Commonwealth of Independent States
CME	Coronal Mass Ejection
CNES	Centre Spatiale d'Etudes Spatiales (French Space Agency)
CNSA	China National Space Administration
CONCORD	European Commission's Annual Competitiveness Assessment Conferences
COPUOS	Committee on the Peaceful Uses of Outer Space
COSPAR	Committee for Space Research
COTS	Commercial Orbital Transportation Services
CPIP	Common Pre-Frontier Intelligence Picture
CRuSR	Commercial Reusable Suborbital Research Programme
CSA	Canadian Space Agency
CSDP	Common Security and Defence Policy

D

DARPA	US Defence Advanced Research Projects Agency
DARS	Digital Radio Audio Satellite
DBS	Direct Broadcast Service
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Space Agency)
DoD	US Department of Defence
DRDO	Defence Research and Development Organisation
DSI	German SOFIA Institute

E

EAC	European Astronaut Centre
EADS	European Aeronautic Defence and Space Company
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortization
ECLS	Environmental Control and Life Support
EEA	European Environment Agency

EGNOS	European Geostationary Navigation Overlay Service
EGP	Eurobot Ground Prototype
EJSM	Europa Jupiter System Mission
ELINT	Electronic Signals Intelligence
ELV	European Launch Vehicle
EMSA	European Maritime Safety Agency
EO	Earth Observation
ERA	European Research Area
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESP	European Space Policy
ESPI	European Space Policy Institute
ESTEC	European Space Technology and Research Centre
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUR	Euro (Currency)
EUROSUR	European Border Surveillance System
EUSC	European Union Satellite Centre
EVE	EUV Variability Experiment

F

FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FCT	Foundation for Science and Technology
FIFA	Fédération Internationale de Football Association
FSS	Fixed Satellite Services

G

GA	General Assembly
GATS	General Agreement on Trade in Services
GCI	GEOSS Common Infrastructure
GDP	Gross Domestic Product
GEO	Geostationary Orbit
GEO	Group of Earth Observation
GEODSS	Ground-Based Electro-Optical Space Surveillance System
GEOSS	Global Earth Observation System of Systems
GERD	Gross Domestic Expenditure on Research and Development
GIS	Geospatial Intelligence System
GLONASS	Global Navigation Satellite System
GMES	Global Monitoring for Environment and Security
GMT	Greenwich Mean Time

GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment Satellite Mission
GSC	GMES Space Component
GSLV	Geosynchronous Satellite Launch Vehicle
GSM	Global System for Mobile Communications
GTO	Geostationary Transfer Orbit

H

HDTV	High Definition Television
HDU	Habitat Demonstration Unit
HMI	Helioseismic and Magnetic Imager
HPGP	High-Performance Green Propulsion system
HST	Hubble Space Telescope
HTV	H-II Transfer Vehicle

I

IADC	Inter-Agency Space Debris Coordination Committee
IAI	Israel Aerospace Industry
IBM	Integrated Border Management
ICG	International Committee on Global Navigation Satellite Systems
ICT	Information and Communication Technology
IDF	Israeli Defence Force
IG	Information Gathering Satellites
IGSO	Inclined Geosynchronous Orbit
ILA	Internationale Luftfahrtausstellung (Berlin Air Show)
ILN	International Lunar Network
ILS	International Launch Services
IMOD	Israeli Ministry of Defence
INSAT	Indian National Satellite System
IOV	In-Orbit Validation
IPRs	Intellectual Property Rights
IRNSS	Indian Regional Navigation Satellite System
ISA	Israeli Space Agency
ISECG	International Space Exploration Coordination Group
ISIC	International Space Innovation Centre
ISO	International Organisation for Standardization
ISRO	Indian Space Research Organisation
ISRU	In-Situ Resource Utilisation Technologies
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunication Union

J

JAXA	Japan Aerospace Exploration Agency
JDA	Japanese Defence Agency
JWST	James Webb Space Telescope

K

KARI	Korea Aerospace Research Institute
KSC	Kennedy Space Center

L

LCO	Lifeline Connectivity Obligation
LEO	Low Earth Orbit
LES	Living with a Star Programme
LLDCs	Least-Developed Countries
LSS	Large Space Simulator

M

MDGs	Millenium Development Goals
MDRS	Mars Desert Research Station
MEO	Medium Earth Orbit
MER	Mears Exploration Rover
MMO	Mercury Magnetospheric Orbiter
MoU	Memorandum of Understanding
MPCV	Multi-Purpose Crew Vehicle
MPO	Mercury Planetary Orbiter
MRO	Mars Reconnaissance Orbiter
MS	Member State
MSL	Mars Science Laboratory
MTG	Meteosat Third Generation Programme

