

The Future of Employment in a Digital World:

Industrial and Education Policy implications

Geneva, 19 of March, 2018

ipea Institute for Applied
Economic Research

Aguinaldo N Maciente
Labor Studies Coordination
Social Studies Division

- **Production** in a digital world
 - Industry 4.0
 - Challenges for firms
- **Employment** in the digital world
 - Tasks, skills and occupations
 - Challenges for workers
- **Industrial and education policies**
 - Traditional features
 - Needed features
 - Challenges to developing countries
- Concluding remarks

The Digital World will reshape production & distribution

- Industry 4.0
 - Cyber-physical systems
 - **Cognitive computing:** self-awareness, self-organizing, decision-making capabilities
 - **Virtualization:** sensing, monitoring and maintenance capabilities
 - Cloud computing
 - **Internet of Things:** connectivity, identifiability, interoperability and security
 - **Big data algorithms:** real-time process, engineering and information representation capabilities

The Digital World will reshape production & distribution

- Industry 4.0 technologies
 - Internet of Things
 - Smart sensors and actuators
 - Connectivity, interoperability, authentication & security protocols
 - Cyber-physical systems
 - Cognitive and in-network computing: self-aware, self-organizing, decision-making capable components and systems
 - Virtualization: real-time process, engineering and information representation capabilities
 - Cloud computing
 - Big data analytics & algorithms
 - Convert data flows into information flows
 - Customer interaction and profiling

PWC (2016) & VDMA's IMPULS Foundation (2015)

- End-to-end integration
 - Vertical and horizontal value chain integration
 - Focus on core competencies
 - Join partner ecosystems
 - Share operative information
 - New business models
- Smart, customized products and data-driven services
 - Developed new and tailored customer relationships

- Human beings as the drivers of value added
 - Manage HR strategically
 - Promote learning culture and learning fitness
 - Design goal-oriented training programs
 - Build collaborative environment
 - Foster flexible and attractive working conditions

The Digital World will reshape labor & education

- Some Jobs will be **replaced**
- Most Jobs will be **reshaped**
 - Task composition
 - Skills & ability requirements
 - Education levels and knowledge fields
 - Vocational training & in-job learning requirements

Town criers



Source: Wikipedia

Switchboard operators



Source: Wikimedia Commons

Jobs will continue to disappear

Taxi Drivers



Source: Hans Vivek on Unsplash

Newsstand vendors



Source: Wikimedia Commons

Policy analysts?



Source: United Nations

Autor, Katz, Kearney (2006); Autor (2013)

- Jobs with a larger share of routine tasks
 - Can be broken down into a series of predictable steps and decision processes
 - Are more easily replaced by automated equipment and software solutions
- Routine tasks can be cognitive or manual
 - Cognitive: Operate and monitor production (e. g., quality control)
 - Manual: Operate machinery and control production pace
- Non-routine cognitive and manual tasks will continue to exist and develop

Most needed skills

- Language usage
- Learning, listening, teaching
- Decision-making
- Time-management
- Systems evaluation
- Science & mathematics

➤ Cognitive skills

Least needed skills

- Repairing
- Maintenance
- Operation & control
- Installation
- Quality control
- Management of resources

➤ Routine skills

Most needed fields

- Computers & electronics
 - Education & training
 - Wealth
 - STEM fields
 - Communications & media
 - Administration
- Science-based manufacturing & services

Least needed fields

- Mechanical
 - Construction
 - Food production
 - Production & processing
 - Transportation
- Commodity-based manufacturing & distribution

Most needed abilities

- Verbal
- Analytical
- Quantitative
- Memory

➤ Cognitive abilities

Least needed abilities

- Body flexibility & coordination
- Physical strength
- Manual dexterity
- Time reaction & speed

➤ Physical & manual abilities

Jacobs, Kagermann & Spath (2017)

- Lifelong learning skills
 - Ageless training mentality
 - Career planning skills
 - Autonomy and self-reliance
- Collaboration skills
 - Cross-functional
 - Beyond company boundaries

- Will traditional policies keep up with these transformations?
 - Recent Brazilian experience and trends
 - What not to do!
 - Challenges for developing countries and regions
 - What to do?

