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THE IMPACT OF DIFFERENTIATED TUITION FEES ON ENROLMENTS

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Abstract

Until recently, uniform statutory tuition fees were charged for all Dutch higher education study programmes. In 2018, tuition fees for teacher training programmes were reduced in an attempt to attract more students. An open question, though, is whether this is a productive strategy. In my thesis, I aim to find the effect of tuition fees differentiated by field of study on enrolments in higher education. The introduction of a three-tiered tuition fee system in Australia is used as a natural experiment to identify the effect of differentiated fees. Enrolments in disciplines with different levels of student contributions are analysed using a differences-in-differences design. I find significant negative treatment effects of reduced fees on enrolments. The differentiated tuition fees led to a decrease in enrolments for low fee disciplines. This finding is not in line with the majority view of the literature on tuition fees and enrolment behaviour. In a setting with differentiated fees, however, tuition fees could have signalling value. Relatively lower tuition fees might signal low earnings potential, status and educational quality. The Dutch government should therefore be careful to avoid any associations between the reduced fees and the earnings potential or status of teachers.

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1 Introduction

Until recently, uniform statutory tuition fees were charged for all higher education programmes in the Netherlands. In 2018, the Dutch government introduced a 'national priority' policy for teacher training programmes. The aim of this policy is to increase the stock of certified teachers and enrolments in this field of study. As part of this priority policy, all students in teacher training programmes (who commenced their studies in the academic year 2018-2019 or later) receive a fifty percent discount on the statutory tuition fees during the first two years of their studies (Ministerie OCW, 2020; 2019).[1] This whereas students in other fields of study only receive this discount during the first year of their studies. The motivation for the additional discount is that it could promote enrolments in teacher training programmes.

Both fee reductions were financed by the Dutch government. The additional fee reduction for education students could be seen as a differential subsidy for this field of study. Subsidies and tuition fees differentiated by field of study have been advocated by economists. Empirically, the effects of such fees on enrolments are, however, not very well known. In this thesis, I therefore set out to answer the following question:

"What is the effect of tuition fees differentiated by field of study on enrolments in higher education?"

In the Netherlands, the reduced fees for the field of study Education were only introduced two years ago. It is therefore too early to draw conclusions about whether such differentiated fees do indeed lead to higher enrolments for teaching programmes. By studying enrolment data from other countries where differentiated tuition fees are in place, one could also get an indication of the efficacy of such a policy.

There are a few countries that charge statutory tuition fees differentiated by field of study. One of the countries where such a system is in place is Australia. The Australian government introduced tuition fees differentiated by field of study in 1997, as part of a reform of the Higher Education Contribution Scheme (HECS). HECS was first introduced in 1989 and originally uniform fees were charged for all fields of study (Parliament of Australia, 2003). In 1997, a three-tiered tuition fee structure was introduced for students commencing in 1997 and onward. The level of the tuition fee for a discipline

[1] In 2018, the statutory tuition fee was €2060. The discounted fee thus equalled €1030.

was determined by both the cost of provision and presumed private benefits of the degree (Chapman, 1997). Like in the Netherlands, the differences in teaching costs and tuition fees were financed by the government. A discounted tuition fee thus equalled an increased subsidy for that field.

I study the introduction of the differential fees in 1997 in Australia as a natural experiment. I use 1989-2000 and 1989-2004 time-series data on the number of commencing students and domestic enrolments in different broad fields of study. To uncover the effect of differentiated tuition fees on enrolments, I analyse enrolments in disciplines for which the tuition fees were set at *Tier 1* and *Tier 2* level.[2] I use a simple differences-in-differences design. *Tier 1* fields of study are the treatment group and *Tier 2* disciplines serve as control group. I estimate whether discounted tuition fees for *Tier 1* lead to an increase in enrolments for these disciplines, relative to enrolments in *Tier 2*. My results suggest that the introduction of the differentiated fees led to a significant and sizeable reduction in (new) enrolments for disciplines with lower fees. The number of commencing students and domestic enrolments in *Tier* 1 fields of study would have been higher, had the tuition fees not been reduced.

These findings are counterintuitive and not in line with the majority view in the literature, which states that reduced fees lead to increased demand for higher education. In a setting with differentiated fees, however, tuition fees could have signalling value. The reduced *Tier* 1 fees might signal low status and create awareness of low earnings potential. As return on investment and status are important determinants of study choice, this may have caused the negative enrolments effects for *Tier 1.* This interpretation is in line with findings by Harvey-Beavis & Elsworth (1998) on related issues. Discounted fees might also be associated with lower educational quality.

My results from the analysis of differential HECS contributions in Australia suggest that discounting fees is not an effective method to attract more students. On the contrary, it may lead to a reduction in enrolments. Whether enrolments for teacher training programmes in the Netherlands will also decrease as a result of discounted fees remains to be seen. An important policy implication is that the Dutch government should be very careful in the communication about the reduced fees. Any associations with low status or low earnings potential should be avoided, instead the communication could emphasize how valuable teachers are to society. This might prevent a negative enrolment effect from occurring in the Netherlands.

[2] For disciplines in *Tier 1,* the tuition fees were set at the lowest level ($3300 in 1997). *Tier 2* student contributions were $1400 higher. In *Tier 3*, the fees were the highest (initially $5500). Enrolments in *Tier 3* disciplines are excluded from the analysis due to the limited availability of data.

This research relates to an extensive body of literature on the relationship between tuition fees and enrolments or demand for higher education. Economic theory predicts that lower tuition fees and higher subsidies for certain fields of study promote human capital formation in those fields (Jacobs & Van der Ploeg, 2006). Furthermore, there is ample empirical evidence for a significant negative relationship between tuition fees and enrolment rates. Examples include Leslie & Brinkman (1987), Heller (1997), Neill (2009), and Hübner (2012). There are, however, also several studies that have shown that educational quality, earnings potential and status are important determinants of field of study choice (Harvey-Beavis & Elsworth, 1998; Drewes & Michael, 2006; Shin & Milton, 2006).

Literature on the effects of differentiated fees on enrolments is very scarce. Several theorists have argued that efficiency requires differentiated subsidies and tuition fees, and have hypothesized about possible effects on enrolments, for example Jacobs & Van der Ploeg (2006) and Rosen & Gayer (2014). There is no other empirical work that focusses specifically on the effect of differentiated fees on enrolments. Although the introduction of HECS in 1989 and differential HECS fees in 1997 have been studied before, these studies did not address how the differential fees affected enrolments in the three tiers. Instead, these papers considered the impact of HECS on financial barriers, university participation by students from low socio-economic status backgrounds and academic performance (Chapman, 1997; Andrews, 1999; Chapman & Ryan, 2002; Chapman & Ryan, 2005; Birch & Miller, 2006). My research addresses this gap in the empirical academic literature.

This study is also highly relevant to policy. It offers insight into whether differentiated fee policies are effective in promoting or discouraging human capital formation in specific fields of study. The results from my analysis also indicate whether the Dutch 'national priority' policy for teacher training programmes could be successful.

