LABOUR MARKET
INTELLIGENCE PARTNERSHIP

Skills, Technology and Capital Intensity: Employment & Wage Shifts in post-*apartheid* South Africa

Labour Market Intelligence Partnership Policy Roundtable

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Outline

LABOUR MARKET INTELLIGENCE PARTNERSHIP

- Introduction
- Data
- Changing Employment Landscape
  - Sectoral and Skills-biased trends
- Skills-Biased Technological Change
  - A Decomposition Analysis
- Task-Based Wage Analysis
  - Quantile Regression Application to Occupational Tasks
- Conclusions

Introduction

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- South Africa is an upper middle-income country:
  - Population 51 million
  - Resource rich, well-developed financial sector
  - GDP per capita US$7,507 (World Bank, 2012)
  - High unemployment (25%)
  - High poverty & inequality levels
- In post-*apartheid* period, continued skills-biased labour demand contributes to inequality & high unemployment rates

Key Questions

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- How has structure of economy changed in 10-year period?
- Are employment shifts 'skills-biased'?
- Do within- or between-sector shifts explain changes in employment?
- What has happened to wage returns across occupation task categories (& its link to technological and capital-intensive change)?
- What are the lessons for 'inclusive growth'?

Data

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- Labour Force Surveys (2001-2007)
  - Bi-annual
- Quarterly Labour Force Survey (2008-2011)
- Stratified random sample of ±30 000 dwellings
- Occupational and Industry codes (ISOC and SIC)
- Wage Data:
  - LFS: 2001-2007
  - QLFS: 2010 and 2011 (annual)

