Does more education reduce the wage gap? An analysis of labour market outcomes for native and foreign PhD *(preliminary)*

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Background

- Mobility of tertiary educated >> mobility others over past 30 years;
- Widespread evidence of skill wastage: occupational downgrade, over-education…. regardless of selective immigration policies;
- Wastage attributed to L-demand (discrimination) and supply (host country language skills, no network…), and more recently to institutional features (e.g. occupational licensing) and
- imperfect transferability of human capital…

Transferability of human capital

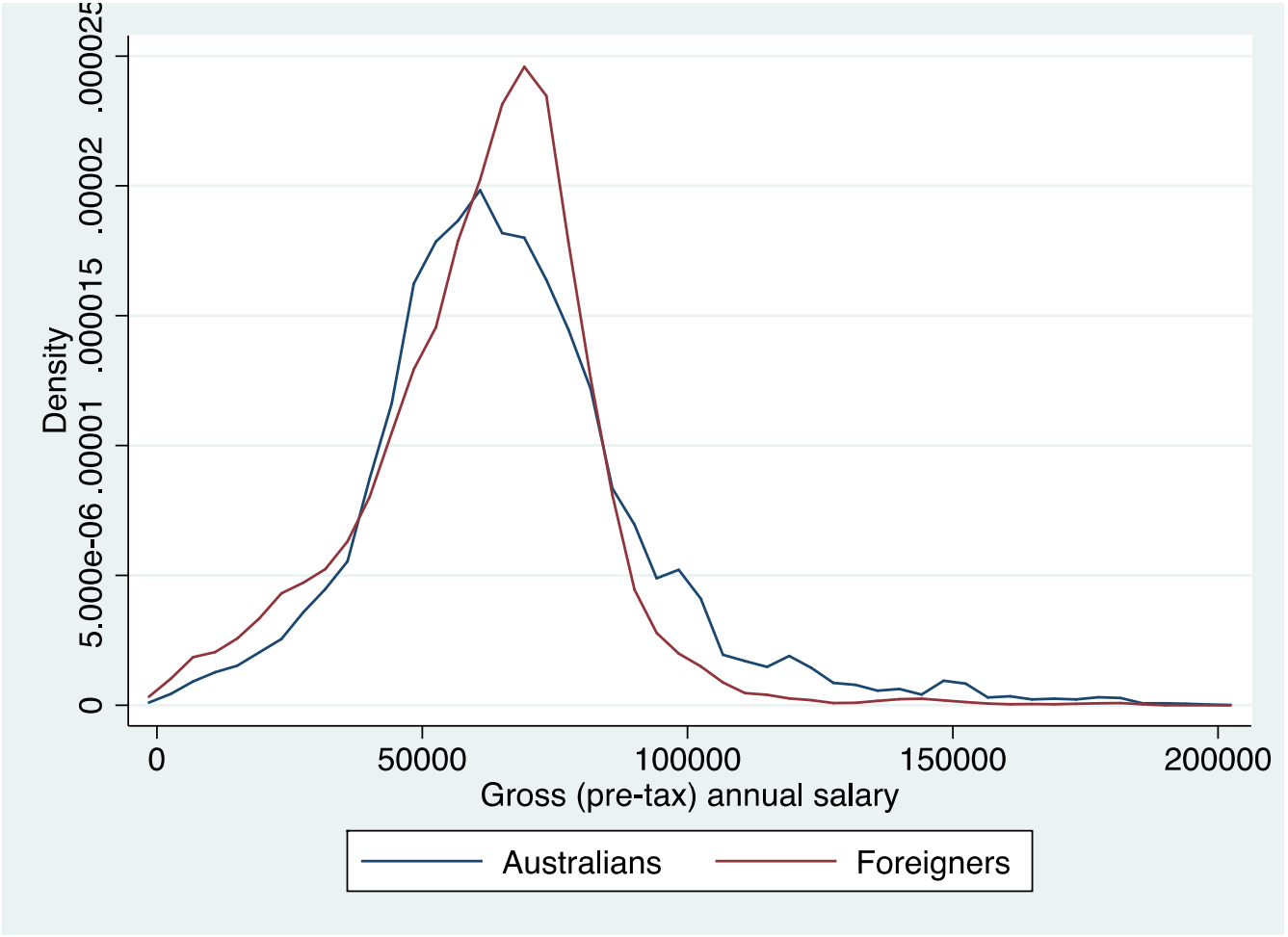
- Deemed imperfect but it conflicts with:
  - Migrants self-selection - they tend to be better able and motivated than stayers (Borjas, 1987, 1991)…
  - Migrants education – it is often higher thanamong stayers and natives (Carrington and Degatriache, 1998, Docqier, Ozden and Peri, 2014)…...
  - Prominence of education and host country language skills in point awarded in selective immigration countries like Australia.
- Also difficult to test - hard to identify perceived quality of foreign schooling from migrants' information about host country labour market

→ **Is transferability imperfect in extreme case of PhD education? (small contribution but also little research)**