N

NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NCC	National Coordination Centre
NDPBs	Non-departmental Public Bodies
NEO	Near Earth Object
NERC	Natural Environment Research Council
NGA	US National Geospatial-Intelligence Agency
NGL	Next-Generation Launcher
NICT	National Institute of Information and Communications Technology
NLR	National Aerospace Laboratory of the Netherlands

NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NRC	US National Research Council
NRO	US National Reconnaissance Office
NSAU	State Space Agency of Ukraine
NSC	Norwegian Space Centre

O

OHB	Orbitale Hochtechnologie Bremen
ONERA	Office Nationale d'Etudes et de Recherches Aérospatiales
OOSA	Office of Outer Space Affairs
OST	Outer Space Treaty

Ö

ÖWF	Österreichisches Weltraumforum (Austrian Space Forum)

P

PMM	Permanent Multipurpose Module
PND	Portable Navigation Device
PNT	Positioning-Navigation-Timing
PPP	Public Private Partnership
PSLV	Polar Satellite Launch Vehicle
PSO	Polish Space Office
PWR	Pratt & Whitney Rocketdyne

Q

QZSS	Quasi-Zenith Satellite System

R

R&D	Research and Development
RATS	Desert Research and Technology Studies
ROSA	Romanian Space Agency

S

SAC	Space Activities Commission
SAP	United Nations Programme on Space Applications
SAR	Synthetic Aperture Radar
SDC	Space Data Centre
SDMP	Space Debris Mitigation Plan

SDO	Solar Dynamics Observatory mission
SEV	Space Exploration Vehicle
SHF	Super High Frequency
SIGINT	Signal Intelligence
SIS	Space Infrastructure Services
SMDC	Space Missile and Defence Command
SME	Small and Medium Enterprise
SNSB	Swedish National Space Board
SOHO	Solar and Heliospheric Observatory
SPAC	Satellite Positioning Research and Application Centre
SPRN	Russian Satellite Network, Russian Abbreviation for Satellite for Warning on Rocket Attack
SRON	Dutch Space Research Organization
SSA	Space Situational Awareness
SSTL	Surrey Satellite Technology Limited
STEREO	Solar Terrestrial Relations Observatory
STFC	Science and Technology Facilities Council
STSS	Space Tracking and Surveillance System
SWOT	Surface Water Ocean Topography Mission

T

TCBM	Transparency and Confidence-Building Measures
TFEU	Treaty on the Functioning of the European Union
TRAI	Telecom Regulatory Authority of India
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
TSB	Technology Strategy Board

U

UARS	Upper Atmosphere Research Satellite
UAS	Unmanned Aircraft System
UHF	Ultra High Frequency
UK	United Kingdom
UKTI	UK Trade and Investment
ULA	United Launch Alliance
UN	United Nations
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly
UNIDIR	United Nations Institute for Disarmament Research
UNIWG	United Nations Geographic Information Working Group
UNOSAT	United Nations Operational Satellite Applications Programme

UNSDI	United Nations Spatial Data Infrastructure
UN-SPIDER	United Nations Platform for Space-Based Information for Disaster Mangement and Emergency Response
US	United States
USAF	US Air Force
USAT	Ultra Small Aperture Terminals
USD	US Dollar (Currency)
USNSSS	US National Security Space Strategy
USRA	Universities Space Research Association

V

VHF	Very High Frequency
VLS	Veículo Lançador de Satélites
VSAT	Very Small Aperture Terminals

W

WARC	World Administrative Radio Conference
WRS	World Radiocommunications Seminar
WSIS	World Summit on the Information Society
WTO	World Trade Organisation

Part I
The Year in Space 2010/2011

Chapter 1
European Space Activities in the Global Context

Spyros Pagkratis

1.1 Global Political and Economic Trends

1.1.1 Global Economic Outlook

In 2010 and 2011 the symptoms of the 2008 financial crisis were still being broadly felt worldwide. Although global financial expansion had already resumed in 2009, its pace remained slow and uncertain. The key element of the recovery has been the uneven pace of its impact on developed and emerging countries, with the latter achieving a much faster and bullish return to growth, as was predicted in the "Space Policies Issues and Trends in 2009/2010" report. Although global economic activity was expected to rise by roughly 5% in 2010 and 4.2% in 2011, advanced economies were projected to expand by only 2.2–2.7%, whereas emerging countries' growth was expected to be up to three times higher.[1]