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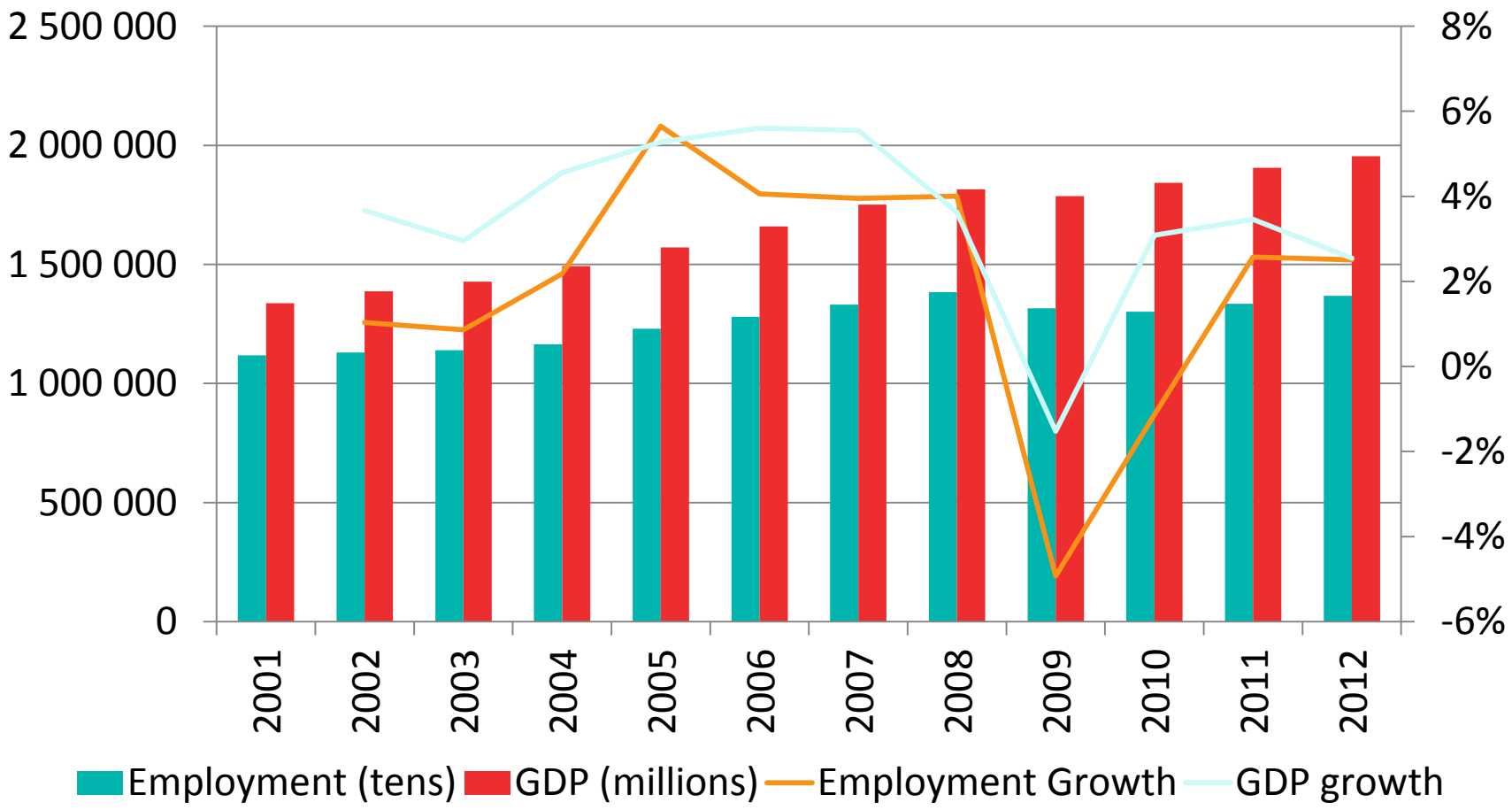
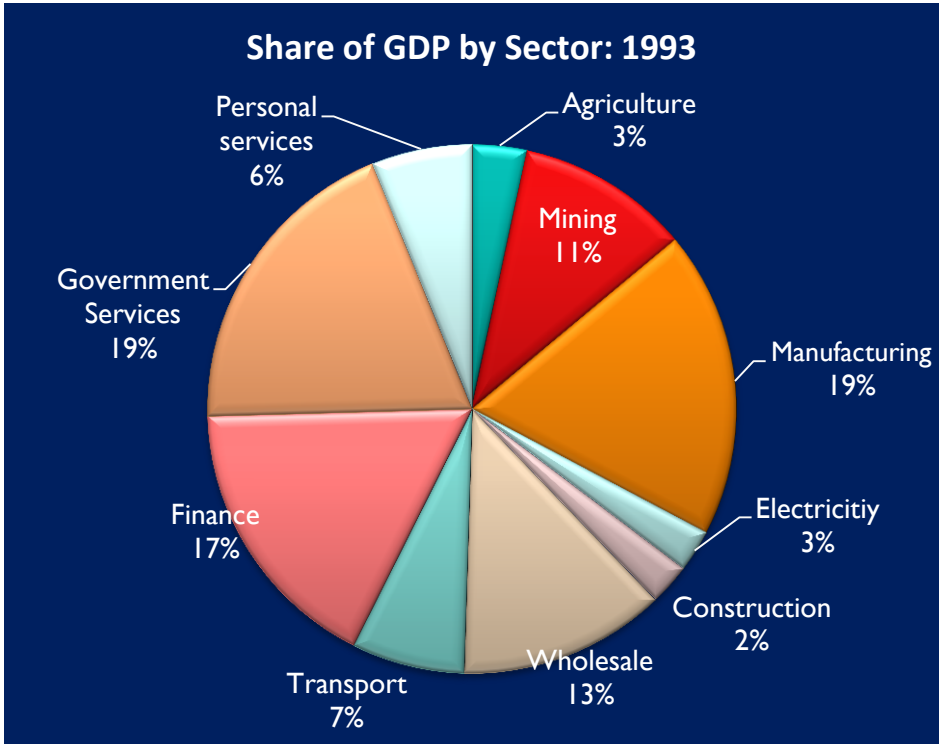
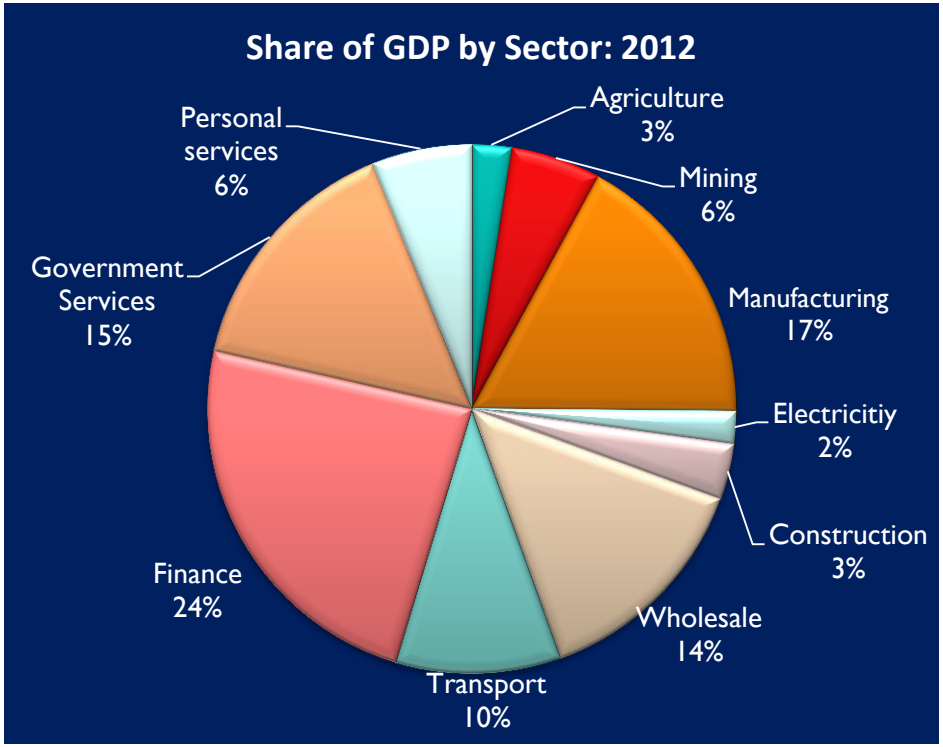
Real Quarterly Annualised GDP & Total Employment: Total & Percentage Change, 2001-2012