Industrial policies in Brazil (2004-2013)

- Subsidized financial support
 - Benefits to established, powerful economic groups
- Focus on manufacturing
 - Commodity-based and/or foreign-owned companies
- Local incentives
 - Amazon special economic zone
 - Maquiladora-style electronics manufacturing
 - Fiscal wars
 - States compete to offer attractive local tax exemptions
 - Financial exhaustion

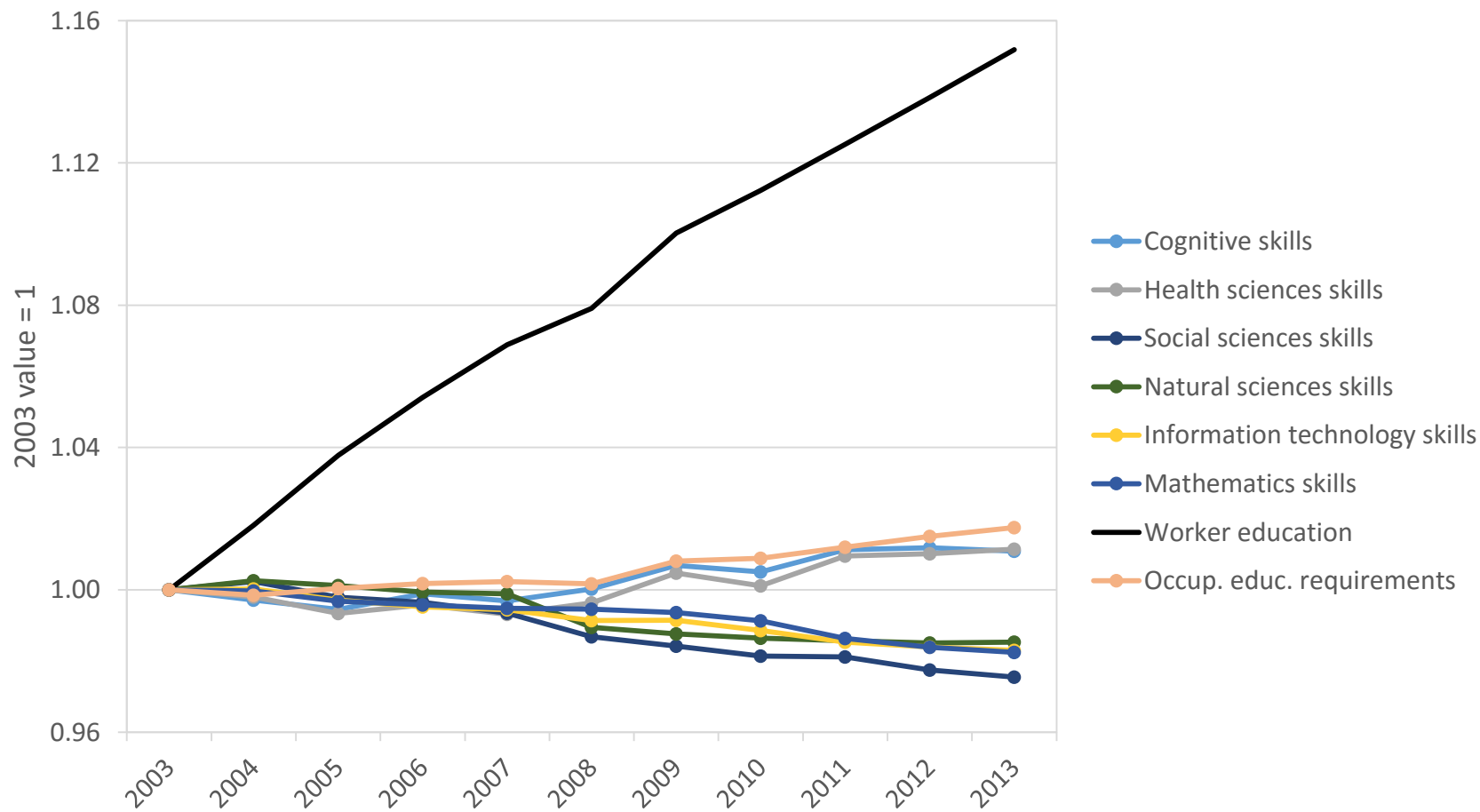
Industrial policies in Brazil (2004-2013)