The structure of my thesis is as follows; I first discuss related literature on the rationale for subsidising higher education and subsidies (tuition fees) differentiated by field of study. Then, I offer the necessary background information on the introduction and reforms of the Australian higher education contribution scheme (HECS). In chapter four and five, I discuss the data and methodology used in my analysis. Chapter six presents the results of the main specification and a number of robustness checks. I further discuss and interpret my findings in chapter seven. In this chapter, I also consider the limitations of my research and implications for policy. I conclude with a summary of my results and some suggestions for further research.

2 Related Literature

2.1 Higher Education Externalities

In many countries, higher education is subsidised. To what extent higher education should be subsidised is nonetheless a heavily debated issue in economics. The two main arguments for subsiding higher education are the equality and externality arguments. Subsidies are intended to create equal opportunities for all students, irrespective of their socio-economic background (Wälde & García-Peñalosa, 2000). Another reason for subsidies is that education produces positive externalities, such that not subsidising it would lead to underinvestment. In this thesis, I aim to find the effect of differentiated subsidies on enrolments. The effect of (differentiated) subsidies on equality of opportunity is beyond the scope of this research. The remainder of this chapter therefore focusses on the externality argument for subsidising education.

Underinvestment in education occurs when the social net present value (NPV) of investing in human capital exceeds the private NPV of investing in human capital. Positive externalities imply lower private benefits relative to social benefits of human capital investment (Heckman &. Klenow, 1998). If higher education does indeed produce positive externalities in excess of private benefits, it should be subsidised to promote individuals to acquire more higher education. Estimating the social returns to (higher) education is, however, quite complicated as external benefits are hard to capture econometrically (Chapman & Lounkaew, 2015). Many studies have tried to estimate social returns to schooling by estimating the effect of an increase in the average level of education on GDP per capita or wages. Some studies find that the macro returns to education are roughly equal to private returns, whereas others do verify that positive externalities exist.

A famous example of a paper that studies the relationship between wages and schooling is Acemoglu and Angrist (1999). They studied U.S. census data from 1950-1990 for multiple states. Differences in compulsory schooling laws and child labour laws across states and time were used as a source of exogenous variation in the average years of schooling. They found that an increase of one year in average schooling leads to an insignificant increase in individual wages of approximately 1 percent. Estimates of education externalities range between -1 and 4 percent for different specifications and samples and are largely insignificant. Hence, the analysis by Acemoglu and Angrist does not provide much evidence for sizeable positive externalities.

Heckman and Klenow (1998) arrived at similar results. To determine whether human capital produces positive externalities, they compared estimates from a cross-country macro-Mincer regression to the coefficients obtained from a cross-individual micro-Mincer equation.[3] When macro-Mincer estimates exceed micro-Mincer estimates, a worker may earn higher wages when the level of schooling of other workers in the country is higher. Heckman and Klenow found macro-Mincer estimates ranging between 7 and 10.6 percent. These results were compared to average micro-Mincer estimates from a large meta-analysis by Psacharopoulos (1994). When controlling for life expectancy and physical capital, the macro-Mincer estimates were roughly equal to the micro-Mincer estimates. This indicates that social returns to schooling do not exceed private returns

Whereas Acemoglu & Angrist and Heckman & Klenow studied returns to schooling in general, Moretti (2004) focussed on social returns to higher education. He estimated spillovers by comparing wages for - otherwise similar - individuals who work in cities with different shares of college graduates in the labour force. He used an individual and city fixed-effects model to analyse data from the National Longitudinal Survey of Youths (NLSY). Moretti found that a percentage-point increase in the supply of college graduates raises wages significantly for high school dropouts as well as high school graduates. Although these estimates are small, they do indicate that higher education produces externalities.

Another study that provides empirical evidence for positive higher education externalities is Voon (2001). Whereas all other papers used U.S. data, this paper studies educational spending and GDP data from Hong Kong. Furthermore, Voon took a different empirical approach. Instead of using an individual wage increment approach, he used an aggregate production function. This model measures social benefits from workforce improvements due to increased investments in education. This study found larger externalities, with social rates of return exceeding private returns by 2 to 3.5 percentage-points. However, the social rates of return did decline over time, likely due to large increases in educational spending. Voon also compared his production function estimates to rates of return computed with the wage increment approach. According to Voon, the wage increment approach may lead to understated estimates of the social welfare benefits of higher education. As the wage increment is only a subset of real GDP growth, the wage increment does not capture all positive externalities.

[3] The macro-Mincer equation takes the log of GDP per capita on average schooling in the population. The micro-Mincer equation is a function of log (individual) wages on years of schooling.

Although the studies by Moretti (2004) and Voon (2001) do indicate there might be positive social returns to higher education, these are not very sizeable. Jacobs and Van der Ploeg (2006) reviewed a large number of empirical papers estimating externalities of (higher) education and also found that empirical evidence for positive externalities is not very persuasive.

2.2 Differentiated Subsidies by Field

Rosen and Gayer (2014) pointed out that even if the positive externalities of higher education can be verified, this does not justify subsidising all eligible students at the same rate. It is unlikely that different study disciplines (e.g. Accounting and Medicine) produce the same external benefits. Hence, efficiency would require differential subsidies. Literature estimating differences in externalities produced across disciplines, however, is scarce and mostly focused on science disciplines.

For example, Winters (2014) studied human capital externalities produced by Science, Technology, Engineering and Mathematics (STEM) graduates. He used an empirical approach similar to Moretti (2004). Winters used survey data to study how the size of the stock of STEM and non-STEM field college graduates affects the wages of other workers in the same urban area. Although both types of college graduates produce positive externalities, these are greater for STEM graduates.

Another study that established differences in returns to education across fields was conducted by Murphy, Shleifer and Vishny (1991). Murphy et al. studied the effect of the proportion of enrolments in different college majors on real GDP per capita growth. They found that engineers have a positive effect on growth, whereas the direct effect of lawyers on growth is negative. This indicates that Law graduates might even produce negative externalities. These negative effects may be due to rent-seeking and signalling.

Jacob and Van der Ploeg (2006) noted that adverse externalities may also arise when human capital in a certain discipline is a status good. The more human capital someone acquires (in this field) relative to the human capital of others, the higher his status. The immaterial return derived from status leads to overinvestment in high-status disciplines. Positive externalities may arise for merit good studies and R&D-related disciplines. Merit good studies are studies with very low private benefits that are very valuable to society. Jacobs and Van der Ploeg mentioned Anthropology, pure Mathematics and Education as examples of merit good studies. R&D-related disciplines (STEM fields) may generate positive externalities when human capital formation in these disciplines contributes to labour productivity.

2.3 Optimal Subsidy Model

In their 2006 study, Jacobs and Van der Ploeg state that governments should not waste their resources on higher education subsidies across the board. To maximise educational welfare, merit good studies should be promoted and the popularity of studies with negative externalities should be reduced. Jacobs and Van der Ploeg developed an optimal subsidy model in which subsidies are differentiated according to the ability of the student and the field of study.[4] I (partially) replicate this optimal subsidy model.