Source: *SARB & StatsSA (LFS 2001-2007 and QLFS 2008-2012), Author's Calculations*

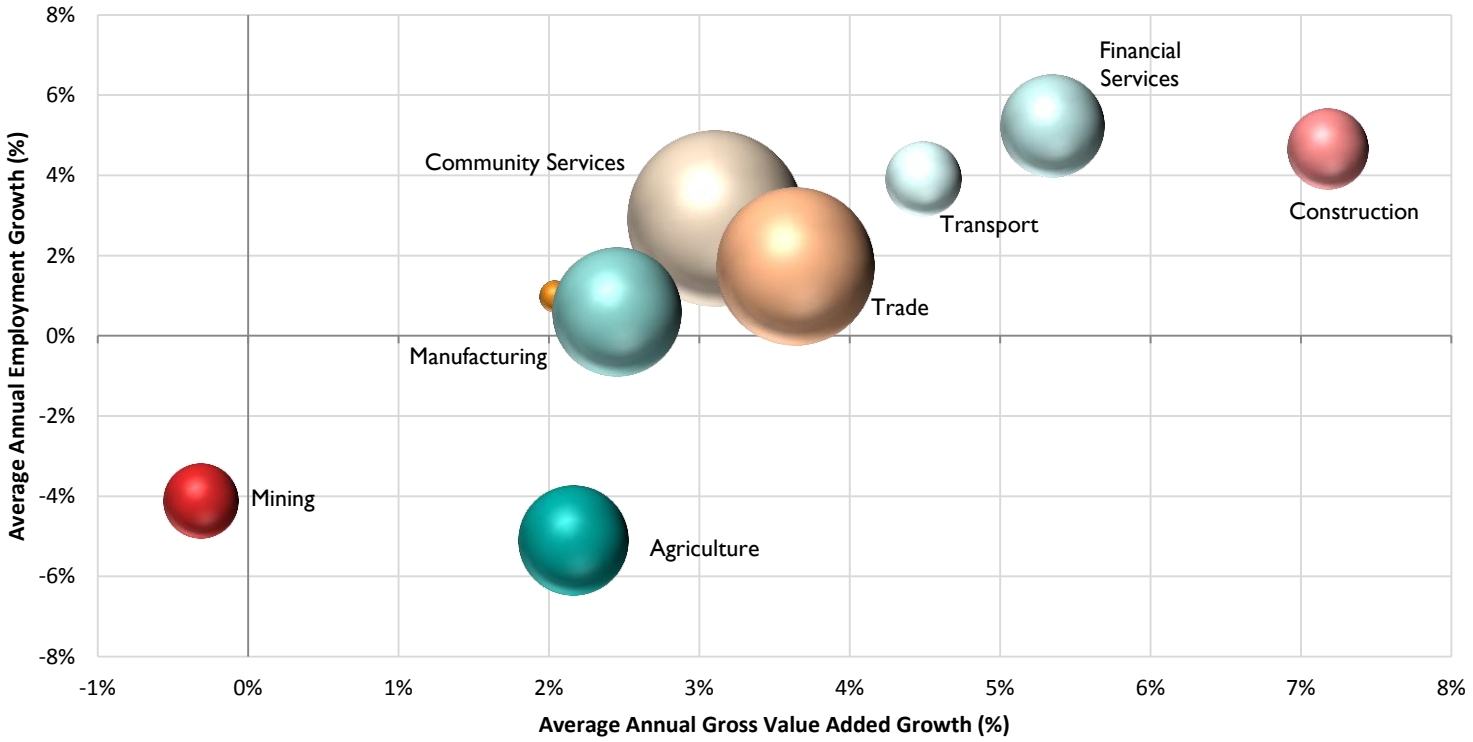
Main Sector Share of Real GDP, 1993 & 2012