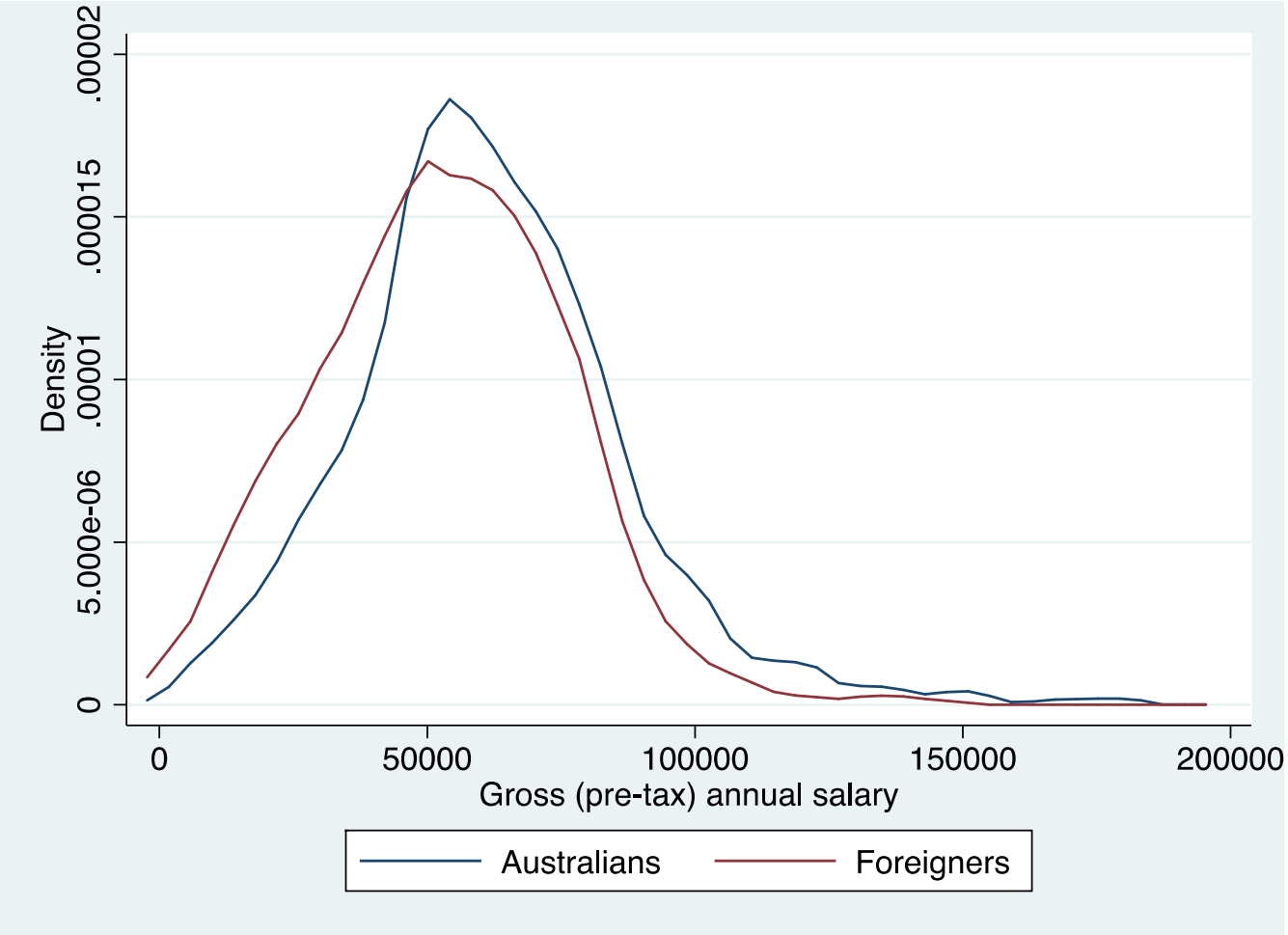
This paper

- Focuses on PhD labour market in Australia
- Data from Graduate Destination Survey 1999-2015
- Focus on decomposition of native-foreign wage difference

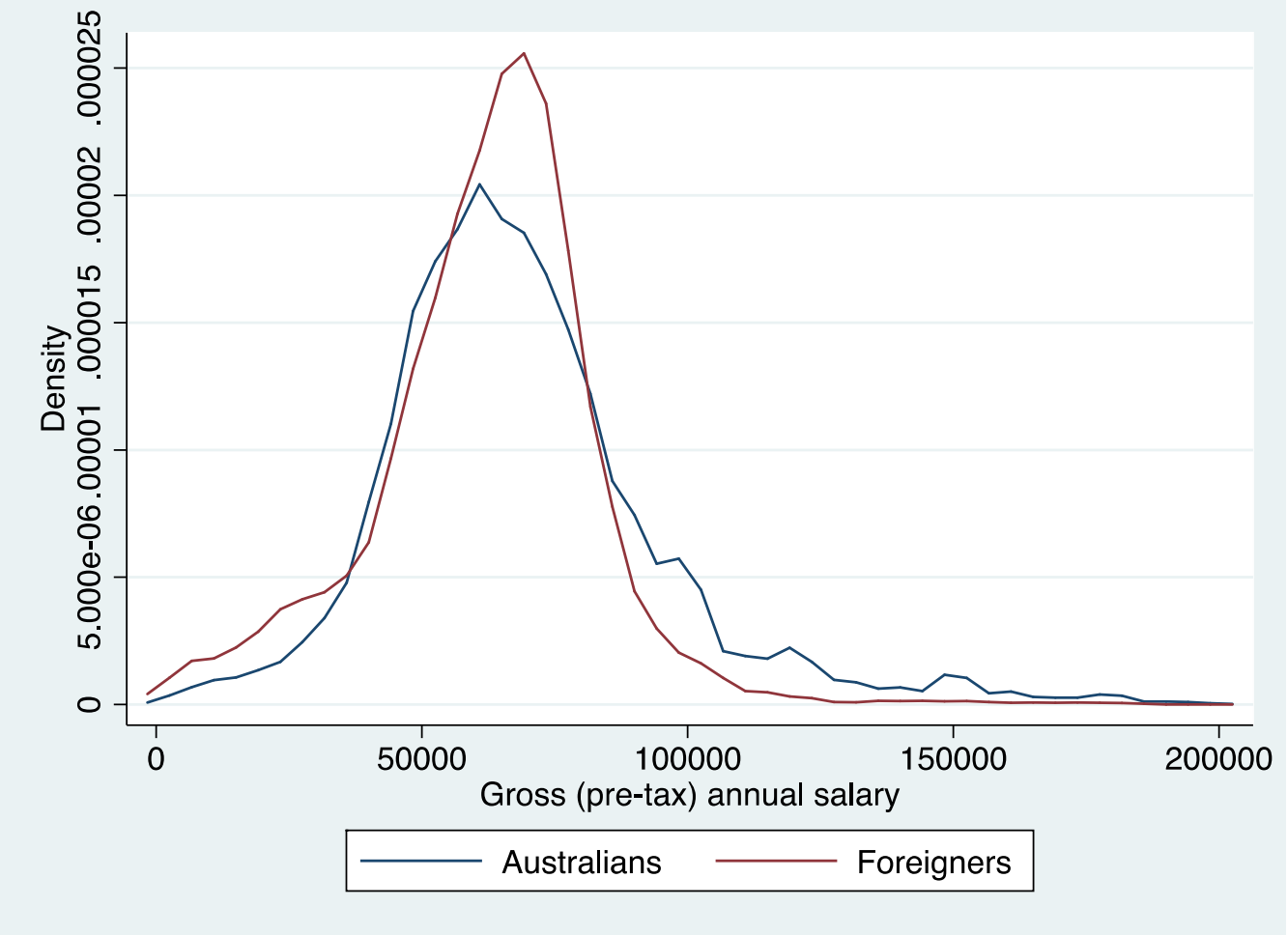
Salary by residence: working in Australia