- National content requirements & high import taxes
 - Costly components
 - No global value chain integration
 - No path to competitiveness
 - Low production scales
- South-South cooperation
 - Didn't advance beyond exporting mineral and agricultural commodities
- No articulation with education and training policies
 - Economic growth of the earlier 2010's plagued by the shortage of skilled labor

- Low effectiveness of education spending
 - Regional imbalances and heterogeneity
 - Low accountability
 - Low investments in teacher training
 - Insufficient focus on student achievement
- Imbalance between primary and secondary, versus tertiary education
 - Low investment in primary & secondary public education harms low-income students
 - High investments on tertiary public education favors high-income students

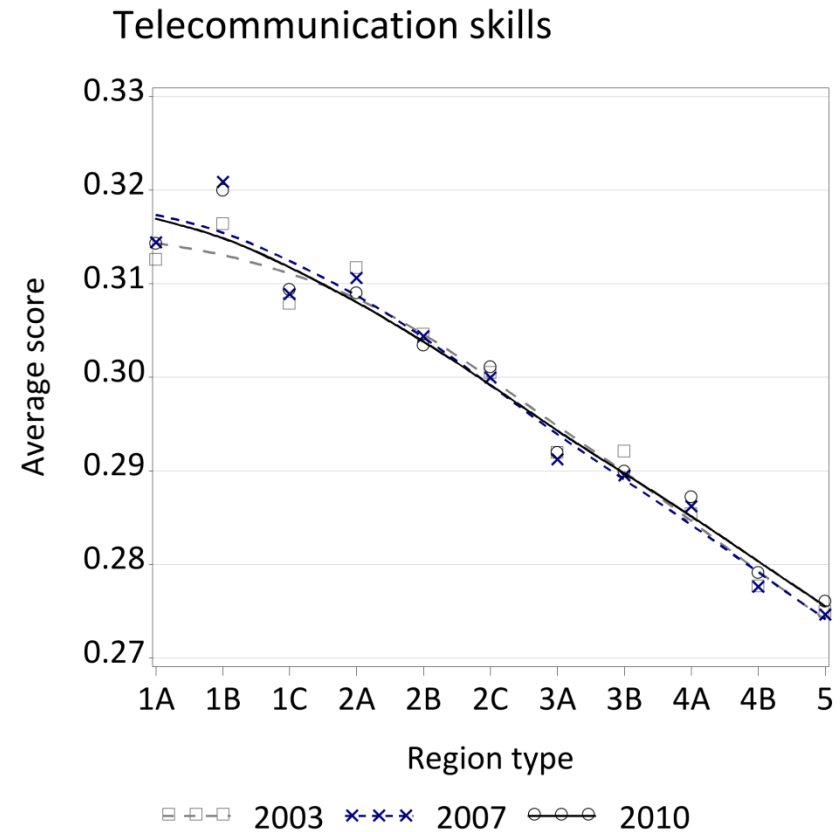
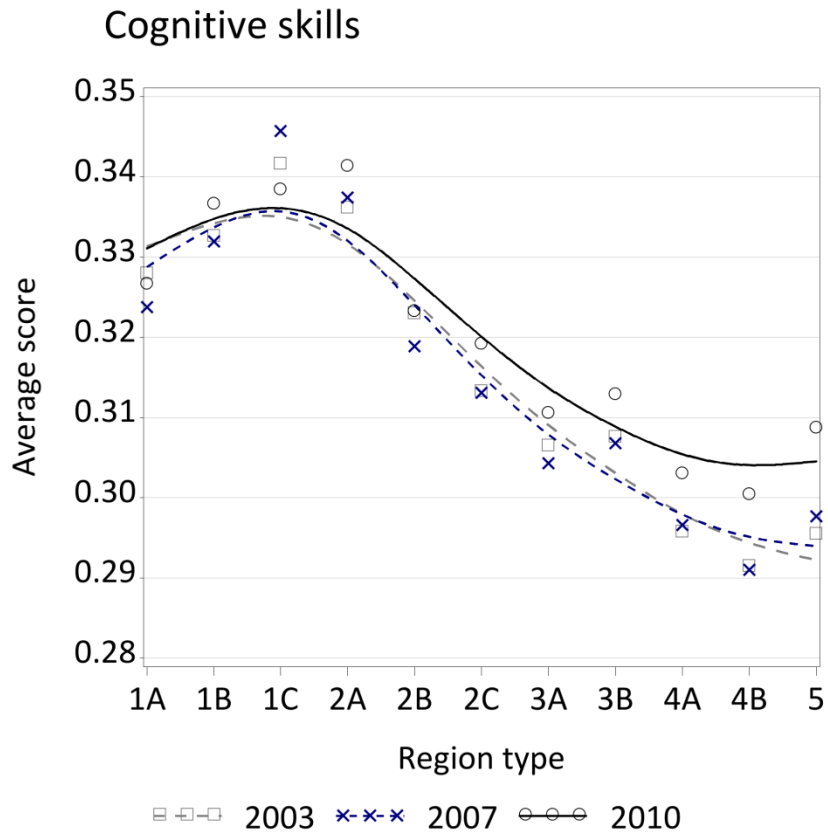
- Secondary & vocational education
 - Focus on 20th century skills
 - Deficient language, mathematics & science attainment
- Tertiary education and research
 - High-cost investment in scientific research
 - Few incentives to partner with private firms