Source: *SARB, Quarterly Bulletin, Various issues and Authors' Calculations*

Gross Value Added and Employment Growth, by Sector: 2001-2012



Source: *SARB, Quarterly Bulletin, Various issues and Authors' Calculations*

Employment Shifts by Main Sector, 2001-12

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	Growth (2001-2012)		*Employment Shares*		Share of Change ($\Delta E_i/\Delta E$)
	Absolute	**Relative** ($\%\Delta E_i/\%\Delta E$)	***2001***	***2012***	**(2001-2012)**
Primary	***-719,232****	***-2.6***	***0.15***	***0.07***	***-0.28***
Agriculture	-514,468*	-2.7	*0.10*	*0.04*	-0.20
Mining	-204,764*	-2.2	*0.05*	*0.02*	-0.08
Secondary	***537,376****	***1.0***	***0.21***	***0.21***	***0.21***
Manufacturing	112,149	0.3	*0.14*	*0.12*	0.04
Utilities	10,774	0.5	*0.008*	*0.008*	0.004
Construction	414,453*	2.5	*0.05*	*0.07*	0.16
Tertiary	***2,720,821****	***1.6***	***0.63***	***0.71***	***1.08***
Trade	513,572*	0.9	*0.21*	*0.21*	0.20
Transport	288,364*	2.1	*0.04*	*0.06*	0.11
Financial	782,108*	2.8	*0.09*	*0.13*	0.31
Comm Serv	1,041,524*	2.1	*0.17*	*0.22*	0.42
Priv Hholds	95,253	0.4	*0.09*	*0.08*	0.04
Total	**2,497,763***	**1.0**	***1***	***1***	**1**

Source: *StatsSA (LFS 2001 and QLFS 2012), Author's Calculations*

Employment Shifts by Sector-Skill Cells, 2001-2012

		Proportions		Change in Prop	Change in No
		2001	2012	2001-2012	
Primary	High-Skilled	0.03	0.08	*0.05*	*27,602*
	Med-Skilled	0.54	0.37	*-0.17*	*-571,229**
	Unskilled	0.43	0.56	*0.13*	*-175,392**
	Total	1	1	***-719,232****	
Secondary	High-Skilled	0.14	0.18	*0.04*	*188,518**
	Med-Skilled	0.70	0.62	*-0.08*	*136,140*
	Unskilled	0.16	0.20	*0.04*	*214,002**
	Total	1	1	***537,376****	
Tertiary	High-Skilled	0.27	0.29	*0.02*	*931,498**
	Med-Skilled	042	0.43	*0.008*	*1,214,349**
	Unskilled	0.31	0.28	*-0.03*	*576,288**
	Total	1	1	***2,720,821****	

Source: *StatsSA (LFS 2001 and QLFS 2012), Author's Calculations*

A Theory of Relative Labour Demand Shifts

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- Relative Labour demand patterns driven at the sectoral level by two forces:
  - *within-sector shifts* (driven, for example, by technological change)
  - *between-sector shifts (*driven, for example, by trade flows and evolving product demand)
- Identifies *relative* demand shifts in net sectoral employment growth

Relative Labour Demand Shifts: A Decomposition Analysis

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- Estimate using standard Katz & Murphy (1992) decomposition technique:

$$\Delta X_k^d = \frac{\Delta D_k}{E_k} = \sum_j \left(\frac{E_{jk}}{E_k} \right) \left(\frac{\Delta E_j}{E_j} \right) = \frac{\sum_j \alpha_{jk} \Delta E_j}{E_k}$$

- The subscript *k* refers to occupation (or other groups) and *j* refers to sectors.
- The total relative demand shift for group *k* in the period under consideration is measured by ΔX_k^d
- or , $\frac{\sum_j \alpha_{jk} \Delta E_j}{E_k}$ where $\alpha_{jk} = \left(\frac{E_{jk}}{E_j} \right)$ is group *k*'s share of total employment in sector *j* in the base year.
- ΔE_j is the change in total labour input in sector *j* between the two years.
- Derive within-sector shift as residual of total- and between-sector shifts.