STEM



Humanities


Density
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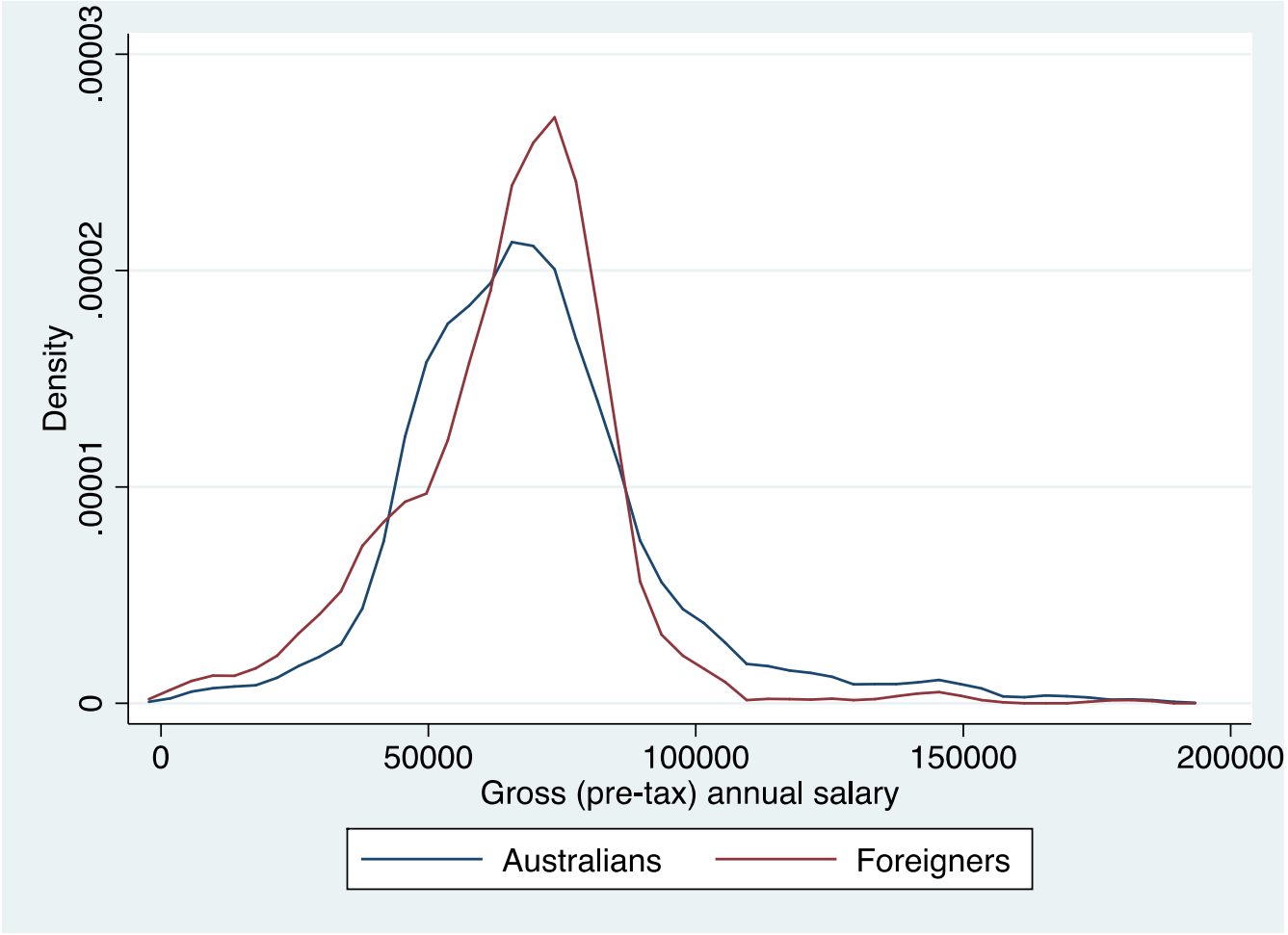
Gross (pre-tax) annual salary
Australians
Foreigners

Medicine



Literature

- Features of PhD programme, occupation, and trends: on-the-job training for research (Mangematin and Mangran, 1998), international labour demand dominated by universities and research centres (Auriol, 2010; Levin, 1996). Rising volumes of graduates (Cyranoski et al, 2011), temporary work (Stephan and Ma, 2005), private sector employment, and mismatch (Di Paolo, 2014) now a feature;

- Determinants of graduates' mobility: work in prestigious institution more important than pay or skill use (De Grip et al, 2010). Return home related to family not work (Franzoni et al, 2012);

Literature

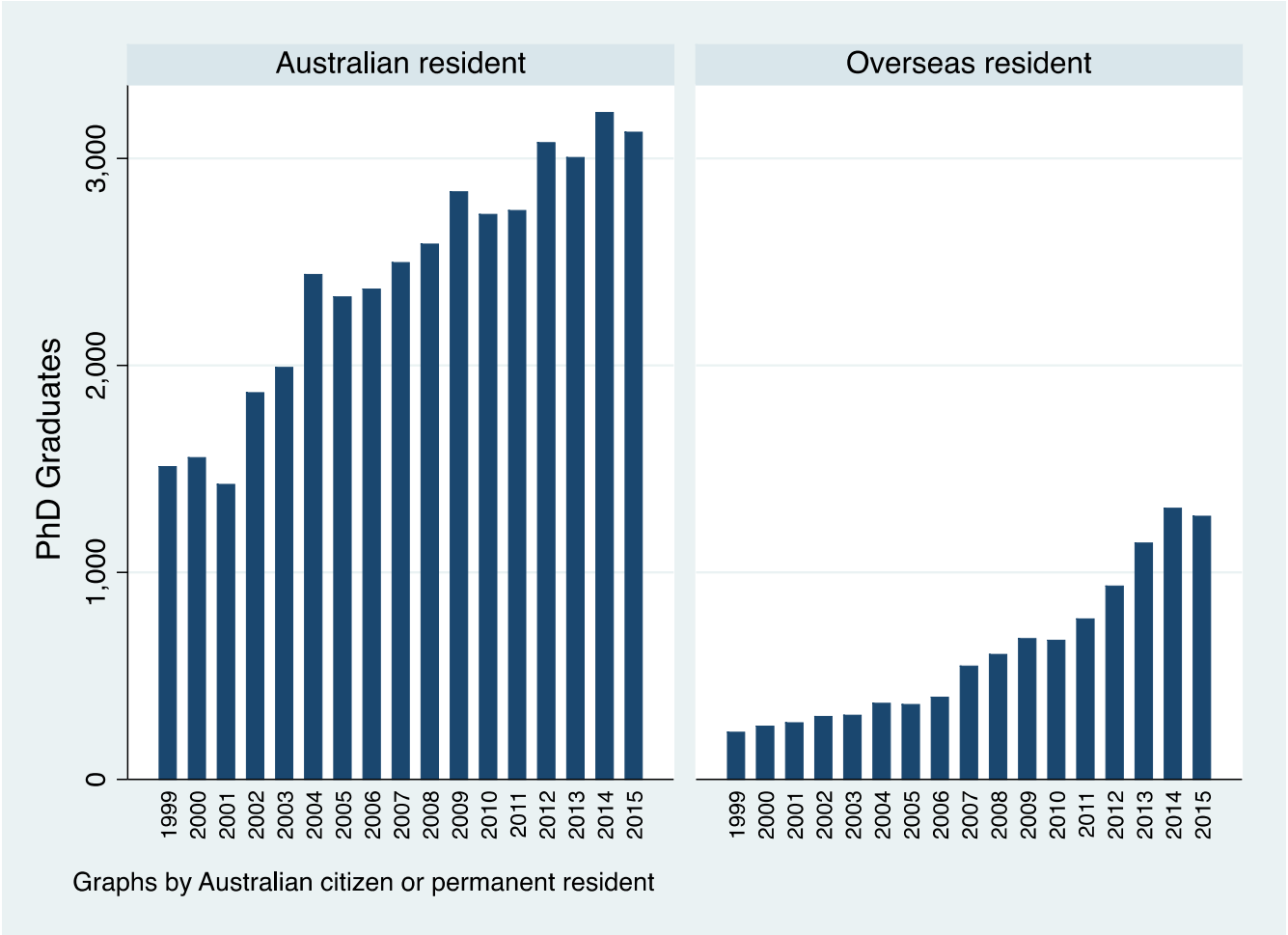
- Labour market outcomes: raise innovation activity via patents and start-ups (Gauthier-Loiselle, 2010), raise international collaboration and productivity at individual (Jonkers et al, 2013), institutional (Carillo et al, 2013) and geographical level (Freeman, 2014).
- Language is barrier to managerial positions, especially in the Sciences (Hunt, 2013). Evidence of over-education also in Sciences (Engineering - Hunt, 2013).
- No research on Australia: some descriptives of graduates' preference for university-industry partnerships (Hartman, 2002)

Data

Graduate Destination Survey

- annual survey asking questions on supervision, labour market outcomes, employer location, and basic demographics (e.g. no marital status, number kids…);
- Pooled cross section across time with good coverage ~ 50-60% graduates;
- Limitations: limited demographic information, no data on dropouts, no information on GPA
- Sample: 16 rounds (1999-2015): 51,761 observations → work in Australia (35,602) with no missing data on salary/hours (29,304): 91.2% Australians (26,678) and 8.8 foreign resident (2,586)