Furthermore, while emerging economies seem to have overcome the worst of the crisis with the help of suitable fiscal policies, advanced economies are still under considerable fiscal stress, especially in Europe. The growing difference between emerging and developed economies has increased the systemic danger of a new crisis by exacerbating global financial imbalances and encouraging excessive capital volatility and especially flows from advanced to emerging economies. This unstable situation is mostly fuelled by the different approaches chosen by developed and emerging economies in order to counter the consequences of the crisis. The former have adopted policies of fiscal consolidation and monetary contraction in order to hedge the risks from the 2008 bailouts, which have resulted

[1] International Monetary Fund. World Economic Outlook: recovery, Risk and Rebalancing. Washington DC: IMF, Oct. 2010.

S. Pagkratis (✉)
ESPI, Vienna, Austria
e-mail: spyros.pagkratis@espi.or.at

P. Hulsroj et al. (eds.), *Yearbook on Space Policy 2010/2011*,
Yearbook on Space Policy, DOI 10.1007/978-3-7091-1363-9_1,

in rising unemployment, crippled domestic demand and increased exports. The latter are following policies that favour domestic consumption, which was expected to rise by 8% in 2010.[2]

The main reason behind the different approaches adopted was the poor condition of sovereign debt and bank balance sheets in developed economies compared to emerging economies. Another reason was the limited margin for further consumption growth in developed economies: starting from much higher consumption rates, they would not have been able to profit from further expansion as much as emerging economies, even with targeted fiscal measures. In the years immediately preceding the crisis, emerging and developed economies had been following completely different paths to economic development. The former chose a fiscally solid, industrial output and export oriented posture, while the latter a fiscally more precarious, financial services' and domestic consumption oriented approach. In the time of global economic expansion, the two different approaches were able to cooperate and complement each other in a mutually beneficial way. It is clear however that in the aftermath of the crisis and the recovery efforts that followed they are set upon two very different and rapidly diverging paths of economic development.

Advanced economies still have a number of challenges lying ahead, with the most important being to carefully balance the necessary sovereign and banking fiscal stabilisation measures with the need to restrain unemployment and improve household finances and consumption. First of all, financial sector policies and practices need to be improved, addressing the financial and banking imbalances that caused the recent crisis. This applies particularly to the banking sector, where bank consolidation is still in process, as well as to mitigating the effects of the sovereign debt crisis that followed the financial melt down. On the other hand however, in the presence of very low interest rates and tax policies that favour production rather than consumption, such measures also increase the risk of deflation. In the short term, such measures seem to be creating excessive unemployment, further complicating efforts to restore demand to pre-crisis levels. In the medium term, they could pose a threat to medium and small enterprises that rely mostly on domestic demand rather than exports. In the longer term, finally, they could lead to further stagnation and deflation as exports to emerging economies will drop as a result of their rapidly improving position vis-à-vis the advanced economies.

The challenges that lay ahead for emerging economies are very different by comparison. Most countries in that category have so far opted to boost their domestic consumption in order to offset the drop in export volume caused by declining international consumer demand created by the crisis. In a similar fashion, they have increased spending on retooling and refurbishing their industrial infrastructure, in an effort to increase liquidity in their economies and limit unemployment. However, such efforts on their own cannot restore output to pre-crisis levels, especially in the case of countries that have relied heavily on manufactured goods demand from advanced economies to boost their growth. In addition to these measures, carefully balanced monetary and exchange rate policies would have to

[2] Ibid.

be put in place in order to avert inflationary risks and maintain credit growth at reasonable levels.

Finally, a key plank during the past 12 months has been the increased capital volatility and flow from advanced to emerging markets. At this point in time, excessive capital outflows from established markets could potentially destabilise the global financial system and compromise its recovery, as they have a direct negative impact on market confidence, credit availability and interest rate levels in advanced economies, further obstructing their path to recovery. At the same time, this increased volatility and speculation in capital markets is also increasing inflationary risks in emerging economies. In essence, this imbalance in global capital and credit flows could increase the pro-cyclical movement of the global economy, significantly complicating the recovery effort worldwide.[3]