Resulting skill trends in Brazil



Source: Maciente (2016)

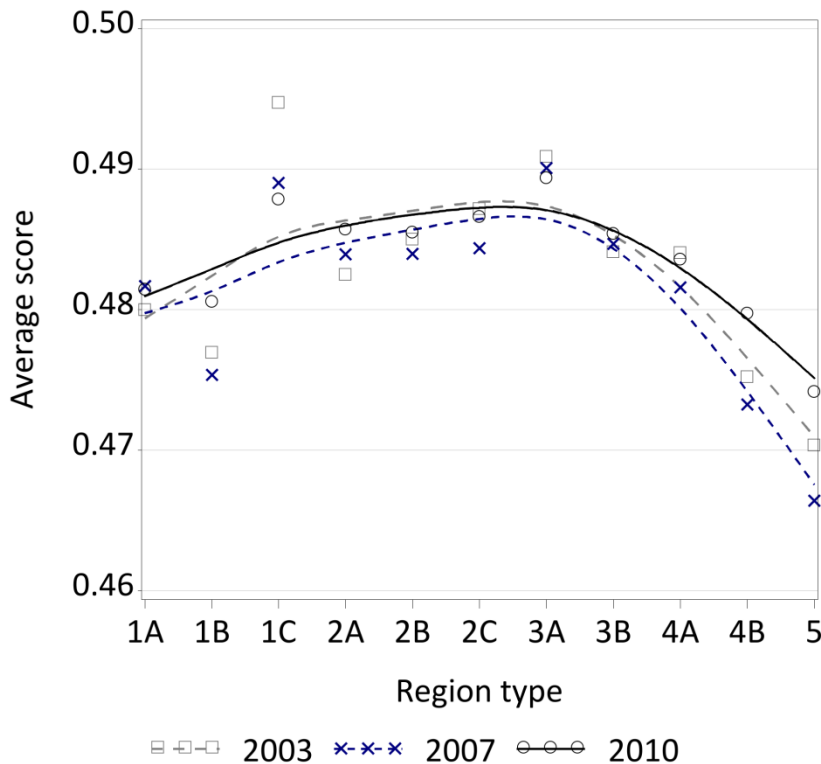
Skills present at larger regions



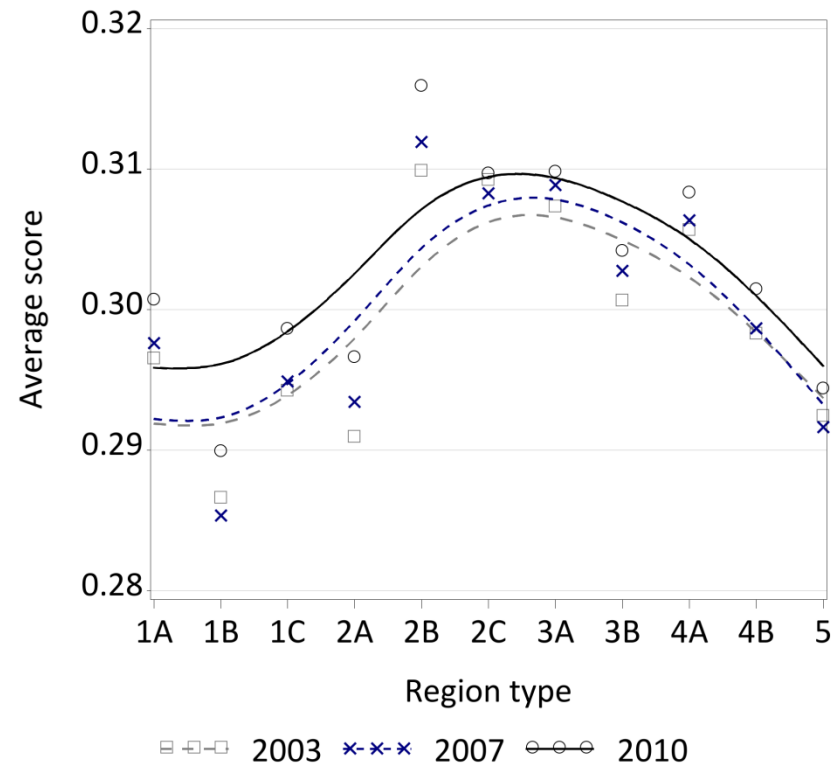
Note: larger municipalities to the left of the horizontal axis

Source: Maciente (2013)