Rising numbers of PhD graduates



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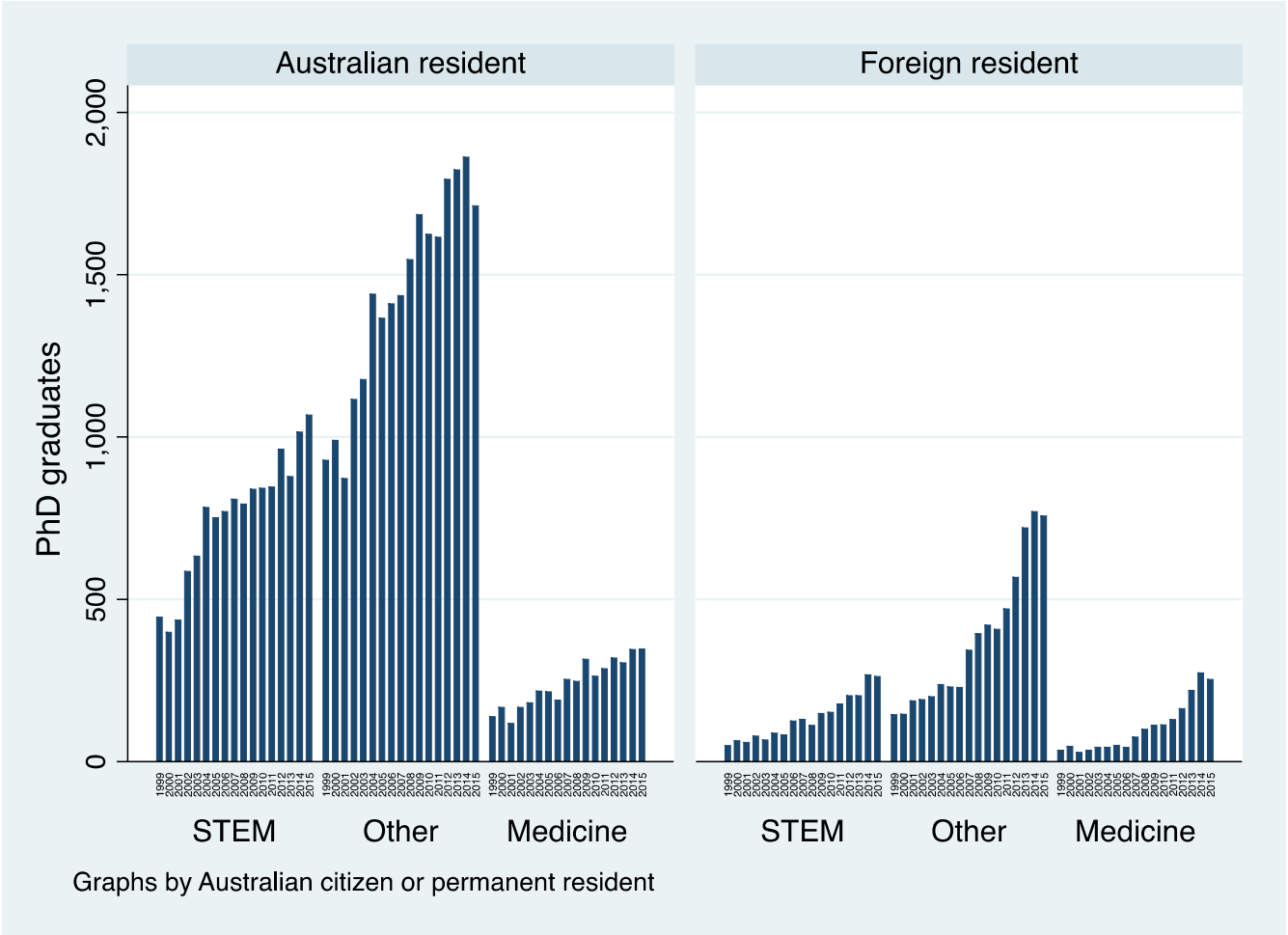
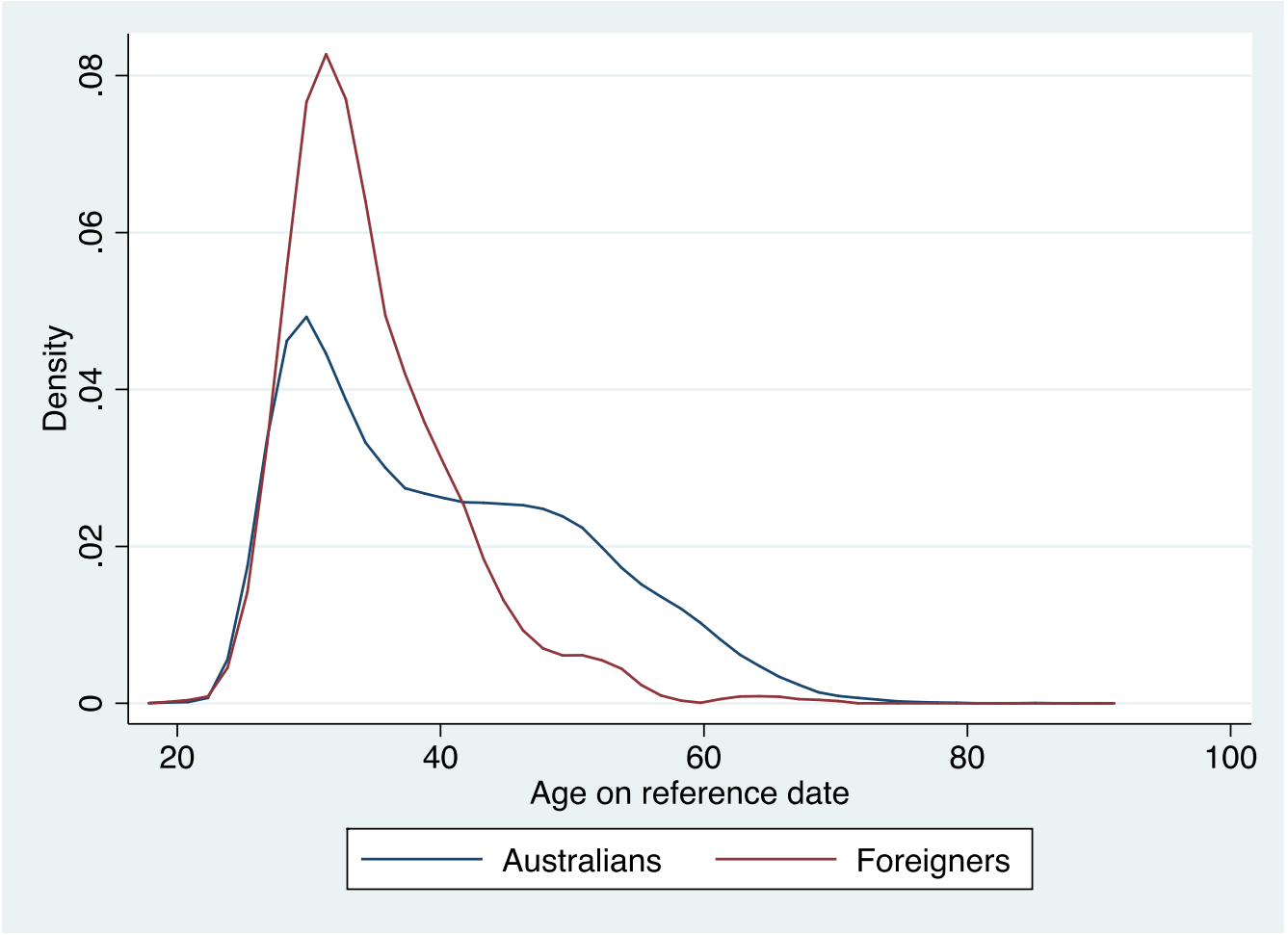
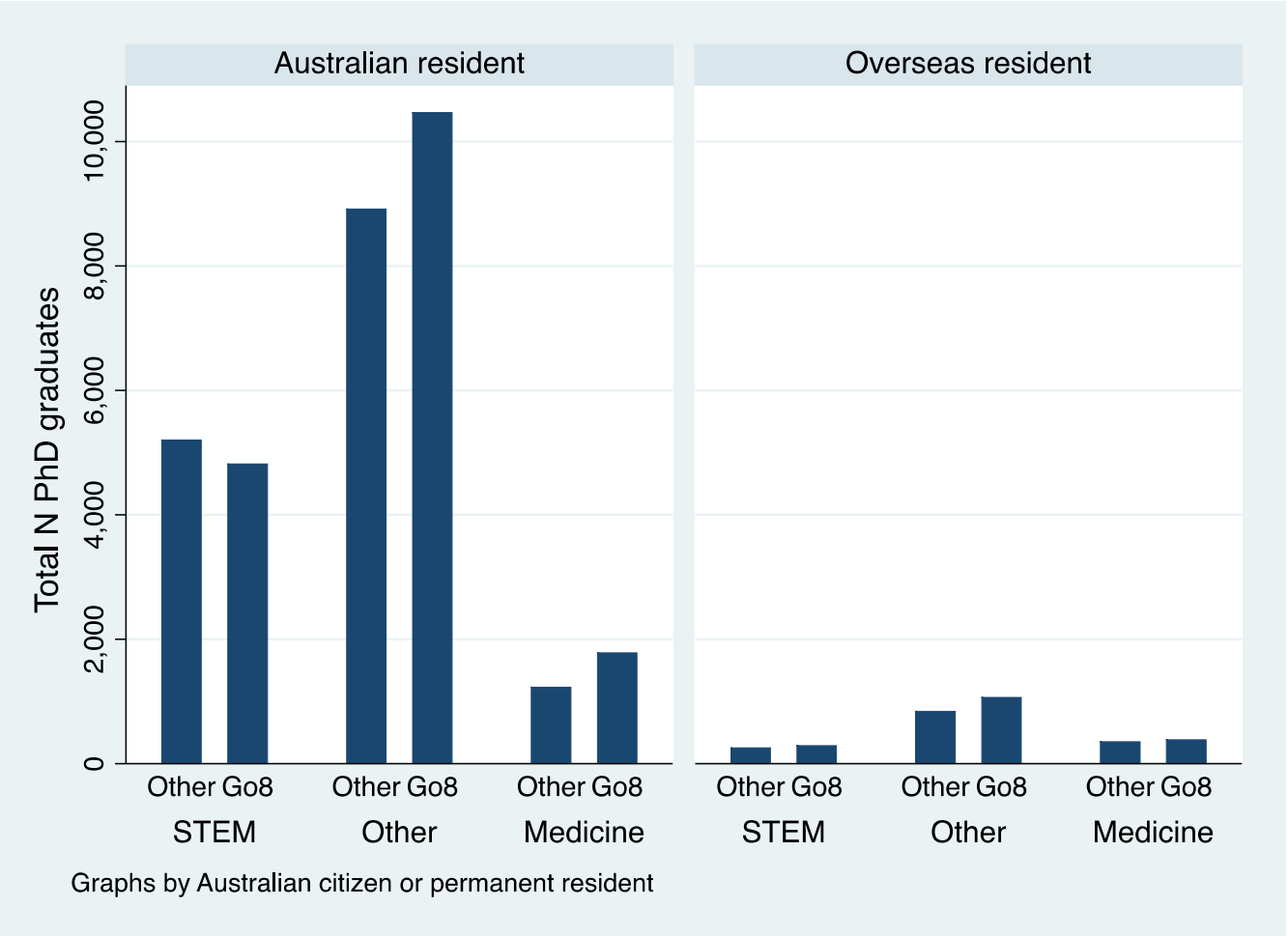
Rise across all disciplines