In the face of these challenges, the space economy and especially the commercial space services sector can play a role in boosting global economic growth, without further fuelling the aforementioned imbalances. Being inherently global by its very nature, it has the potential to repatriate capital flows to advanced economies while at the same time distributing beneficial services to emerging countries. In fact, space services can instigate growth in both cases, without creating the negative effects from capital flows mentioned above. Space infrastructure creates jobs both in advanced and emerging economies; it encourages global synergies and enhances international cooperation; and its operating costs are evenly distributed among its users, who can nevertheless reap the full advantages of its use. As space infrastructure is not based in any territory, it does not have any of the disadvantages related to more traditional international investments or services' exports, especially for the importing countries. Furthermore, it allows space services' providers to enjoy operational and financial flexibility that constitute a decisive advantage in view of the crisis's consequences for global economic integration. At the same time, it can benefit both from the fiscal consolidation measures applied in high income economies (that encourage outsourcing services to the private sector), and from the booming growth in emerging countries.

1.1.2 Political Developments

1.1.2.1 Security

From a security perspective, 2010 and 2011 were marked by the geopolitical events that took place in the Middle East. Earlier protests that took place in Egypt and Tunisia were followed on 16 February 2011 by civil protests against the Libyan leader Moammar Gadhafi and his government that had been running the country since a coup d'état in 1969. Gadhafi confronted the civil protests and declared his

[3] The World Bank. Global Economic Prospects: Navigating Strong Currents. Washington DC: World Bank, Jan. 2011.

intention not to leave the country.[4] Amid violent repression of the protesters and government attacks against civilians, the death toll began to rise. This continued violence forced the U.N. Security Council to intervene.[5] It approved a no-fly zone resolution for Libya and gave permission for the use of any means necessary to protect civilians. There were no opposing votes at the 15-member council, but China, Russia, Germany, India and Brazil abstained. The prolonged civil unrest and armed conflict that followed had repercussions in many fields, including global oil prices and the stock market. OPEC was forced to intervene in order to stabilize petroleum prices, as Libya's production fell to less than 400,000 barrels per day, or approximately ¼ of pre-crisis production levels, with the increased risk of a complete production halt, according to Libya National Oil officials.

Prolonged combat between government and opposition forces created significant refugee flows to neighbouring countries. Satellite imagery was one of the means applied by international and humanitarian organisations to identify and mitigate the consequences of this event by setting up appropriate humanitarian aid operations. The use of satellite imagery and maps during the crisis was particularly successful on a United Nations level, with the exploitation of the UN Operational Satellite Applications Programme (UNOSAT).[6] Finally, on 22 March 2011, international military operations started in western Libya against Gadhafi's regime among protests from Russia, China and certain Arab League countries that originally supported the operation.

1.1.2.2 Environment

On March 11, 2011 a tsunami spawned by the fifth-largest earthquake ever recorded slammed Japan's eastern coast. The magnitude 8.9 offshore earthquake unleashed a 7 m tsunami that was followed by more than 50 aftershocks that shook Japan for hours, causing major damage in broad areas of northern Japan.[7] The incident's death toll climbed to over 20,000 people.[8] Following the earthquake, a catastrophic failure occurred at the Fukushima nuclear power station that was closest to the earthquake's epicentre and was also struck by the ensuing tsunami. A state of

[4] "The Libya War of 2011."STRATFOR Global Intelligence, 21 March 2011, http://www.stratfor.com/analysis/20110319-libyan-war-2011?utm_source=SpecialReport&utm_medium=email&utm_campaign=110319a&utm_content= readmore&elq=3c7acd0ccb4540ad8f71e78079162462

[5] "U.N. Security Council Approves No-Fly Zone in Libya." CNN, 18 March 2011, http://edition.cnn.com/2011/WORLD/africa/03/17/libya.civil.war/index.html

[6] Godoy, Julio. "Satellite Technology to Help the Displaced." Terraviva, 15 March 2011, http://www.ipsterraviva.net/UN/news.asp?idnews=54851 and http://allafrica.com/stories/201103151462.html

[7] "Japan Hit By Tsunami after Massive Earthquake." 11 March 2011, http://www.bbc.co.uk/news/world-asia-pacific-12709850

[8] "Japão confirma 22 mil mortos e desaparecidos." Publico, 22 March 2011, http://www.publico.pt/Mundo/japao-confirma-22-mil-mortos-e-desaparecidos_1486147.

emergency was declared and the entire region evacuated. As a consequence of the damages caused to the nuclear plant, large amounts of radioactive particles were released into the atmosphere, making this the worst nuclear incident since Chernobyl.[9] The situation inside the plant came close to a total core meltdown, a danger that was averted by the narrowest of margins and only after considerable self-sacrificing efforts by fire fighting and damage control crews. A rise in seawater contamination levels near the Fukushima facility was also reported, with iodine levels reaching 27.1 times higher than normal and caesium levels 2.5 times higher than normal.[10] In the process of identifying and preventing further damage from the spreading radiation, weather and oceanographic satellites offered considerable assistance in identifying the speed and pattern of contamination, based on prevailing winds and sea currents in the region. The availability of such information in near real time was pivotal in the operational planning of evacuation and humanitarian assistance operations in the immediate aftermath of a disaster, the full environmental impact of which will reveal itself only in the long term.