The objective of educational polices should be maximising educational welfare (Γ), which is the weighted sum of human capital investments in merit good studies:

$$\Gamma \equiv \int_I \sum_{n=1}^{N} \xi_{in} e_{in} \, \mathrm{dF}(i), \tag{1}$$

ξ_{in} denotes the marginal contribution to educational welfare of individual *i* in education of type *n*. e_{in} is the educational investment in study *n:* the number of years student *i* is enrolled in discipline *n*. ξ_{in} captures all external effects that individual *i* generates by his investment in education. If students invest in a merit study, the marginal contribution to educational welfare is positive ($\xi_{in} > 0$). Status-seeking or signalling, however, will have adverse effects on social welfare ($\xi_{in} < 0$). Furthermore, the marginal contribution ξ_{in} depends on the ability of individual *i*. Students with greater ability likely generate more educational surplus.

Jacobs and Van der Ploeg derive a Pigouvian subsidy model under full information (2006, pp. 563-565). Universities can thus differentiate fees they charge students according to individual ability *i* and discipline *n*. The subsidies are financed from tax revenues, the expenditures are $(1+r)p_{in}s_{in}$. In this, p_{in} denotes the annual cost of a study programme and s_{in} is the subsidy rate for individual *i* in discipline *n*. The interest factor $(1+r)$ is included because social surplus is only generated after students graduate. The costs of raising public revenue is given by η, which is greater than unity if distortionary taxes are levied. The marginal costs of the programmes of study (p_{in}) are assumed to be constant. The government aims to maximise social welfare, which is the sum of individual utilities and educational welfare:

$$\max_{\{s_{in}\}} \int_I \left(U_i + \sum_{n=1}^{N} (\xi_{in} e_{in} - \eta(1+r) p_{in} s_{in} e_{in} \right) \mathrm{dF}(i) \tag{2}$$

[4] This optimal subsidy model only covers efficiency aspects of funding. Equity issues are not considered as other measures can be used to redistribute income (Jacobs and Van der Ploeg, 2006).

This yields the following first-order conditions for optimal educational subsidies:

$$\frac{s_{in}}{1-s_{in}} = \frac{1}{\varepsilon_{in}+\sigma_{in}}\left[\left(\frac{\varepsilon_{in}\xi_{in}/\eta}{((1+r)(1-t_i)(1-s_{in})p_{in})}\right) - \frac{\sigma_{in}}{\eta} - \left(1-\frac{1}{\eta}\right)\right], \forall_{i,n} \tag{3}$$

The term $\varepsilon_{in} + \sigma_{in}$ denotes the net elasticity of educational effort to the subsidies. The second term in equation (3) is a Pigouvian term for the merit good value of education, expressed in private welfare by dividing though the cost of raising public revenue (η). The optimal subsidy increases with the social benefits created (ξ_{in}). If society values education in field *n* more, than the subsidies for disciplines in that field should be higher. Furthermore, optimal subsidies decrease with ability of student *i* in field *n*, because higher ability leads to higher private returns. The lower the private return relative to social return, the higher the optimal subsidy. In the case of adverse externalities ($\xi_{in} < 0$), however, education should be taxed to correct for overinvestment in (certain types of) human capital.

The third term is the 'peer' or 'reputation' effect, which lowers the value of the optimal subsidy. σ_{in} is the elasticity of fees with respect to peer or reputation effect, expressed in private welfare units divided over the cost of public funds. The lower the elasticity of prices with respect to peer and reputation effects, the smaller this term.

The last term in equation (3) is the Ramsey motive of taxation, which insists that higher education should be taxed if public funds are scarce (Jacobs & Van der Ploeg, 2006, p. 565). Scarcity of funds thus decreases the value of the optimal subsidy to below Pigouvian level. If the elasticity of educational effort ($\varepsilon_{in} + \sigma_{in}$) is low, that is when a lot of tax revenue is needed to encourage human capital investment, this reduction in subsidies is large. The more costly raising public revenue, the larger the decrease in the optimal subsidy. Finally, if a discipline has no merit value ($\xi_{in} = 0$) and public funds are scarce, this discipline should be taxed rather than subsidised

If, however, the government can levy non-distortionary taxes and there is no scarcity of funds, then the optimal subsidies in absence of peer effects ($\sigma_{in} = 0$) are:

$$s_{in} = \frac{\xi_{in}}{(1+r)p_{in}}, \forall_{i,n} \tag{4}$$

The optimal subsidies fully internalise the positive externalities of different types of education. If the social rate of return to education (ξ_{in}) exceeds private benefits by *x* percent, then private costs (institutional tuition fees) will be subsidised at *x* percent. Such a subsidy model will promote human capital formation in merit good studies. The greater the difference between social and private returns, the greater the optimal subsidy. Pigouvian subsidies (in relative terms) also decrease with the cost of a type of education, as costly disciplines often have larger private returns. Jacobs and Van der Ploeg also note that if education generates adverse externalities, it should be optimally taxed. This would then discourage human capital formation in types of education that reduce social welfare.

This model merely serves as a benchmark. In reality, raising public revenue is costly (η > 1) and public funds are scarce. Furthermore, fees and subsidies cannot be differentiated according to individual ability *i.* This decreases the value of the optimal educational subsidy. Nonetheless, this model does clearly show that it is optimal to target education subsidies towards those studies that contribute most to social welfare. Disciplines that generate negative or zero external benefits should not be subsidised. Furthermore, fees should also reflect differences in the cost of provision of study programmes. According to Jacobs and Van der Ploeg (2006), charging uniform fees for all fields of study simply makes no sense from an economic perspective.

3 Higher Education Contribution Scheme – HECS

3.1 The Origin of the Higher Education Contribution Scheme

Up to 1974, tuition fees were an essential element of the funding of Australian higher education. Research on this period indicates that the majority of university students came from wealthy and more advantaged backgrounds (Australian Government Publishing Service, 1988, pp. 3–5). In 1974, the Commonwealth Government abolished tuition fees in an attempt to make higher education accessible for all, irrespective of income, gender or socio-economic status. A large study by Anderson and Vervoorn (1983) showed that this fee abolition had minor effects on the participation of socially and economically disadvantaged students, and that access to higher education remained mainly limited to the more privileged.

Since the abolition of fees was not very effective in increasing accessibility and the growth of Australia's higher education system put great pressure on the government budget, a committee for Higher Education Funding was established in 1987. This committee (referred to as the Wran Committee) was to make recommendations about funding options and schemes that would allow for both expanding the capacity, improving the effectiveness and improving the accessibility of the Australian higher education system. Given the budgetary pressure, the Government requested the committee to consider possible sources of funding involving the direct beneficiaries of higher education (Australian Government Publishing Service, 1988, pp. vii-ix). The goal of the Wran committee was to develop a funding scheme that raised contributions from individual users, minimised financial barriers to access at point of entry and took into account the student's capacity to pay. They developed a scheme that included an income contingent repayment of a tax debit on higher education that would best meet these requirements.