Monitoring and compliance skills



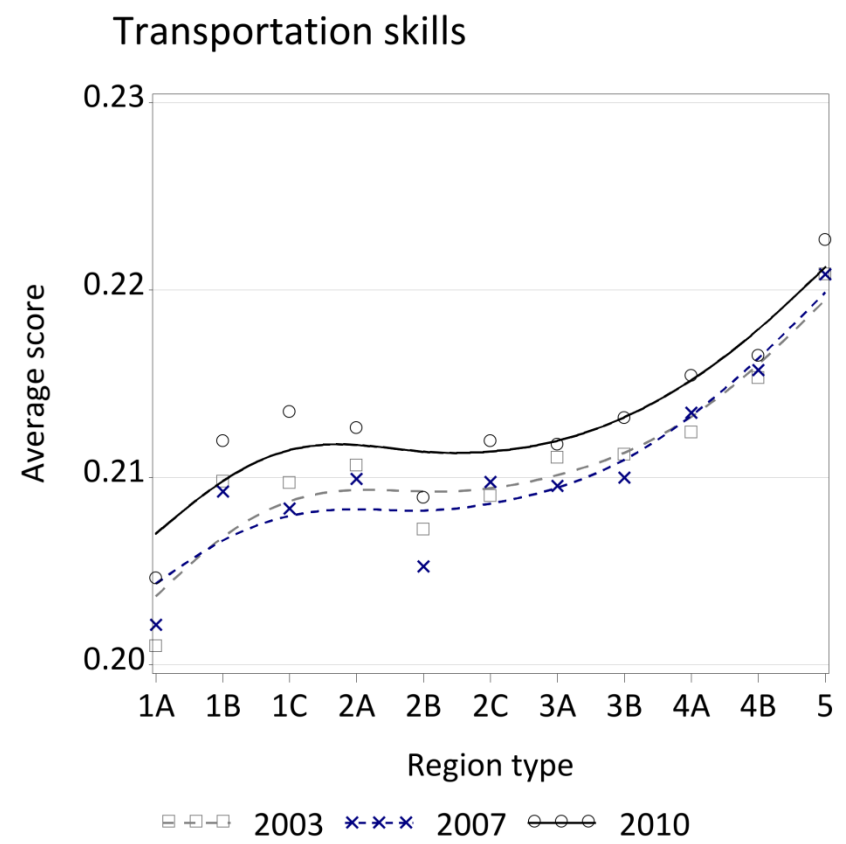
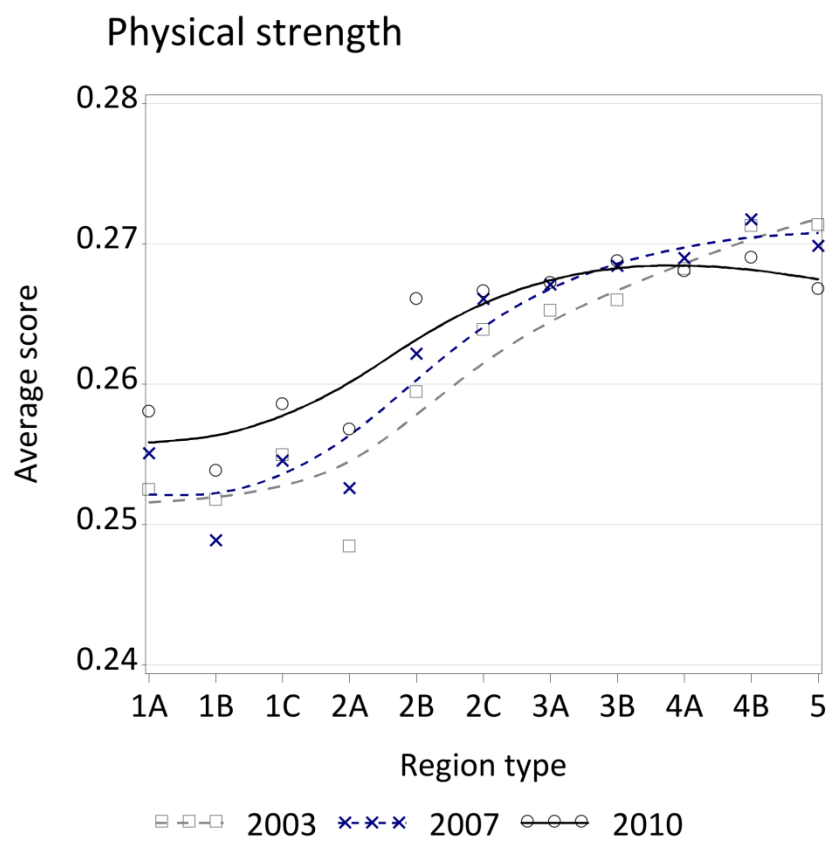
Design and engineering skills



Note: larger municipalities to the left of the horizontal axis

Source: Maciente (2013)

Skills present at smaller regions



Note: larger municipalities to the left of the horizontal axis
Source: Maciente (2013)

- Integration of economic and education policy goals
- Generalize basic reading, math and Science skills
- Special attention to educational attainment in
 - Rural and mineral producing regions
 - Large-city low-income population
- Create training opportunities and modular certification paths for adults workers
- Better integration between science investments and private-sector technological needs

- Focus on productivity, competitiveness and better job opportunities (regardless of sector)
- Search strategic opportunities in global value chains (regardless of region)
- Focused financial support
 - Data infrastructure
 - Logistics
 - Emerging players instead of established ones
- Attention to business regulations
- International dialogue on regulation, certification, standards, cyber security and property rights