Industry-Based Relative Demand Shift Measures, by Occupation: 2001-2012

	Between	Within	Total	*Share of Within in Total*
High-Skilled				
Managers	0.92	12.63	**13.32**	*94.9%*
Professionals	3.03	15.04	**17.20**	*87.4%*
Medium-Skilled				
Clerks	1.59	12.88	**14.07**	*91.6%*
Service & Sales Workers	1.92	11.75	**13.23**	*88.9%*
Skilled agric and fishery	-0.55	-19.60	**-20.47**	*95.8%*
Craft & Trade Workers	1.35	7.88	**9.01**	*87.4%*
Operators & Assembler	0.19	1.63	**1.81**	*90.1%*
Unskilled				
Elementary Workers	0.28	1.10	**1.37**	*80.1%*
Domestic Workers	0.37	3.49	**3.83**	*91.1%*

Source: StatsSA (LFS 2001 and QLFS 2012), Author's Calculations

Real Wages Shifts by Occupational Tasks

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- How have wages changed for those involved in specific tasks?
- Autor, Levy & Murnane (2003), Goos & Manning (2007), Acemoglu & Autor (2011) identify 'occupational tasks' as a key channel for wages shifts
- Relevant in face of capital deepening and skills-biased technological change
- Jobs requiring cognitive skill, creative problem-solving or face-to-face interaction are unlikely to be automated or threatened by international competition or technological change
- Routine tasks on an assembly line, for e.g. face high risks

From an Occupation- to a Task-based Measure of Skills

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- **Information and communication technology (ICT)**-related jobs: High information content; likely to be affected by technological change through adoption of new technologies, or face global low-cost competition. Include activities such as getting information, analysing data, recording information, and often involve interaction with computers. In the SASCO codes this consists of occupations such as software engineers, computer programmers, typists, data entry, and so on.
- **Automation/routinisation**: Jobs routine in nature and potential to be automated; involving repeated tasks; structured work environments, and where the pace of the job is often determined by mechanical or technical equipment. These jobs could also potentially be at risk through increased trade and import penetration. They include occupations such as textile weavers, engravers, machine operators, and assemblers.
- **Face-to-Face**: Work that relies on face-to-face contact, such as establishing and maintaining personal relationships, working directly with the public, managing people, caring for others, teaching, and work requiring face-to-face discussions. Generally these are jobs that cannot be easily automated or replaced by a competing international firm. Such jobs range from room service attendants, food vendors, labour supervisors, travel guides, to therapists and teachers.
- **On-Site**: Jobs that require the worker to be present at the particular place of work, and usually include tasks involving physical work, controlling machines/processes, operating vehicles or mechanical equipment, inspecting equipment, constructing physical objects. Again, these jobs are not easily offshorable and are generally made up of construction workers, machine operators, drivers, mechanics, and various kinds of manual labourers.
- **Decision-Making/Analytic**: Work that requires non-routine decision-making abilities, usually tasks that involve creative thought, problem-solving, developing strategies, taking responsibility for outcomes and results. Such jobs cannot easily be automated and are usually at lower risk of being displaced by international competition. Occupations include artists, all types of professionals, managers, and other jobs generally considered to be high-skilled jobs.

Occupation Categories and Occupational Tasks, 2001

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LFS September 2001	ICT		Automated		Face-to-Face		On-site		Analytic		Total	LFS Totals
	No.	Share	No.	Share	No.	Share	No.	Share	No.	Share		
Managers	0	0.00	0	0.00	663 227	0.19	8 681	0.00	663 227	0.35	1 335 135	663 945
Professionals	77 922	0.12	2 986	0.00	249 490	0.07	31 776	0.00	381 861	0.20	744 036	485 829
Technicians	178 638	0.29	205 165	0.05	531 864	0.15	134 110	0.02	671 219	0.36	1 720 996	1 176 031
Clerks	368 923	0.59	1 029 770	0.26	356 139	0.10	100 998	0.02	51 481	0.03	1 907 311	1 090 772
Service	0	0.00	0	0.00	1 034 643	0.29	740 526	0.12	32 993	0.02	1 808 162	1 429 021
Skilled Agriculture Workers	0	0.00	283 450	0.07	0	0.00	292 128	0.05	43 464	0.02	619 042	520 699
Craft Workers	0	0.00	724 015	0.18	0	0.00	1 297 763	0.20	30 134	0.02	2 051 912	1 529 375
Operators and Assemblers	0	0.00	475 869	0.12	0	0.00	878 239	0.14	0	0.00	1 354 108	1 127 155
Elementary Workers	0	0.00	1 311 656	0.33	673 791	0.19	2 055 714	0.32	0	0.00	4 041 162	2 252 554
Domestic Workers	0	0.00	0	0.00	0	0.00	881 411	0.14	0	0.00	881 411	881 411
Total	625 483	1	4 032 912	1	3 509 154	1	6 421 344	1	1 874 380	1	16 463 277	11 156 792