The committee recommended the introduction of a Higher Education Contribution Scheme (HECS) with contributions by individual beneficiaries of around 20 percent of teaching costs, varied broadly according to the cost of provision per discipline. They suggested three levels of contributions based on relative costs of provision (respectively $1500, $2500 and $3000 annually). Furthermore, it was recommended that HECS should allow students to defer payment of the contributions. These deferred student contributions would then become a tax debit. This debit was to be repaid through the tax system at a rate of two percent of taxable income, if and only if an income threshold was reached. This is essentially an income-contingent loan for the payment of the fees (Chapman & Ryan, 2005). Upfront payment and accelerated repayment of the contributions should also be made possible.

3.2 Introduction of the Higher Education Contribution Scheme

In 1988, the Higher Education Funding Act was passed and in January 1989 the Higher Education Contribution Scheme was introduced (Higher Education Funding Act, 1988). The government had accepted and followed nearly all recommendations made by the Wran Committee. The suggestion for implementing three contribution levels to reflect the difference in teaching costs was, however, not taken up. Chapman (1997) discusses the choice for the uniform tuition fees and states that the arguments for differential charges on cost basis are strong, as HECS is fundamentally a cost recovery scheme. The government justification for a uniform charge was that setting differential fees would lead to high administrative costs. The annual student contribution (statutory fee) was thus set at $1800 for 1989, which amounted to roughly 20 percent of the average costs of course provision. The tuition fees were indexed according to the Consumer Price Index each year. Table 3.2.1 in Appendix A provides an overview of the HECS student contributions and shows that tuition fees increased from $1800 in 1989 to $2764 in 2003.

Persons enrolling in (award)[5] study programmes at higher education institutions could pay their HECS contribution upfront and receive a 25 percent discount or defer their payment, which then became a HECS debt. The HECS debts are indexed for inflation each year, are interest free and repayment is required if and only if the compulsory repayment threshold is reached. The repayment rates were initially set between 1 and 3 percent, depending on the level of taxable income reached, and were adjusted each year. Voluntary repayments were also possible at any time and encouraged by offering bonusses for large repayments. HECS debts are cancelled at death (Parliament of Australia, 2003). For a more extensive discussion of the rationale for HECS and HECS in practice, see Chapman (1997).

[5] An award course is a programme of study formally accredited by the Higher Education Provider which leads to an academic award granted by the Higher Education Provider, see HEIMSHELP (n.d.).

3.3 Reforms of the Higher Education Contribution Scheme

In 1996, major HECS reforms were announced by the government (Higher Education Legislation Amendment Bill, 1996). In January 1997, a three-tier fee structure was introduced for commencing students. For Arts, Humanities & Social Sciences, Education and Nursing, student contributions were the lowest, originally set at $3300. For disciplines in the second tier – STEM studies,[6] Agriculture, Architecture & Building, Business and Economics – the student contribution was set at $4700. For Law, Medicine, Medical Science, Dentistry and Veterinary Studies the student contributions were set at tier 3 level, or $5500 (Parliament of Australia, 2003). In general, the student contributions were higher for more expensive disciplines (such as Medicine), but the presumed direct private benefits of studying a particular discipline were also weighted in determining the student contributions. This is thus not a differentiated cost recovery scheme, as suggested by the Wran Committee, but a hybrid model which also considered earnings potential. This is why Law*,* one of the cheapest study programmes, was charged at the highest level, whereas student contributions for Nursing (a relatively costly discipline) were set at the lowest level (Chapman, 1997).[7]

Fees were slightly adjusted upwards each year, but the relative size of the student contributions remained the same. Table 3.3.1 in Appendix A provides an overview of the student contributions for each of the tuition fee tiers for 1997-2003. For *Tier 1*, the fees increased from $3300 in 1997 to $3680 in 2003. *Tier 2* contributions rose from $4700 to $5242 and for *Tier 3* the fees increased from $5500 in 1997 to $6136 in 2003. Note that students previously enrolled before 1997 were still eligible for the uniform fees, as given in Table 3.2.1.

The 1996 *Higher Education Amendment Bill* also included some other, smaller HECS reforms. These changes were: lowering of the income thresholds for repayments; small changes to the voluntary repayment arrangements; the introduction of 1000 undergraduate merit-based scholarships; exemption from HECS repayments for low-income groups and moving Legal Studies (not Law) from *Tier 3* to *Tier 1* (Parliament of Australia, 2003). [8]

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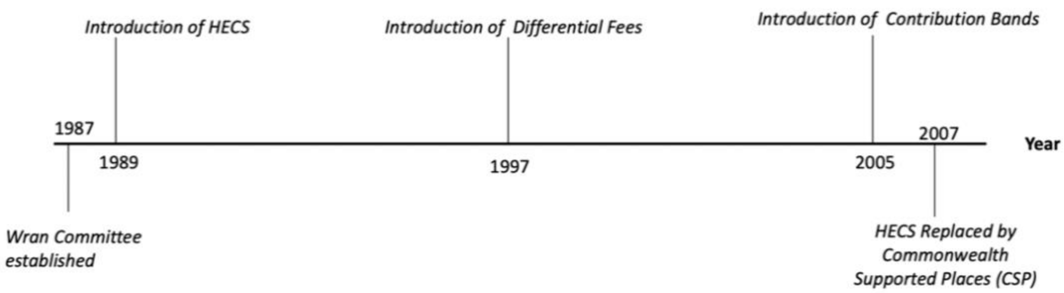
[6] STEM is an acronym for Science, Technology, Engineering and Mathematics.

[7] Note that this three-tiered fee structure loosely follows the optimal subsidy model from Jacobs and Van der Ploeg (2006), as discussed in chapter 2.3. Disciplines with high earnings potential (no or small externalities) are subsidised at a lower rate and therefore the tuition fees are higher. Low earnings potential studies for which social benefits exceed private benefits are subsidised at a higher rate. Furthermore, the differences in cost of provision are also considered.

[8]Individuals holding *Law* degrees can get licensed to practice as lawyers, whereas *Legal Studies* degrees do not grant access to this licensing process.

In 2005, another large reform of HECS was implemented (Parliament of Australia, 2003). Amongst other major changes, the three-tier fixed student contributions were replaced by three-tier student contribution ranges. The bottom of each range was set at $0, a ceiling for each tier was defined, and universities could set the student contribution at any point within these ranges. Additionally, a fourth tier called 'National Priorities' was added, which included studies in Education and Nursing. The maximum contribution for this tier was set at the 2004 *Tier 1* contribution, whereas the maximum of the ranges for the other tiers was increased compared to the 2004 student contribution. Although HECS was replaced by Commonwealth Supported Places (CSP) in 2007, the basis of the three-tier contribution structure implemented in 1997 is still in place today (Study Assist, 2019). Figure 3.3.1 summarises the timing of all events that were discussed above.