An Australian anomaly: age at completion



Who stays and who goes: work in Australia



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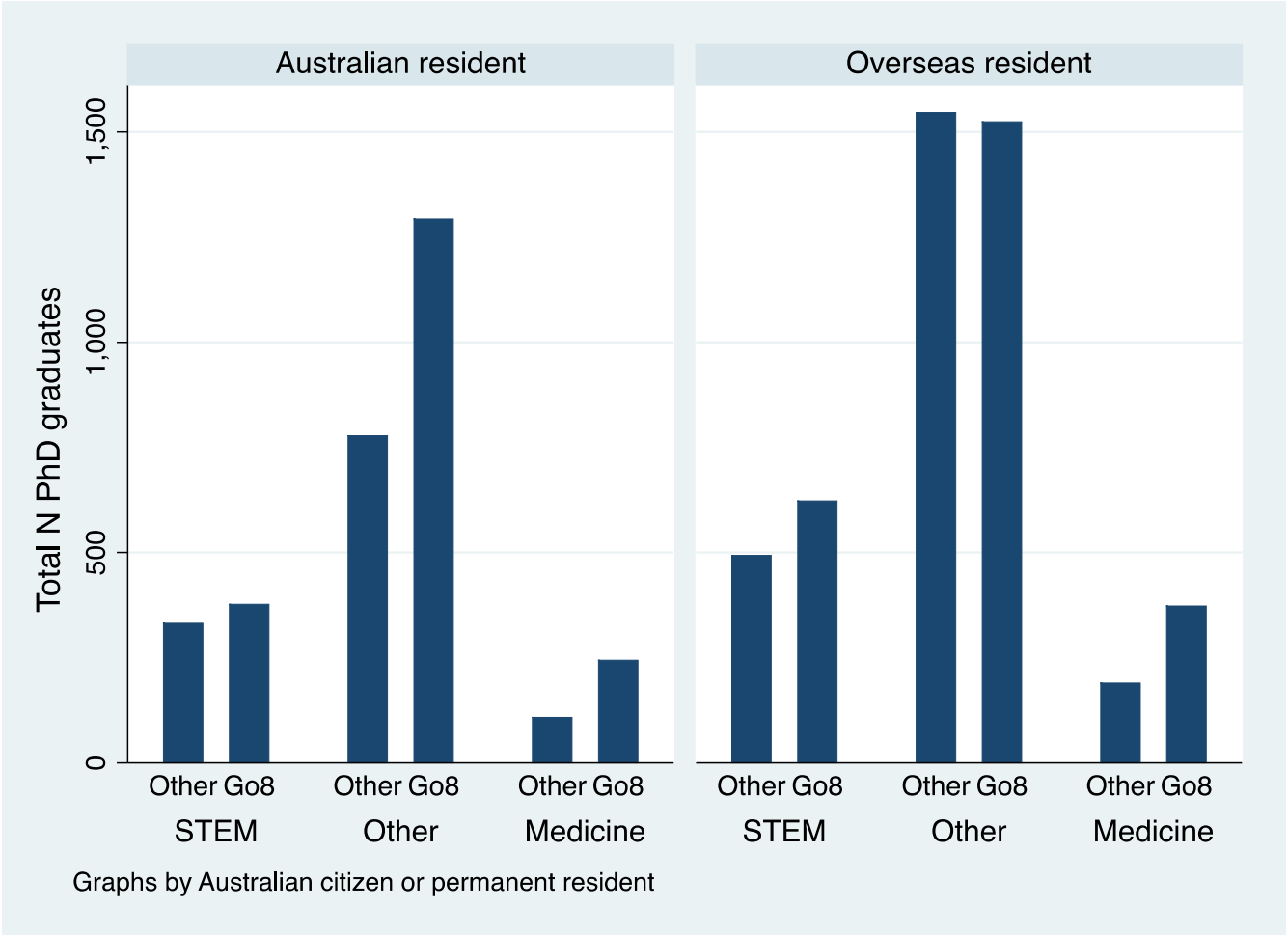
Who stays and who goes: work abroad



