Labour market implications of promoting women's participation in STEM in Australia

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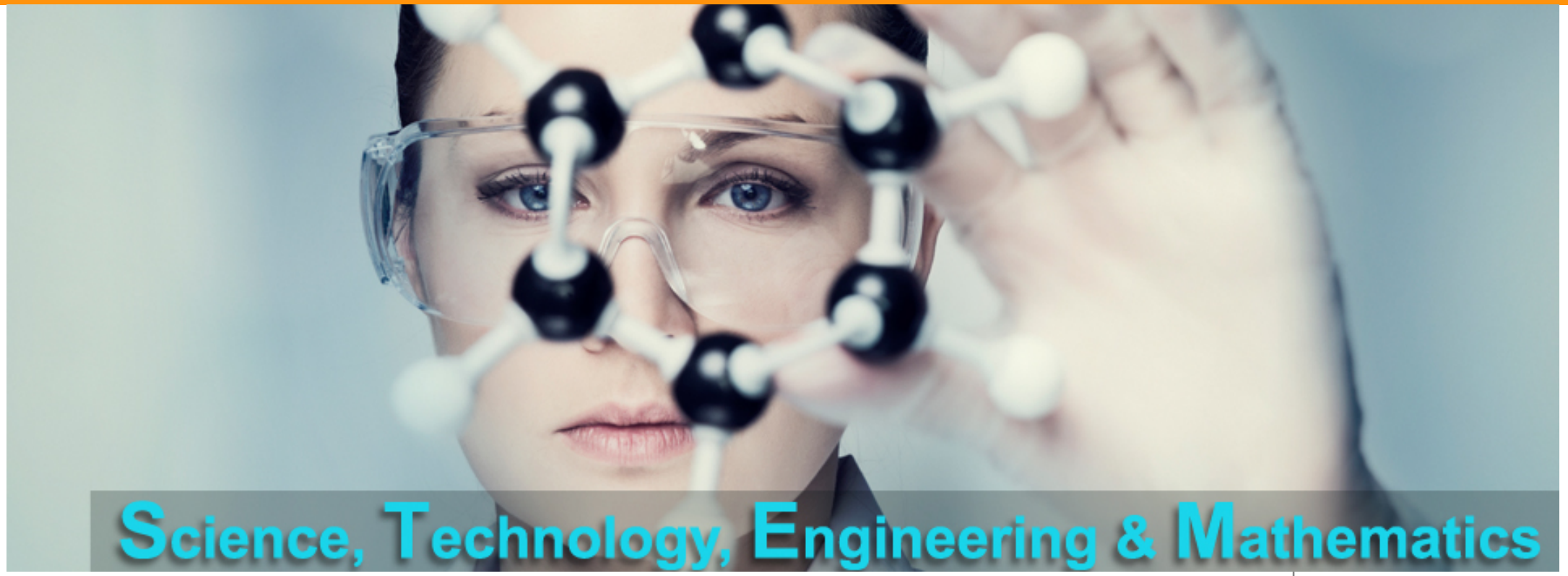

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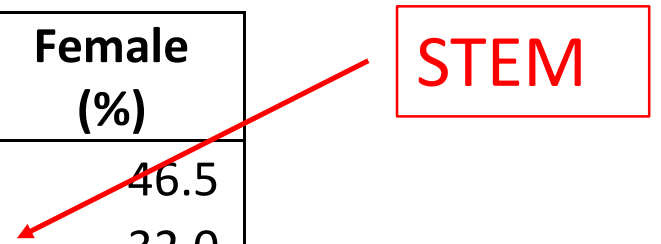
The Policy Context

- The “knowledge economy”
  - Need to increase proportion of workforce with tertiary qualifications (Bradley Review)
  - STEM skills critical to innovation and economic growth (Australian Industry Group, Office of the Chief Scientist, PwC)
    - “Jobs of the future”
    - International comparisons
    - Labour market shortages
  - Women now make up over half of graduates, but only around 20% of graduates in STEM
    - Need to promote women in STEM

Definition of STEM: Persons with Bachelor degree or higher by field of study, HILDA 2016 (population estimates)

Field of study	Persons	Female (%)
Natural and physical sciences	264,540	46.5
Information technology	260,011	32.0
Engineering and related technologies	401,248	14.4
Architecture and building	100,820	29.0
Agriculture, environment and related studies	105,459	37.1
Medicine	157,939	46.4
Nursing	350,809	91.3
Other health-related	317,485	71.4
Education	765,976	71.4
Management and commerce	1,029,647	44.3
Law	173,621	43.8
Society and culture	630,985	68.9
Creative arts	186,242	58.9
Food, hospitality and personal services	43,738	48.9
Other	70,400	61.3
Total	4,858,920	54.3



STEM and the labour market

- Labour market demand
  - Shortages
    - Healy et al. (2016) – shortages apparent in engineering, employers report difficulties filling vacancies
  - Over-supply
    - Norton (2016) - more STEM graduates than market can absorb
- For women?
  - Li et al. (2017), recent graduates earn 16% lower wages, markedly less likely to be in a well-matched job
  - Barriers to promotion, lack of family-friendly work arrangements, lack of role-models, high reported incidence of discrimination and (in US) sexual harassment.