Source: *StatsSA (LFS 2001 and QLFS 2012), Author's Calculations*

Task Distributions, By Main Sector: 2001

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	ICT		AUTO		FACE		ONSITE		ANALYTIC	
	ICT		**AUTO**		**FACE**		**ONSITE**		**ANALYTIC**	
Sector	*No.*	*Share*	*No.*	*Share*	*No.*	*Share*	*No.*	*Share*	*No.*	*Share*
Primary										
Agriculture	6 252	0.01	1 054 458	0.26	23 619	0.01	1 195 143	0.18	53 543	0.03
Mining	19 338	0.03	415 210	0.10	26 215	0.01	453 409	0.07	23 024	0.01
Secondary										
Manufacturing	104 652	0.17	1 028 247	0.25	197 030	0.05	968 729	0.15	237 079	0.12
Utilities	7 170	0.01	40 058	0.01	19 569	0.01	68 856	0.01	15 792	0.01
Construction	7 244	0.01	223 553	0.05	38 761	0.01	586 422	0.09	36 106	0.02
Tertiary										
Trade	85 840	0.14	505 761	0.12	1 566 343	0.44	1 265 933	0.19	298 041	0.16
Transport	38 665	0.06	162 219	0.04	175 122	0.05	230 025	0.04	109 699	0.06
Financial Services	240 845	0.38	302 898	0.07	491 164	0.14	338 458	0.05	343 788	0.18
Community Services	114 706	0.18	378 878	0.09	1 032 946	0.29	544 978	0.08	794 582	0.41
Private HHs	0	0	0	0	6 502	0	898 622	0.14	235	0
Total	624 712	1	4 123 115	1	3 582 898	1	6 553 495	1	1 917 247	1

Source: *StatsSA (LFS 2001 and QLFS 2012), Author's Calculations*

Estimation Strategy

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- If we take a general statement of this approach across all points, or quantiles, in the distribution, we have the estimation for the regression quantile as minimising the equation:

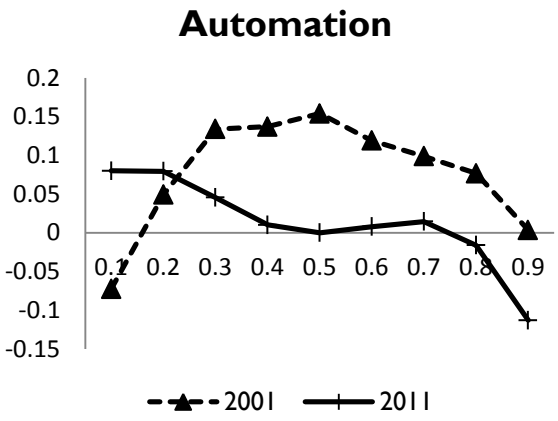
$$\underset{\beta \in \Re^k}{Min}\left[\sum_{i \in \{i: y_i \geq X_{i\beta}\}} \theta \left|Y_i - X_i\beta\right| + \sum_{i \in \{i: y_i < X_{i\beta}\}} \left(1-\theta\right)\left|Y_i - X_i\beta\right|\right]$$

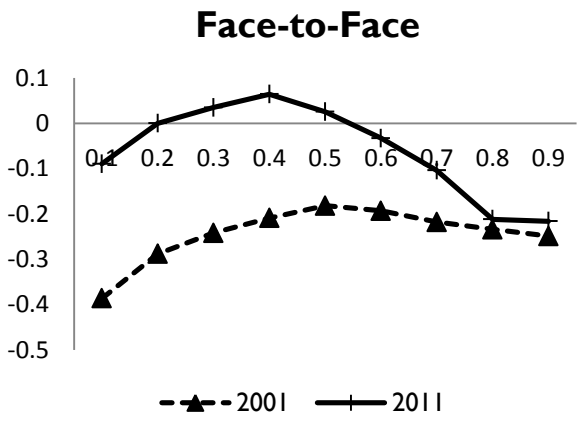
- This then provides the solution for the θ^{th} quantile, where $0<\theta<1$, allowing for estimation at any given point in the distribution of the outcome variable. In the above, Y_i is the dependent variable, $\boldsymbol{x_i}$ is the $kx1$ vector of independent variables and $\boldsymbol{\beta}$ is coefficient vector (Koenker and Bassett, 1978).
- Following Firpo, Fortin, & Lemieux (2011) we use 4-digit occupation codes and link every occupation with the 5 task categories and estimate a conditional quantile regression of the form:

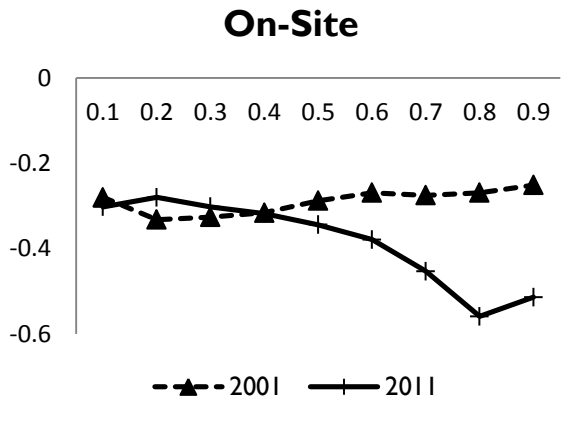
$$Log\ of\ Monthly\ Wages_t = \beta_1 + \beta_2 X_t + \beta_3 (Task\ Category_t) + \alpha$$

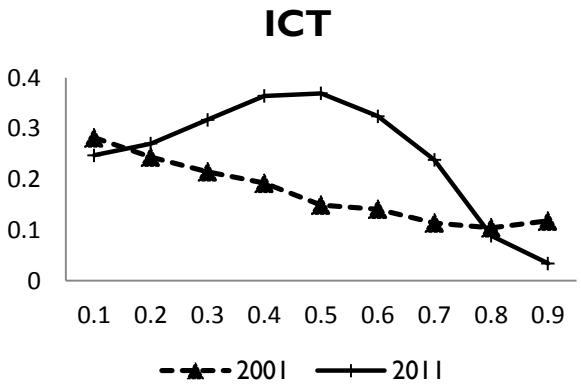
- where t is the year, β_1 is a dummy for each of the five categories, and X includes controls for age, race, and education. Variable of interest is coefficient on β_3, in each occupational category, for each decile of the income distribution in any given year.

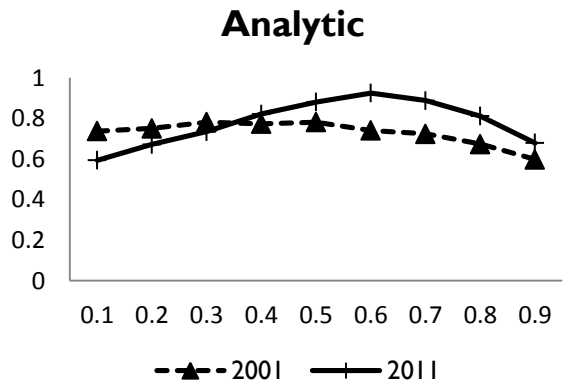
Task Wage Premia, plotted by Quantiles: 2001-2011