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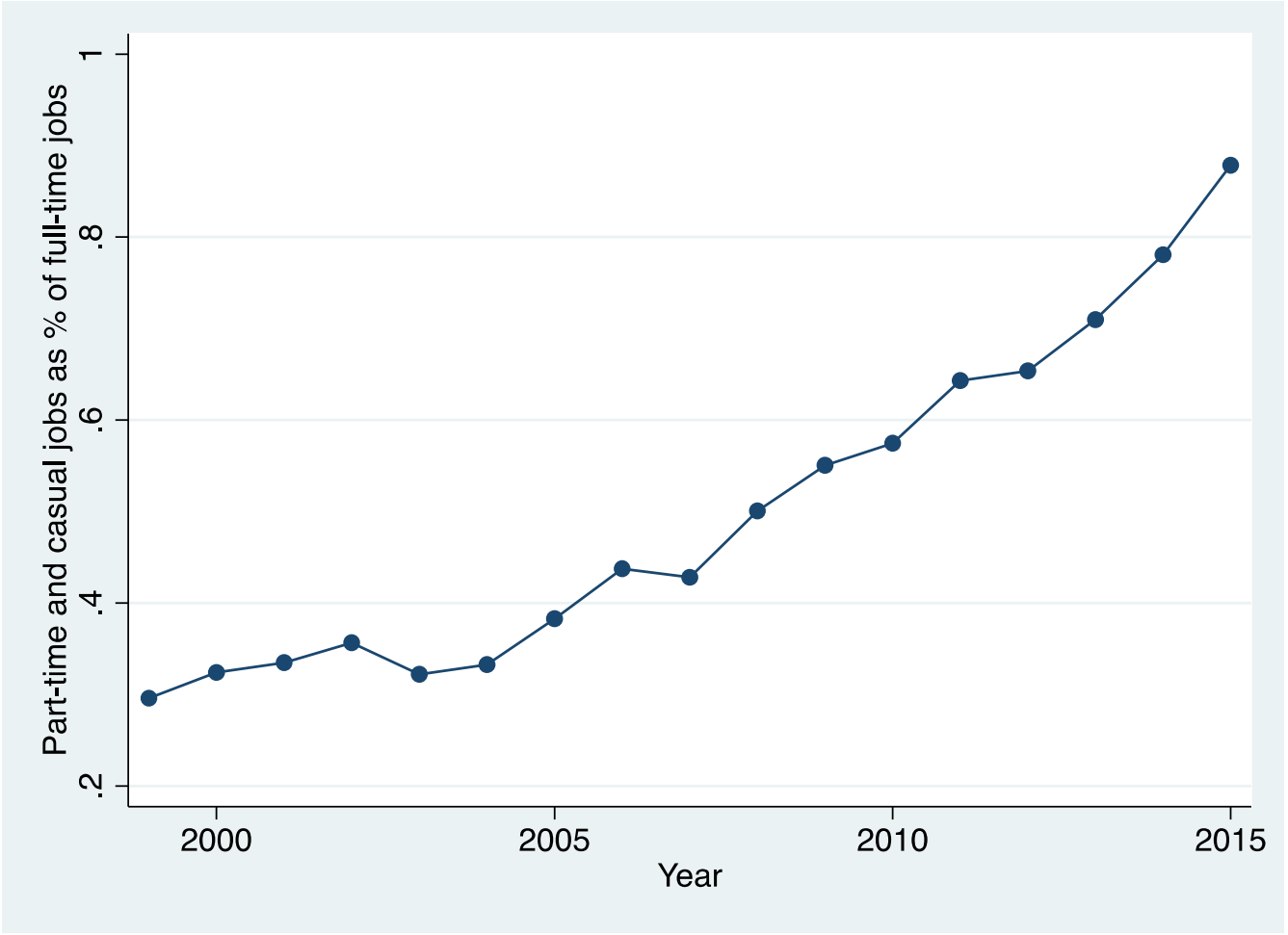
Temporary jobs on the rise



Unconditional means

Variable	Natives	Foreigners	Difference
Unemployed	.061	.103	-.042***
	(.239)	(.305)	
Works in Australia	.912	.402	.510***
	(.283)	(.490)	
Working in Australia			
Wage (annual)	$65,925	$56,135	$9,790***
	($47,072)	($53,119)	
Ln hourly wage	3.437	3.317	.120***
	(.652)	(.910)	
Age	38.98	33.60	5.38***
	(10.49)	(5.98)	
Females (share)	.530	.372	.158***
	(.499)	(.483)	
Years of enrolment	6.16	4.82	1.34***
	(2.33)	(1.32)	
NESB – English at home	.818	.254	.564***
	(.386)	(.436)	
Go8 university	.526	.545	-.019**
	(.499)	(.498)	
Field of study: STEM	.309	.171	.138***
	(.462)	(.376)	
Humanities	.598	.598	-.000
	(.490)	(.491)	
Medicine	.093	.231	-.138***
	(.290)	(.423)	
Worked in last year	.860	.672	.188***
	(.347)	(.470)	
Employer public sector	.678	.660	.018**
	(.467)	(.473)	

Some notable features

- Little difference in employment rate
- Large difference in emigration/return rate
- Females are majority among natives
- Almost 20% natives do not speak English at home
- Humanities most common overall (60%). Foreigners prefer Medicine to STEM (23% vs 17%). Opposite among natives
- Temporary job for reaching almost 50%. Rise exponential since GFC (2007-8)

Methodology

- Oaxaca-Blinder decomposition at the mean (Stata oaxaca), and

- As second stage on quantiles (25^{th}, 50^{th}, 75^{th}) using Recentred Influence Function at quantile of interest (Firpo et al, 2009; Fortin et al, 2011): use 25^{th}, 50^{th}, 75^{th} quantile – Stata rifreg then oaxaca

Some choices

- Ln hourly wage as dependent variable
- Covariates:
  - Demographics: gender, age and age squared, speaks English at home, if disabled or from an aboriginal background;
  - Education: Go8, % foreign students in the same field of study and university, mode of attendance;
  - Labour market: lagged average wage and lagged unemployment rate by year and field of education.
  - Fixed effects: year, state of employment.
- Adjustment to control for selection on emigration decision (IMR): work in last year of study and years since enrollment as exclusion restrictions

Results at mean – all ages and jobs

Table 2 – Baseline results Oaxaca-Blinder decomposition at the mean: all observations