10-year trends in STEM population in Australia: 2006 and 2016 ABS Census

	2006				2016			
	Male	Female	Total	% Female	Male	Female	Total	% Female
Natural & physical sciences	104,034	84,866	188,900	44.9%	146,587	138,283	284,870	48.5%
Information technology	88,055	29,123	117,178	24.9%	161,741	57,365	219,106	26.2%
Engineering & related Tech.	167,674	23,498	191,172	12.3%	285,577	54,954	340,531	16.1%
STEM	359,763	137,487	497,250	27.6%	593,905	250,602	844,507	29.7%
Other fields[a]	786,979	1,198,060	1,985,039	60.4%	1,255,673	2,081,218	3,336,891	62.4%
All graduates	1,146,742	1,335,547	2,482,289	53.8%	1,849,578	2,331,820	4,181,398	55.8%
STEM share all graduates	31.4%	10.3%	20.0%		32.1%	10.7%	20.2%	

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Trends in labour market status

	NPS	IT	ERT	STEM	non-STEM
2006 Census					
Participation rate					
Men	82.6%	93.4%	86.1%	86.9%	87.0%
Women	77.9%	83.6%	79.7%	79.4%	80.3%
Unemployment rate					
Men	3.04%	4.18%	2.63%	3.15%	2.66%
Women	3.38%	4.80%	4.91%	3.96%	2.53%
2016 Census					
Participation rate					
Men	80.2%	93.4%	85.8%	86.2%	82.9%
Women	76.4%	80.3%	78.5%	77.7%	78.6%
Unemployment rate					
Men	3.63%	3.92%	3.16%	3.49%	4.70%
Women	4.28%	6.22%	6.02%	5.06%	4.13%

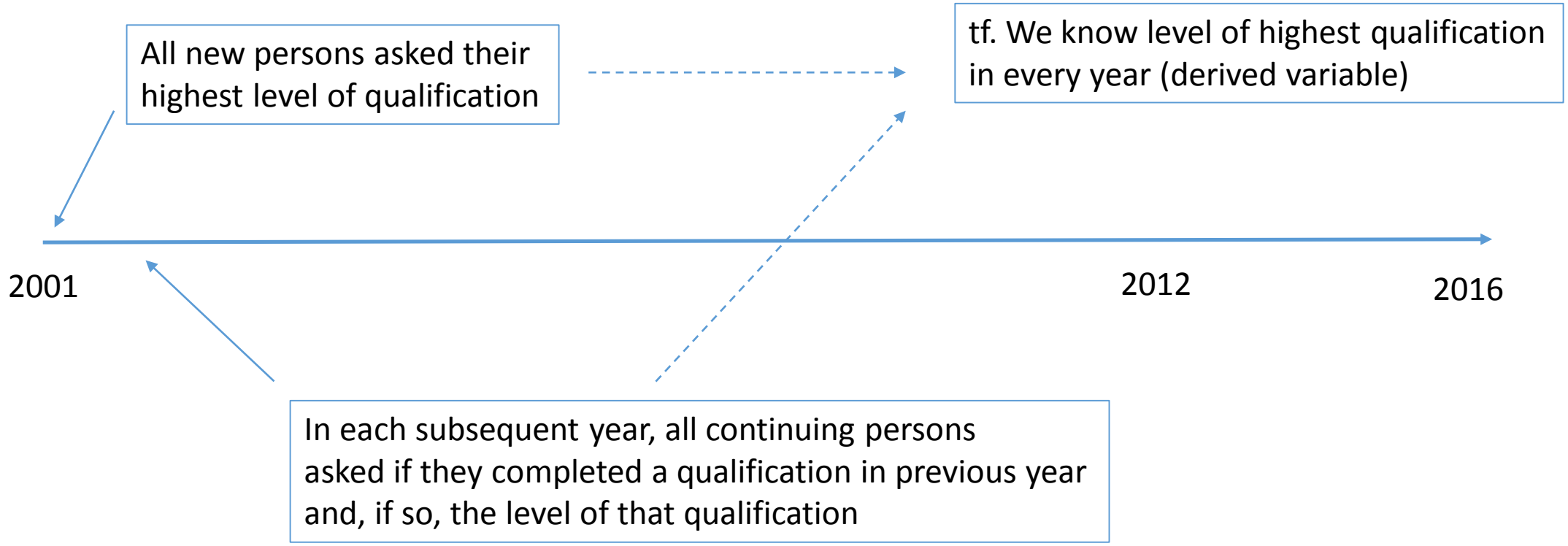
The Data: Household, Income and Labour Dynamics in Australia Survey (HILDA)