Figure 3.3.1 – The Higher Education Contribution Scheme (1987-2007)



Source: Own illustration

4 Data

4.1 Data Sources and Categorisation

The analysis uses Australian Higher Education Student Time Series Data for the years 1989 to 2004. These Higher Education Statistics are available through the Department of Education, Skills and Employment (Department of Education, Skills and Employment, 2019a, b). The Student Data cover the enrolments in Australian Higher Education institutions (HEis) in a given year. To estimate the effect of differentiated tuition fees, the enrolments categorised by broad field of study are used.

Data of before 2001 are largely archived and almost impossible to access, particularly for non-Australians. Hence, the only available data for the period 1989-2004 are time series tables on (1) the number of commencing students by broad field of study, differentiated by gender as well as (2) the total number of enrolments in the different broad fields of study, differentiated by gender and citizenship category (domestic or overseas). For 2001 to 2004, multi-dimensional time series are available through the Higher Education Data Cube (uCube). This dataset allows for further differentiation by course level, state, institution and mode of attendance (Department of Education, Skills and Employment, 2019a). In the time series tables and uCube, enrolment data for different study programmes are clustered into broad fields of study.

To uncover the effect of differentiated tuition fees, the different broad fields of study are matched to the three different tuition fee tiers. Unfortunately, the different study programmes clustered in the broad fields of study may fall into different tuition fee tiers. The field of study Health, for example, includes both Dentistry and Medicine (*Tier 3* studies) and Nursing (a *Tier 1* study). This means that only part of the broad fields of study can be matched to one specific tuition-fee tier and that the analysis does not cover the full student population. An additional complication is that the categorisation of the broad fields of study changes in 2001. In these new clusters, a greater number of broad fields of study includes study programmes with different levels of student contributions. Furthermore, for some fields of study the categories are mixed or split in such a way that the 1989-2000 and 2001-2004 categories cannot be matched. This further reduces the number of fields of study that can be included in the analysis. Therefore, the data for 1989-2000 are used for the main specification. Table 4.1.1 in appendix B provides a comprehensive overview of the classification of the broad fields of study and corresponding tuition fee tiers for respectively 1989-2000 and 2001-2004.

For the analysis, the relevant data were handpicked from the time series tables and uCube. Subsequently, the enrolment data by broad field of study were converted to enrolment data by tuition fee tier. For the period 1989-2000, the following broad fields of study are included in the dataset: Education; Arts, Humanities & Social Sciences (*Tier 1)* and Agriculture & Animal Husbandry; Architecture & Building; Science; Engineering & Surveying; Business, Administration & Economics *(Tier 2).* A separate dataset was compiled for the years 1989 to 2004, so that robustness checks can be done. The following broad fields of study are included in this dataset: Education (*Tier 1*) and Agriculture & Animal Husbandry; Architecture & Building; Science; Engineering & Surveying (*Tier 2*). [9]

Furthermore, the broad field of study Veterinary Science could technically be used to construct tier 3 for 1989-2000. However, Veterinary Science is a small and relatively unstable field and it is therefore not suitable for inclusion in the analysis.[10] Tier 3 is therefore excluded from further analysis and descriptive statistics for both the period 1989-2000 and 1989-2004.

4.2 Main Variables and Descriptive Statistics

As previously discussed in chapter 3, the introduction of differential tuition fees affected only students commencing in a study programme after January 1, 1997. Furthermore, only domestic students were eligible for HECS fees. A domestic student is either an Australian citizen, a New Zealand citizen or a permanent visa holder (HEIMSHELP,n.d.). International students had to pay institutional fees. Unfortunately, there are no data available about the height of these fees. It can, however, be assumed that the institutional fees are (much) higher than the statutory student contributions for domestic students.

The variable *domestic commencing students* would therefore be the best measure of the effect of differentiated fees. Unfortunately, the commencing student data cannot be differentiated by citizenship category for the years 1989-2000. The variable *commencing students* is instead used as the main dependent variable. As new enrolments of international students are also included in this variable, this adds noise to the model. Moreover, if there were structural changes in the fees for overseas students in the few years before or after the introduction of the new HECS contributions, this might bias the effect.

It is not known how the fees for international students developed during the period 1989-2004. I therefore check whether the inclusion of new enrolments by international students significantly

[9] For convenience, I will refer to the pre-2001 classification of the broad fields of study throughout this thesis.
[10] Less than 2000 total enrolments annually for the period 1988-2000.

influences the results by doing a secondary analysis. In this analysis, *domestic enrolments* is used as the outcome variable. The data on domestic enrolments might provide a more accurate estimate of the effect, because the enrolments of international students are excluded.

Time-varying factors that might influence students' choices for field of study are potential earnings and labour market conditions. Unfortunately, there are no wage or labour market indicators available by field of study. Instead, GDP per Capita (in constant 2010 US$) and the unemployment rate (percentage of total labour force) are used as control variables.[11]

The unemployment rate is an indicator of the opportunity cost of enrolling in higher education. When there are fewer employment opportunities, individuals are more likely to invest more in human capital (Heller, 1999). Furthermore, the height of the unemployment rate might also influence individual's choice of a field of study. During a recession, individuals might be more likely to enrol in disciplines with higher job availability, job security or higher earnings potential. The variable *unemployment* thus captures changes in enrolment behaviour due to business cycle changes. This variable is expected to be positive correlated with total (domestic) enrolments.

GDP per capita reflects the income level and thereby the ability to pay for higher education. Sapkota and Bastola (2015) found that education is a normal good and that college enrolments rise with income levels. The variable *GDP per capita* is thus also expected to be positively correlated with the number of commencing students and domestic enrolments. Changes in the average income level might also affect a student's choice for the type of education. When national income increases, students might (on average) be more likely to enrol in disciplines with higher costs (higher fees). The variable *GDP per capita* captures changes in both overall enrolments and enrolments per field of study, caused by variations in aggregate income.

Table 4.2.1 reports descriptive statistics for the 1989-2000 sample. The average number of commencing students is approximately 238,000 and the mean of domestic enrolments is 544,000. These are the total numbers for the whole of Australia, including enrolments in the fields of study that are not included in the analysis. The descriptive statistics for the *Tier 1* and *2* studies only cover the fields of study included for further analysis, see the note in Table 4.2.1 for a specification of the included fields.

[11] These indicators were retrieved from the World Bank (2019a,b).

It is noteworthy that the mean number of commencing students is much higher for *Tier 2* disciplines (around 114,000) than for *Tier 1* studies (merely 88,000). The same is true for the average of domestic enrolments in *Tier 1* and *2*. Table 4.2.2 in appendix B reports a similar overview of summary statistics for the 1989-2004. Appendix B also includes plots for all variables reported in Table 4.2.1.

The study programmes for which the tuition fees are set at the *Tier 1* level, are the treatment group. These are the study programmes included in the broad field of study Education.[12] The study programmes which fall under tuition fee *Tier 2* (programmes in the broad fields of study Agriculture & Animal Husbandry; Architecture & Building; Science; Engineering & Surveying) function as the control group.[13] Tables 4.2.3 and 4.2.4 in appendix B report the means of domestic enrolments and the number of commencing students before and after the introduction of the differentiated tuition fee structure. The means are reported separately for the *Tier 1* and *Tier 2* study programmes. The mean number of commencing students in *Tier 1* increased from approximately 82,000 for 1989-1996 to 97,600 for 1997-2000. For both tiers, the mean number of commencing students and mean of domestic enrolments are larger for 1997-2000 and 1997-2004. This indicates that enrolments increased over time.