	OLS	Adjusted Pooled OLS	STEM	Humanities	Medicine
Difference in ln hourly wage: Δ_t	.091***	.091***	.0001	.192***	-.025
	(.028)	(.026)	(.074)	(.040)	(.057)
Nr observations	29,304	29,304	8,724	17,568	3,012
Decomposition:					
Explained (E)	-.024	-.0005	-.006	.009	.008
	(.044)	(.009)	(.021)	(.010)	(.016)
Unexplained (U)	.096***	.096***	.0006	.184***	-.033
	(.028)	(.028)	(.077)	(.039)	(.061)
Interaction	.019	-	-	-	-
	(.045)				
E contributors:					
Gender	-.011*	-.014***	-.004**	-.014***	-.001
	(.006)	(.002)	(.002)	(.001)	(.002)
Age	-.105	.212***	.190***	.232***	.002
	(.135)	(.021)	(.033)	(.029)	(.004)
NESB	.068***	.032***	.020	.037***	.022**
	(.019)	(.008)	(.016)	(.007)	(.010)
Go8	-.003	-.002**	.0007	-.002**	.002
	(.002)	(.0007)	(.0008)	(.0008)	(.001)
Years of enrolment	-.004	-.005	.0002	-.009***	.017***
	(.017)	(.003)	(.003)	(.003)	(.007)

Results at mean: age<=45 and full time job

Table 3 – Results Oaxaca-Blinder decomposition at the mean (age <=45 and FT only)

	OLS	Adjusted Pooled OLS	STEM	Humanities	Medicine
Difference in ln hourly wage: Δ_t	-.031	-.031	-.136	.054	-.069
	(.047)	(.045)	(.170)	(.049)	(.043)
Nr observations	13,813	13,813	3,584	8,419	1,810
Decomposition:					
Explained (E)	-.083*	.033***	-.019	-.017	-.036
	(.048)	(.011)	(.036)	(.013)	(.028)
Unexplained (U)	.0007	.002	-.117	.071	-.032
	(.049)	(.045)	(.166)	(.045)	(.053)
Interaction	.051	-	-	-	-
	(.049)				
E contributors:					
Gender	-.009	-.009***	.00004	-.010***	-.002
	(.008)	(.002)	(.002)	(.002)	(.003)
Age	.058	.079***	.014	.101***	.029
	(.097)	(.019)	(.021)	(.025)	(.029)
NESB	.042	.020***	.013	.029***	.011
	(.027)	(.008)	(.019)	(.010)	(.015)
Go8	-.001	-.0009	.0004	-.0002	.001
	(.001)	(.0009)	(.002)	(.002)	(.002)
Years of enrolment	-.023	-.007**	.002	-.013***	.018
	(.023)	(.003)	(.006)	(.003)	(.011)

Results at mean: age<=45 and part time job

Table 4 – Results Oaxaca-Blinder decomposition at the mean (age <=45 and PT only)

	OLS	Adjusted Pooled OLS	STEM	Humanities	Medicine
Difference in ln hourly wage: Δ_t	.109***	.109***	.118	.165***	-.014
	(.037)	(.040)	(.111)	(.048)	(.093)
Nr observations	8,163	8,163	2,394	4,840	929
Decomposition:					
Explained (E)	-.027	-.033***	-.064**	-.025	-.011
	(.045)	(.013)	(.031)	(.016)	(.029)
Unexplained (U)	.146***	.143***	.182	.191***	-.003
	(.038)	(.043)	(.118)	(.050)	(.096)
Interaction	-.009	-	-	-	-
	(.046)				
E contributors:					
Gender	-.009	-.011***	-.003	-.015***	-.0004
	(.010)	(.003)	(.003)	(.002)	(.002)
Age	.028	-.003	-.018	-.001	-.021
	(.025)	(.006)	(.031)	(.016)	(.044)
NESB	.058	.041***	.005	.049***	.017
	(.036)	(.008)	(.023)	(.013)	(.014)
Go8	.004	.0007	-.001	.003*	-.0004
	(.004)	(.0010)	(.002)	(.001)	(.003)
Years of enrolment	.008	-.007	-.014**	-.006	.023*
	(.017)	(.004)	(.007)	(.006)	(.010)

Results along distribution – all ages and jobs

Table 5 – Main results Oaxaca-Blinder decomposition along the wage distribution

	OLS - Pooled			STEM			Humanities			Medicine		
	25q	50q	75q	25q	50q	75q	25q	50q	75q	25q	50q	75q
$\Delta_t, \Delta_t(\tau)$ adjusted	-.009	-.004	.041***	.045	.024	.059	.052*	.019	.048***	-.059*	-.048**	.002
	(.024)	(.015)	(.012)	(.045)	(.041)	(.042)	(.027)	(.019)	(.017)	(.033)	(.023)	(.020)
Decomposition:												
Explained (E)	-.052***	-.051***	.003	-.028*	-.028*	-.003	-.041***	-.038***	.019*	-.071***	-.055***	-.019
	(.005)	(.005)	(.006)	(.015)	(.015)	(.012)	(.007)	(.007)	(.010)	(.013)	(.011)	(.013)
Unexplained (U)	.043*	.046***	.038**	.073*	.052	.062	.094***	.058***	.030	.012	.007	.021
	(.024)	(.016)	(.015)	(.045)	(.042)	(.043)	(.028)	(.020)	(.019)	(.035)	(.022)	(.020)
Contribution to E												
Gender	-.008***	-.008***	-.009***	-.001	-.0008	-.002	-.008***	-.009***	-.009***	-.001	-.002*	-.003**
	(.001)	(.001)	(.001)	(.001)	(.0008)	(.001)	(.001)	(.001)	(.002)	(.001)	(.001)	(.002)
Age	.162***	.195***	.205***	.168***	.173***	.127***	.177***	.206***	.229***	.047**	.029**	.059***
	(.014)	(.012)	(.014)	(.027)	(.027)	(.019)	(.016)	(.016)	(.018)	(.020)	(.015)	(.016)
NESB	.015***	.012***	.021***	.011	.013	.006	.022***	.016***	.027***	.016***	.008*	.014**
	(.003)	(.003)	(.004)	(.011)	(.009)	(.009)	(.005)	(.004)	(.005)	(.006)	(.005)	(.006)
Go8	-.0005**	-.0005**	-.0008**	.0009	.001	-.0002	-.0008*	-.0007**	-.0009**	.001	.0008	.0008
	(.0002)	(.0002)	(.0003)	(.0009)	(.0009)	(.0008)	(.0004)	(.0003)	(.0004)	(.0009)	(.0006)	(.0009)
Years of enrolment	-.0005	-.002	-.003	.003	.005**	.0007	-.004*	-.005**	-.006**	.003	.006	.008
	(.002)	(.001)	(.003)	(.003)	(.002)	(.003)	(.003)	(.002)	(.002)	(.006)	(.004)	(.005)

Results along distribution: age <=45 and FT

Table 6 – Main results Oaxaca-Blinder decomposition along the wage distribution (age <=45 and FT only)