- Panel established in 2001, data available for Waves 1 to 16
- Representative sample of private households, all persons aged 15 and over surveyed
- ≈13,000 responding individuals from 7,000 households per year
  - In 2011 top-up sample of 2,153 households with 4,009 responding individuals

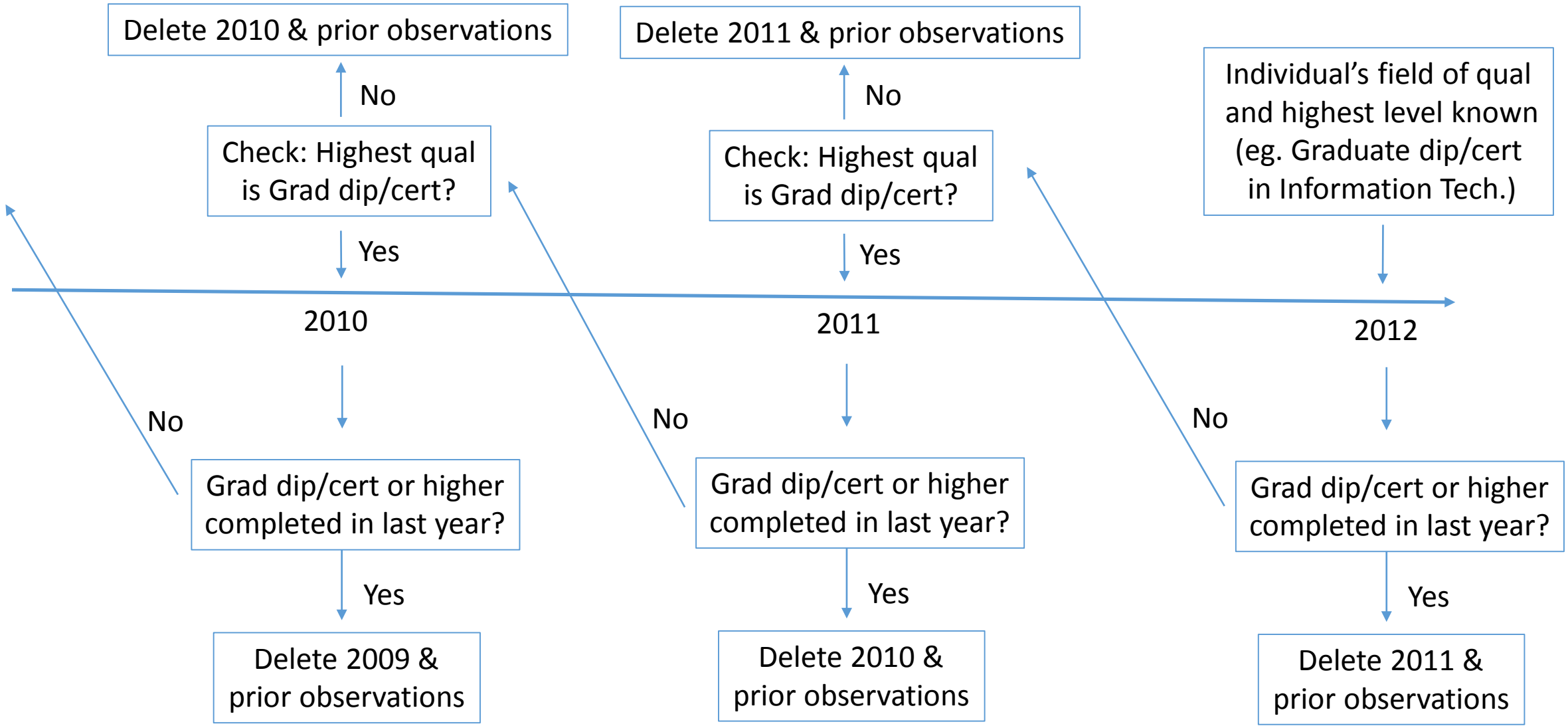
HILDA Survey (cont'd)