4.3 Data Limitations

Although the dataset discussed in the previous section may suffice for a simple analysis, there are many data limitations that must be addressed. The main concern is that the available enrolment data are clustered in broad fields of study. As previously discussed, tuition fees may differ for study programmes clustered within the same broad field of study and hence multiple broad fields of study cannot be included in the analysis. As a result, only part (35-45%) of the student population is covered in the analysis. Also, there are no enrolment data for tier 3 study programmes available and tier 3 can hence not be included in this study. This limits the scope of this research drastically: without enrolment data for tier 3 studies, the only effect of differentiated tuition fees that can be uncovered is the extent to which enrolments increase for study programmes with the lowest student contributions. The effect of the large increase in tuition fees for tier 3 study programmes (e.g. Law) on enrolments, cannot be found with this data.

[12] For an analysis of enrolments from 1989 to 2000, study programmes included in the broad field of study *Arts, Humanities and Social Sciences* are also in the treatment group.

Table 4.2.1 – Descriptive Statistics 1989-2000

	Obs.	*Mean*	*Std. Dev.*	*Min*	*Max*
Total Enrolments					
Total Enrolments[a]	12	594,317.20	80,447.95	441,074	695,485
Commencing Students					
Total Commencing	12	237,890.30	33,381.59	181,092	285,518
Tier 1 Studies[b]	12	87,974.92	88,41.93	73,676	99,821
Tier 2 Studies[c]	12	114,066.90	22,804.70	81,866	149,211
Domestic Enrolments					
Total Domestic	12	544,256	59,013.13	419,962	603,156
Tier 1 Studies	12	206,910.80	19,795.99	171,852	231,107
Tier 2 Studies	12	256,638.10	38,290.66	186,330	303,847
Controls					
GDP per Capita[d]	12	38,420.25	3,244.03	35,034.53	44,334.39
Unemployment Rate[e]	12	8.35	1.63	6.18	10.87

Notes: a) Total enrolments, total commencing enrolments and total domestic enrolments are the total numbers for Australia for all fields of study, including the fields not included in the analysis. The numbers for the Tier 1 and 2 studies are only for the fields included in analysis. b) For 1989-2000, Tier 1 includes the broad fields of study Education and Arts, Humanities & Social Sciences. c) For 1989-2000, Tier 2 includes the fields Agriculture & Animal Husbandry, Architecture and Building, Science, Engineering & Surveying and Business, Administration & Economics. d) GDP per Capita is measured in constant 2010 US dollars. e) Unemployment rate as percentage of the total labour force.

Another issue that is slightly problematic is the difference in the documentation of enrolment data before and after 2001. As discussed in the previous section, the data of before 2001 is archived and the only available data are time series tables. Apart from the categorisation changes already discussed and reported in table 4.1.1. (appendix B), there are indications that there might be some changes in the reporting of the data. When looking at the development of total enrolments over time (see figure 4.1.1. in appendix B), we can see a relatively large and sudden jump in total enrolments and the number of commencing students for 2000-2001. This pattern is also visible in some of the other plots for enrolments in specific tuition fee tiers or study programmes. The time series tables for 1989-2000 include some notes on the composition of the enrolment data, but these do not address specifically how the data are compiled or for which institutions enrolment data is included. Further information on the compilation of the pre-2001 data cannot be found and the cause for this sudden jump in enrolments can therefore not be identified. The data for 1989-2000 are therefore used as the main specification. Enrolment data for 1989-2004 are used for robustness tests.

Finally, the number of observations and the possibilities for heterogeneity analysis are clearly very limited. However, because the observations are the sums of enrolments in multiple, large study programmes, the data might be used to produce simple but meaningful results. Although the data clustered in fields of study is not at all ideal, this is the best data that can be obtained with the limited time and resources available for this research. To the best of my knowledge, there is no data from other countries available that captures similar policy reforms. The Australian data is therefore the best available data to identify the effect of differentiated tuition fees on enrolments.

5 Methodology

5.1 Selection of Method and Treatment Group

The empirical approach employed in this paper is to use the introduction of differentiated tuition fees in Australia in 1997 as a natural experiment. This study examines the changes in the enrolments after the introduction of the differentiated fees for two tuition fee tiers using a differences-in-differences design (DiD). The appeal of this method is its simplicity and its potential to circumvent endogeneity problems that typically arise when making comparisons between heterogenous groups and individuals (Bertrand, Duflo & Mullainathan, 2004). The differences-in-differences method allows for a controlled before-after comparison in observational settings where the regressor of interest varies only at a more aggregate level such as state or cohort (Angrist & Pischke, 2009, p. 169). When evaluating policies, sources of unobserved variable bias are often unobserved variables at group or year level. Differences-in-differences removes this source of bias by including a *year effect* or *common trend*, which is assumed to be identical for both the treatment and control group. Furthermore, permanent differences between treatment and control group can also be captured by a *time-invariant group effect* (Angrist & Pischke, 2009, pp. 170-171). Differences-in-differences is therefore an adequate method to study the effect of the differentiated tuition fee policy, as it allows for an unbiased post-intervention comparison between treatment and control group.

In conventional DiD applications, the control group is usually a state or cohort that is not affected by the implementation of a certain policy. In this study, however, both the control group and the treatment group are affected by the reform of the Higher Education Contribution Scheme. The study programmes for which the student contributions were set at the *Tier 1* level are the treatment group in this study. The disciplines for which the fees are at *Tier 2* level serve as the control group; see Table 4.1.1 for the exact composition of *Tier 1* and *Tier 2.*

For both the treatment and control group, there is a significant increase in tuition fees from 1996 to 1997.[14] Table 5.1.1 gives an overview of these changes in tuition fees. For the control group, the student contribution nearly doubles from $2422 in 1996 to $4700 in 1997, whereas the new tuition fee for the treatment group is $3300.

[14] Note a that the new tuition fee structure only applies to student commencing January 1, 1997 or later. For an overview of the fees, see Table 3.2.1 and 3.3.1.

Table 5.1.1 – Change in Tuition Fees for Commencing Students for 1996 - 1997

1996		*1997*	
Uniform Fee	$2422[a]	*Tier 1 Fee*	$3300
		Tier 2 Fee	$4700
		Tier 3 Fee[b]	$5500

Notes: a) Annual student contributions. b) As discussed in chapter 4, there is no data that can be used to construct Tier 3. Table adapted from: Parliament of Australia (2003).