Source: *StatsSA (LFS 2001 and QLFS 2012), Author's Calculations*

Conclusions: Employment

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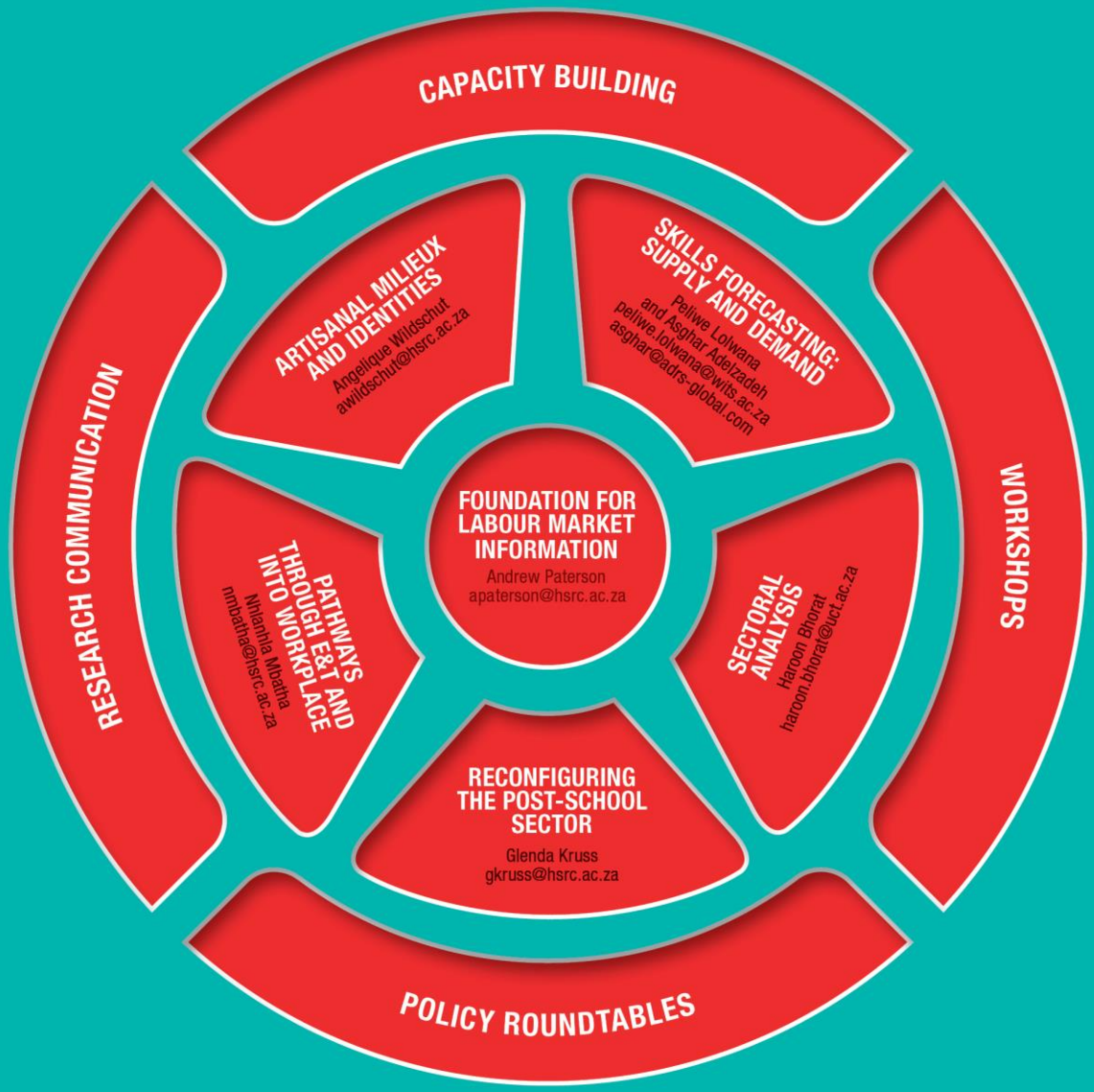
- Employment driven by 2001-2008 growth
- Primary sector employment collapse
  - Agriculture (Impact of W_m) and Mining together losing over 700 000 jobs
    - Both employers of least-skilled workers
- Lacklustre employment growth in Manufacturing
- Growth within tertiary sectors such as financial services and community services
  - Public sector as a growing source of employment
  - Financial Services & Temporary Empl. Service Providers
- Employment gains in high- and medium-skilled occupations
- Decomposition Results: Technological change, increasing capital intensity: within-sector shifts dominate reasons for relative labour demand shifts in South Africa

Conclusions: Wages

- Jobs that involve **automated or routine tasks** have experienced a drop in wage levels (Agriculture, Mining and Manufacturing)
- Jobs involving **face-to-face tasks** and those with an **ICT component** have seen rising wages in general (largely Community, Trade & Financial Services)
- **Onsite jobs** saw falling returns at upper end of the distribution (Manufacturing, Agriculture) but stable returns at the lower end (Domestic Workers)
- **Analytic jobs** posted high and relatively stable wages (community and financial services)
- At the bottom of the distribution wages remained relatively stable or rose in all task categories. Impacts of minimum wages and collective bargaining outcomes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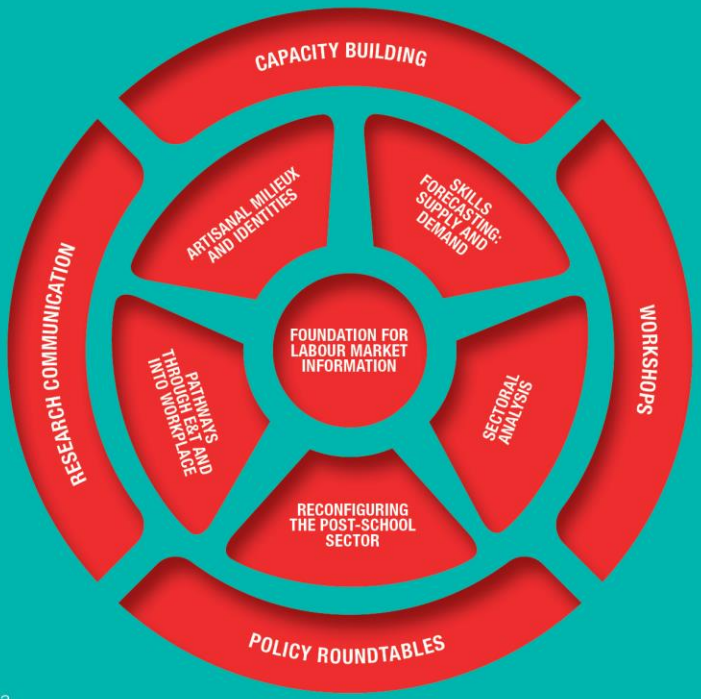

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