- Wealth of information on labour market experiences, background demographics, attitudinal data, etc.
  - Data on overall job satisfaction and satisfaction with different aspects of your job
    - With pay, security, the work itself, hours, flexibility.
  - Special education modules included in 2012 and 2016
    - **Field of study of highest education only asked in those modules in 2012 & 2016**

Identifying people with STEM qualifications



Deriving panel data (Bachelor degree or above)



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Graduates with field of study of highest qualification determined, HILDA sample

	Observations (persons)			Female share (%)		
Wave	STEM	Non-STEM	Total	STEM	Non-STEM	Total
1 (2001)	218	952	1170	22.5	62.1	54.7
2 (2002)	233	1022	1255	24.0	61.8	54.8
3 (2003)	258	1104	1362	25.2	61.8	54.8
4 (2004)	284	1202	1486	24.3	61.9	54.7
5 (2005)	307	1331	1638	24.4	62.0	54.9
6 (2006)	319	1370	1689	25.4	62.4	55.4
7 (2007)	355	1550	1905	25.6	62.6	55.7
8 (2008)	379	1673	2052	26.4	61.9	55.4
9 (2009)	417	1829	2246	26.6	61.5	55.0
10 (2010)	444	2000	2444	27.7	62.3	56.0
11 (2011)	660	2899	3559	28.8	62.5	56.2
12 (2012)	715	3275	3990	28.7	62.5	56.4
13 (2013)	685	3238	3923	28.8	62.2	56.3
14 (2014)	669	3313	3982	28.8	62.4	56.8
15 (2015)	698	3438	4136	29.2	62.7	57.1
16 (2016)	744	3656	4400	30.6	63.0	57.5
Pooled	**7385**	**33852**	**41237**	**27.6**	**62.3**	**56.1**

Multivariate panel model results: HILDA Waves 1-16

Sample	Males and females						Females only	
Independent. var	Female		STEM		Female*STEM		STEM	
Model/Dep var.	β	P>z	β	P>z	β	P>z	β	P>z
Binary logit								
Participation[a]	n.a.		n.a.		n.a.		-0.37*	0.08
Unemployment	-0.28*	0.07	-0.03	0.87	0.38	0.30	0.33	0.28
OLS								
Real hourly wages	-0.11***	0.00	0.09***	0.00	-0.09**	0.02	0.00	1.00
Ordered probit (Satisfaction with …)								
Emp. opportunities	0.00	0.90	-0.04	0.48	-0.18*	0.06	-0.21***	0.00
Total pay	0.02	0.59	0.08*	0.10	0.09	0.32	0.18**	0.02
Job security	0.00	0.98	-0.05	0.39	-0.04	0.69	-0.10	0.23
The work itself	0.06*	0.07	0.03	0.60	-0.10	0.22	-0.09	0.19
Hours worked	0.05	0.17	0.09**	0.04	0.18**	0.04	0.24***	0.00
Flexibility	-0.02	0.62	0.12**	0.01	0.15	0.11	0.24***	0.00
Job overall (disagree/agree…)	0.06	0.10	0.05	0.28	0.00	0.96	0.03	0.70
Uses skills/abilities	0.16***	0.00	0.06	0.28	-0.34***	0.00	-0.27***	0.00

Notes: ***, * *and * indicate the estimated coefficient is significantly different from zero at the 1, 5 and 10 percent levels, respectively; a. sample restricted to persons aged 69 and under.

Analyses by sub-discipline

- The lower participation of females with STEM qualifications applies primarily to those with qualifications in the natural and physical sciences
- The higher incidence of unemployment is driven by higher unemployment for women with information technology
  - Estimates suggest a female with IT qualifications is 4 times more likely than a male with IT qualifications to be unemployed
- Women's reduced satisfaction with employment opportunities applies across the three fields
  - Most pronounced for IT
- Women with engineering related qualifications earn 20% higher hourly wages than women with non-STEM qualifications
  - it is these women that drive the higher pay-satisfaction among STEM qualified women
- The perceptions of under-utilisation of skills and abilities applies to women with qualifications in the natural and physical science and in IT
  - it does not apply to women in engineering fields.

Concluding thoughts

- Sceptical of arguments of the need for more STEM graduates
- Policies to encourage more women into STEM need to be more carefully considered:
  - ➢ Supported with demand-side (workplace) policies?
  - ➢ Compensatory incentives?
- More research needed to validate arguments and to guide policy
  - ➢ Differences by sub-disciplines seem important
    - ❖ Mixed evidence re. effects of male domination
- Significant limitations relating to definitions and data