Nonetheless, the implementation of the three-tier fee structure can still be studied effectively with a DiD-design. The aim of this paper is not to find the effect of a tuition fee increase, but the effect of differentiated fees. As discussed in chapter 3, the tuition fee is set at *Tier 2* level for most disciplines. For disciplines with low teaching costs and/or low earnings potential, the fee is discounted and set at the lower *Tier 1* level. For the most expensive disciplines and disciplines with relatively high earnings potential, the student contribution is increased to *Tier 3 level.* As previously discussed, *Tier 3* cannot be used in the analysis. Therefore, we will only use *Tier 1* as the treatment group and *Tier 2* as the control group and compare enrolments before and after the implementation of the policy. The differences-in-differences estimates will then reveal whether differentiated tuition fees lead to an increase in enrolments for disciplines with discounted fees.

5.2 Estimation Strategy

5.2.1 Main Model

This empirical approach employed is adopted from Hübner (2012). To estimate the effect of differentiated subsidies at Tier level, I estimate regressions of the form

$$Y_{jt} = \beta_0 + \beta_1 T_j t + \beta_2 T_j + \beta_3 t + \delta X_t + \varepsilon_{jt.} \quad (5)$$

Y_{jt} denotes the number of commencing students in tier j in period t (t = 0,1). T_j, the treatment indicator, takes on one for *Tier 1* and zero otherwise. t is a dummy variable indicating whether the policy has been implemented and takes on one for 1997 and onward.[15] The coefficient of interest β_1

[15] The choice for the use of a simple before-after design in a multi-period setting was inspired by other papers in the field, specifically Hübner (2012). A generalised differences-in-differences mode with year dummies l is conventional in a multi-period setting as it can control for time-varying omitted factors. A simple before-after model cannot control for these, but there are not many time-varying omitted factors in the setting studied. A lot of time-varying factors are already captured by the control variables (GDP and unemployment).

captures the impact of the interaction term $T_j t$. The latter takes on one for the treatment group after the implementation of the differentiated fees (1997). ε_{jt} represents the error term, $E[\varepsilon_{jt}|T_j \ ,t] = 0$. As control variables, GDP per capita and the unemployment rate are added to the regression for each period t, as represented by X_t.

Taking first differences of enrolment rates across both *Tiers* and time gives:

$$\begin{aligned} \text{DD} = \; & ([Y_{jt}|T_j = 1, t = 1] - [Y_{jt}|T_j = 1,\ t = 0]) \\ & - ([Y_{jt}|T_j = 0, t = 1] - [Y_{jt}|T_j = 0, t = 0]) \\ & = \beta_1 \end{aligned} \qquad (6)$$

This coefficient allows us to infer the effect of increased subsidies and consequently decreased tuition fees. As decreased tuition fees lead to lower marginal costs of education and hence a higher rate of return, I expect this coefficient to be positive.

5.2.2 Sensitivity and Heterogeneity Analysis

As discussed in chapter 4, the data for 1989-2000 will be used for the main specification of the models. Additional analysis will be done using the 1989-2004 data, to see whether the effect of the differentiated tuition fees persists. Furthermore, the robustness of results will be tested for a variety of sample and treatment periods. I will estimate several specifications with a range of periods preceding and following the introduction of differentiated fees.

As a sensitivity analysis, I will estimate a second model using domestic enrolments in *Tier j* for period *t* as the dependent variable. Only domestic commencing students are affected by the introduction of the new fee structure in 1997. There is no data available on the domestic commencing students before 2000 and therefore commencing students was chosen as a dependent variable. The variable *commencing students* does, however, also include new enrolments by overseas students. These students are not affected by the new three-tiered tuition fee structure, as they pay the institutional

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As an additional check, I estimated an (unreported) generalised differences-in-differences model with a dummy for each period (year).The estimates produced by this model are nearly identical to those produced by model (5). The results are robust to the inclusion of multiple time (year) dummies. In fact, when adding the control variables to the generalised model, these are omitted because of collinearity with the year dummies. This indicates that the variables GDP per capita and unemployment capture all time-varying factors. This shows that the simple-before after design (with controls), as given by equation (5), is appropriate for the setting studied.

fees. To test if the new enrolments by international students affected the treatment effect, I conduct a robustness check using *domestic enrolments.* Furthermore, the domestic enrolments are much more stable and might thus provide greater statistical power.

Finally, I will test for heterogeneity across gender. Plots indicate that the enrolment behaviour and response to the three-tier fee structure is quite different for the female and male subsamples. Moreover, the disciplines with *Tier 1* contributions are dominated by women. It is therefore relevant to test how gender differences impact the results.

5.3 Model Assumptions and Limitations

To estimate a causal effect using DiD, the following assumptions must hold: the intervention is unrelated to baseline outcome; the Stable Unit Treatment Value Assumption (SUTVA) and common trends for the treatment and control groups (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016, pp. 50-52; 135-136). The first assumption entails that allocation of treatment is not determined by the outcome, i.e. that fees were discounted for certain disciplines because enrolments were low. This does not seem to be the case, as the fee structure was determined by a hybrid model weighing cost and earnings potential.

SUTVA requires that there are no spill-over effects. Spillovers occur when nonparticipants are affected by an intervention (Gertler et al., 2016, p. 163). In the setting studied, spillovers are likely. This is because the intervention (reduced fees for *Tier 1*) also affects the relative prices for disciplines in *Tier 2* (and *3*). As a result of treatment, the relative price for enrolling in a *Tier 2* discipline is higher. It is therefore likely that the intervention did not only affect enrolments for *Tier* 1 disciplines, but enrolments for study programmes in *Tier* 2 as well. This could be considered a *general equilibrium effect* (Gertler et al., 2016, p. 164). I expect the reduced fees to affect enrolments in the control group in the direction opposite to the effect on the treated. These spillovers are problematic for comparison of enrolments in *Tier* 1 and *2,* and the construction on the counterfactual. Indirect effects of the fee reduction on *Tier 2* enrolments will therefore likely lead to an overestimation of the average treatment effect on the treated.

Lastly, the common or parallel trends assumption assumes that the outcomes of treated and non-treated would have changed in the same way in the absence of treatment. The biggest threat to the model is the violation of the common trends assumption, as it would lead to biased estimates. There are some potential issues with the common trends assumption for this DiD-design. First of all, there might be an anticipation effect leading to an increase in commencing students (domestic enrolments) for several fields. As the policy was announced a year prior, this might be partially solved by excluding data for 1996. Furthermore, this assumption also seems to be violated for some of the subsamples used in the analysis. Although this violation might be partially solved by reducing the number of years included in the analysis, this would reduce the statistical power greatly. Other strategies to overcome this violation, such as running the model on a matched sample are also not feasible given the low number of observations. Whether the common trends assumption holds for the different samples is tested both visually and formally; the results from this analysis are reported in a separate section in chapter six.

Finally, an issue with time-series applications of differences-in-difference, is that the standard errors are often underestimated (Bertrand et al., 2004). This leads to overrejection of null-hypotheses in DiD papers; an important reason for this overrejection is that the OLS estimator cannot account for autocorrelation. Bertrand et al. present several econometric corrections that can be used to test the accuracy of the standard errors and estimates, but these cannot be applied to small samples - as used in this study - due to low power.