	OLS - Pooled			STEM			Humanities			Medicine		
	25q	50q	75q	25q	50q	75q	25q	50q	75q	25q	50q	75q
$\Delta_t, \Delta_t(\tau)$ adjusted	-.012	.013	.078	.212	.168	.301	-.037	-.016	.025	-.046	-.016	.052
	(.067)	(.060)	(.066)	(.237)	(.245)	(.311)	(.093)	(.097)	(.110)	(.121)	(.169)	(.112)
Decomposition:												
Explained (E)	-.064***	-.067***	-.016	.006	-.014	.010	-.058**	-.054**	.012	-.103***	-.087**	-.058*
	(.014)	(.020)	(.017)	(.044)	(.040)	(.043)	(.022)	(.022)	(.022)	(.033)	(.040)	(.035)
Unexplained (U)	.051	.080	.095	.206	.182	.290	.020	.038	.013	.056	.071	.110
	(.068)	(.063)	(.069)	(.242)	(.261)	(.304)	(.095)	(.100)	(.114)	(.112)	(.166)	(.113)
Contribution to E												
Gender	-.010***	-.010***	-.010***	-.003	-.003	-.007	-.009***	-.009***	-.008***	-.008	-.008	-.009*
	(.002)	(.003)	(.003)	(.004)	(.004)	(.005)	(.002)	(.002)	(.003)	(.005)	(.005)	(.005)
Age	.054*	.082**	.093***	.063	.061	.071	.024	.056	.075**	.063	.068	.058
	(.031)	(.035)	(.027)	(.051)	(.058)	(.064)	(.033)	(.038)	(.036)	(.052)	(.047)	(.046)
NESB	.024**	.022*	.039***	.027	.022	.030	.036**	.037**	.063***	-.011	-.011	-.005
	(.012)	(.013)	(.013)	(.030)	(.030)	(.034)	(.016)	(.015)	(.018)	(.021)	(.021)	(.020)
Go8	-.0004	-.0005	-.0007	-.002	-.001	-.003	-.00007	-.00008	-.0001	.004	.004	.004
	(.0007)	(.0006)	(.0008)	(.002)	(.002)	(.003)	(.0007)	(.0007)	(.001)	(.004)	(.004)	(.004)
Years of enrolment	.002	.002	.002	.003	.008	.008	.005	.003	.003	-.024*	-.014	-.011
	(.004)	(.005)	(.005)	(.009)	(.011)	(.010)	(.005)	(.006)	(.006)	(.010)	(.015)	(.013)

Summary of results at mean

- Natives enjoy higher hourly wages than foreigners, but this is driven by Humanities:
  - Effect mostly due to unexplained.
  - Among explained component effect of age and NESB (up) compensated by gender (down)
  - Similar implications to results at mean: maybe difficult to find objective productivity measures as signal from university (Go8) matters
  - Effect for STEM and Medicine arise only at 10 and 90 quantile.

Summary of results along distribution

- Natives have similar hourly wages to foreigners, aside from Humanities:
  - Gap wider at higher hourly wage level
  - Unexplained component predominant
  - Among explained component effect of NESB (up) always present (age too but only if include the 45+), but reduced by gender (down)
  - Maybe difficult to find objective productivity measures as signal from university (Go8) matters
  - Result characterises both full-time and part-time job for under-45
  - Implies top quality candidates face no discrimination but average quality candidates are subjected to it (controversial?).

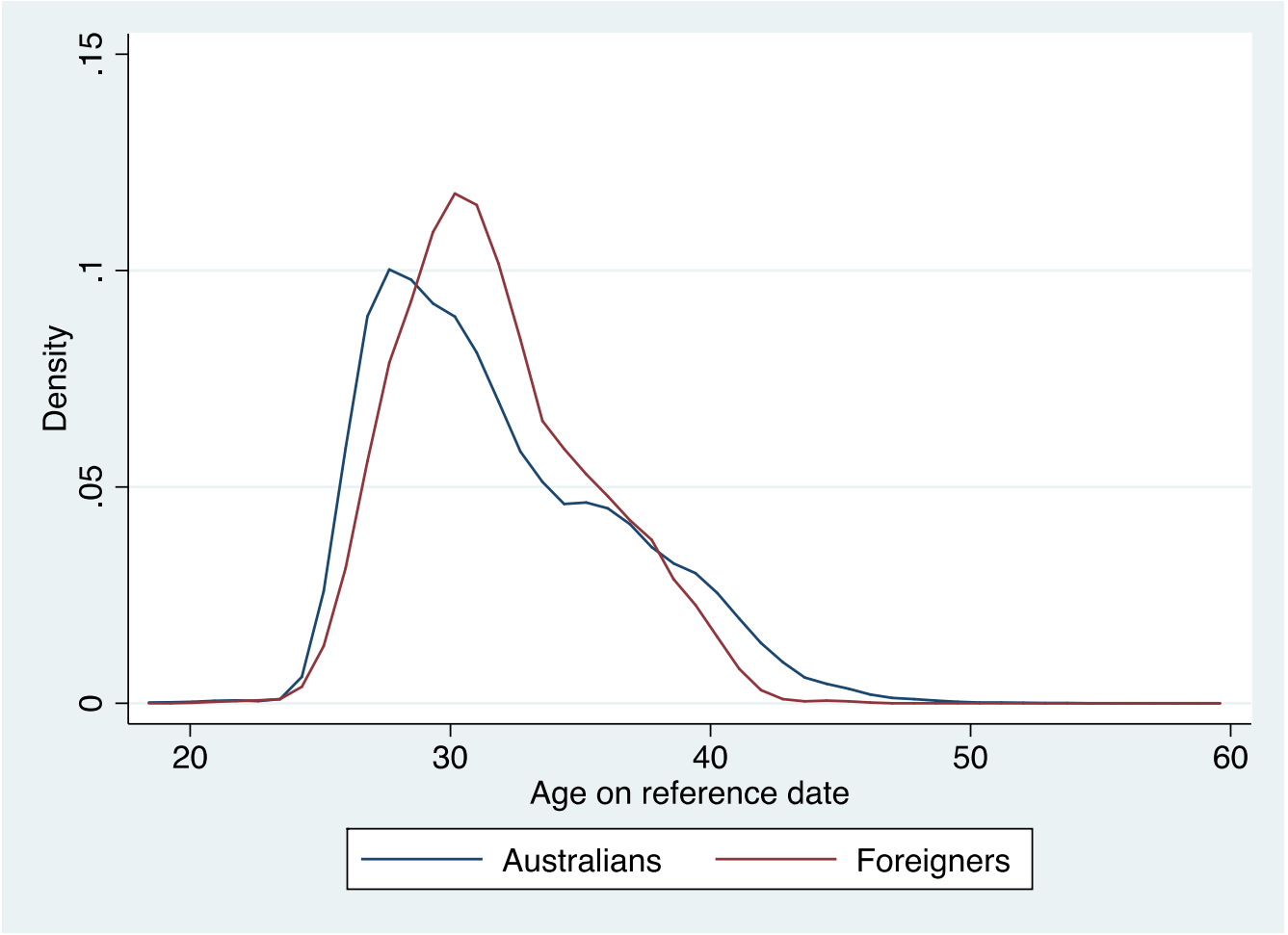
Implications (preliminary)

- No evidence of wage gap in PhD trained and working in Australia aside from Humanities;
- Gender effect intriguing: why males get penalised?
- NESB: language matters but probably also includes culture, habits, beliefs → “if speaks with accent then thinks and does with accent”
- Lack of difference reassuring but growing lack of permanent jobs since GFC maybe is not → competition on observables where they exist (STEM, Medicine) but less in Humanities
- Other evidence point to natives moving to occupations with comparative advantage (language/culture). Results from graduate labour market reflect this.

Q&A

Thanks for your attention and feedback

Age distribution for age start < 36



Hourly salary of foreigners staying or returning