1.1.2.3 Energy

Increased volatility in energy sector prices was a persistent trend throughout the reporting period that continued from the first half of 2010. In spite of the fact that consumption levels still lagged behind pre-crisis levels, investing in oil and other fossil energy resources was a constant trend since the 2008 financial crisis, as investors increasingly took refuge in commodity positions to hedge against increased market volatility and decline. However, the perception of oil as a secure asset class in the midst of financial turmoil led to considerable fluctuations in the oil market as well, including a considerable decoupling of oil prices from real demand and supply conditions. The unforeseen geopolitical events in the Middle East at the end of 2010 and the beginning of 2011 mentioned above further exacerbated the situation. It should be noted that despite the progress made in alternative power sources, fossil fuel is expected to remain dominant in the global energy consumption mix. This long term trend is mainly due to rising demand in the transportation sector, particularly in emerging Asian markets that are responsible for 75% of the projected consumption growth in the next 20 years. On the other hand, the rising

[9] "Concentracões elevadas de iodo radioactivo detectadas no pacífico." Publico, 21 March 2011, http://www.publico.pt/Mundo/concentracoes-elevadas-de-iodo-radioactivo-detectadas-no-pacifico_1485890

[10] "Japanese Government Confirms Meltdown." STRATFOR Global Intelligence, 12 March 2011, http://www.stratfor.com/analysis/20110312-japanese-government-confirms-meltdown?utm_source=redalert&utm_medium=email&utm_campaign=110312%286%29&utm_content=readmore&elq=96da7bd6198c44f9a29a05659469a594

potential of gas utilisation might also lead to a change in the internal balance of fossil fuel consumption, from crude oil to gas use.[11]

Compared to the years immediately preceding the crisis, demand in 2010 witnessed modest growth over 2009, although consumption was still low compared to pre-crisis times. On the other hand, oil extraction costs continued to rise as well, requiring considerable upstream investments to increase production, especially within the OPEC countries. In the absence of such investments, crude oil production would remain at roughly the present levels in the medium term, something which may not be sufficient if global economic activity returns to pre-crisis levels, which at the same time could instigate further price speculation should additional geopolitical disturbances occur. On the other hand, if recovery proves to be slower than anticipated, demand could remain flat in the medium term, depriving fossil fuel extraction companies of the resources necessary to invest in modernising production.[12] In conclusion, the current situation is full of challenges for the oil industry that might become trapped in a vicious circle of stagnating demand, coupled with rising investment costs for future exploitation projects.

The combination of low demand and rising infrastructure modernisation costs has particularly hit the refining industry in advanced economies that, since the outbreak of the financial crisis, has been consistently demonstrating increasing excess capacity. This trend is expected to continue as refining capacity in emerging countries (especially Asia) increases, severely limiting the medium-term profitability of European and North American competitors. In general, demand in advanced economies is considered to have reached its historical peak, a fact that, when combined with the aforementioned medium term trends, might move the centre of downstream oil services from the Atlantic to the Pacific region.[13] This trend could be even accelerated in the medium term, if economic recovery remains sluggish in advanced economies and new climate change and energy policies are implemented, especially in the U.S. Carbon related legislation in particular, which is still in a formative stage, could potentially further reduce demand growth and increase competition for markets.

Whatever may be the long term prospects for oil consumption, increased gas supply and demand will most likely preserve the capital importance of fossil fuels in the global energy mix. This trend is expected to confirm the importance of satellite services for the operation of global energy flows. Earth observation satellites will continue to provide useful support for geological surveys related to fossil fuel exploitation, navigation and communication spacecraft will ensure the reliability of fuel transport, and environmental monitoring spacecraft will help monitor and mitigate pollution issues. In the long term, the increased importance of gas supply might increase the role of terrestrial energy flows via pipelines,

[11] Organisation of the Petroleum Exporting Countries. World Oil Outlook. Vienna: OPEC, Sept. 2010.
[12] Ibid.
[13] Ibid.