6 Results

6.1 Commencing Students Results

I estimated four different specifications of the main model. The dependent variable in each specification is the number of commencing students in Tier *j* in period *t* (*t* = 0 for 1989-1996, *t = 1* from 1997 onward).

Table 6.1.1 – Impact of Differentiated Tuition Fees on the Number of Commencing Students per Tier for 1997-2000 and 1997-2004

	Treatment 1997-2000		***Treatment 1997-2004***	
	Sample period 1989-2000		*Sample period 1989-2004*	
	(1)	(2)	(3)	(4)
Tier 1	- 17,381.50***	-17,381.50 **	- 20,763***	- 20,763***
	(2,837.04)	(5,254.49)	(1924.74)	2130.801
After (t=1)	16,287.72**	40,560.50***	9,837.68**	24,300.88***
	(7,245.31)	(5,798.01)	(4,709.61)	(4,216.95)
Treatment Effect	- 26,131.50***	- 26,131.50**	- 23,399.13***	-23,399.13***
	(4,716.70)	(6,328.02)	(3397.93)	(4,360.90)
GDP per Capita ($)	4.70***		2.12***	
	(1.03)		(0.51)	
Unemployment (in %)	1,978.87**		946.41	
	(793.67)		(640.59)	
Constant	- 88,545.77**	100,546.80***	- 31,687.25	54,079.13***
	(38,930.69)	(4,704.50)	(21720.61)	(2,034.53)
No. of Obs	24	24	32	32
R^2	0.95	0.85	0.95	0.91

*Notes: Robust standard errors in parentheses. The dependent variable is the number of commencing students per tier. Specification 1 and 2 use the 1989-2000 dataset and for specification 3 and 4, the 1989-2004 data is used. Tier 1 is a dummy variable indicating the treatment group, After indicates whether the differentiated fees have been implemented. The variable Treatment Effect is the variable of interest, this is the interaction effect of the treatment and time dummy (Tier 1 x After). In specification 1 and 3, GDP per Capita (in constant 2010 US dollars) and the Unemployment rate are included as control variables. * Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.*

Table 6.1.1 reports the results. For specification 1 and 2, the period 1997-2000 is used as treatment period. The treatment period for specification 3 and 4 is 1997-2004. *Tier 1* is a dummy variable indicating the treatment group. *After* indicates whether the differentiated fees have been implemented. *Treatment Effect* is the variable of interest, this interaction effect (*Tier 1 x After)* allows us to infer the effect of the differentiated tuition fees. In specification 1 and 3, GDP and unemployment are included as control variables. GDP per Capita is measured in constant 2010 US dollars and unemployment as the percentage of the total labour force. Robust standard errors are reported in parentheses and the asterisks indicate statistical significance.

For the first specification, the coefficient for *Tier 1* is negative. This indicates that, both before and after the intervention, the number of commencing students in the treatment group is significantly lower than in the control group. The estimate for *After* is significantly positive, which shows that the total number of commencing students increased after the implementation of the differentiated tuition fees (1997). I find a negative treatment effect of -26,131.50, significant at the one percent level. Hence, the introduction of the lower fees for *Tier 1* led to a total decrease of approximately 26,000 students commencing in *Tier 1* disciplines in 1997-2000. Furthermore, I find that both GDP per capita and the unemployment rate are significantly positively related to the total number of commencing students.

The results of the second specification are reported in column 2. This specification uses the same data and (in)dependent variables, but does not control for GDP and unemployment. For specification 2, the estimate of the coefficient of *Treatment Effect* is identical to the estimate in the first specification, but the standard errors are higher in specification 2. Moreover, removing GDP and unemployment as independent variables led to a decrease in the R-squared from 0.95 to 0.85. The first specification thus produces more accurate estimates and is a better fit for the data.

Specification 3 takes 1997-2004 as the treatment period. For this specification, the number of commencing students in the treatment group is also significantly lower than in the control group. The estimate *After* is slightly smaller for this specification, but also significant and positive. The number of commencing students was on average higher for 1997-2004 than for 1989-1996. In specification three, the estimate of *Treatment Effect* is -23,399.13 and significant at the one percent level. The introduction of the lower fees for *Tier 1* thus led to reduction in the number of commencing students reduced the total number of commencing students in *Tier 1* fields of study by approximately 23,500 in the seven-year period following the introduction of the new fees.

The treatment effect for 1997-2004 is smaller than for 1997-2000 (approximately -26,000 in specification 1). This could be an indication that the negative effect of the discounted fees for *Tier 1* disciplines does not persist after 2000. Note, however, that there are several issues that hinder further comparison of these results. Due to categorisation changes, some disciplines are excluded from the 1989-2004 dataset. Furthermore, there is an odd jump in (new) enrolments from 2000 to 2001, for which the reason is not known. It is therefore important to be careful in drawing conclusions from the results using this data.

Finally, specification 4 also uses 1989-2004 data and does not control for GDP and unemployment. The *Treatment Effect* estimate is identical to specification 3, but has slightly higher standard deviations. Removing the control variables also reduced the R-squared from 0.95 to 0.91, hence specification 3 seems to be more accurate.

In short, I find a negative treatment effect for all four specifications. Both the models using the 1989-2000 and the 1989-2004 data indicated that the introduction of the differentiated fees led to a large and significant decrease in the number of commencing students for *Tier 1* disciplines. Against my expectations, the relatively lower fees led to a decrease in new enrolments for the disciplines in *Tier 1*.

In the next sections, I will conduct robustness test in order to corroborate the main findings. I will also analyse whether or not the common trends assumption is violated. After that, I will interpret the findings in chapter 7.

6.2 Robustness Checks

6.2.1 Variation Treatment and Sample Period

I performed a variety of tests to check whether the negative treatment effect is robust. The first check is to test whether this negative effect persists for a variation of treatment and sample periods.

The common trends assumption may become problematic when (too) many years before the intervention are included in a differences-in-differences model. If this assumption is violated, the estimates may be biased and will then not reflect the treatment effect accurately.[16] I therefore indirectly test whether the negative treatment effect found in prior analysis persists when including only a few years before the introduction of the differentiated fees.

I estimate four specifications for different sample periods, each using the number of commencing students as a dependent variable. For the first specification, 1993 – 2000 is used as a sample period. For the second specification, I also include four years before and after the introduction of the new fee structure, but exclude 1996. As the introduction of the differentiated tuition fees was announced a year prior, there might have been an anticipation effect which has led to downward bias of the treatment effect. I also test whether the effect persists when including only three and two years before and after the implementation of the policy.

Table 6.2.1 reports the results for the different sample and treatment periods. For all four specifications, the estimate of the *Treatment Effect* is negative and quite large. These results confirm that the introduction of the differentiated fees led to a decrease in enrolments for *Tier 1* disciplines. Moreover, three of the negative estimates are statistically significant at the 10 percent level at least. The estimate for the specification excluding the year 1996, is even significant at the one percent level. This estimate does not differ much from the other estimates of the treatment effect; this indicates that any anticipation effects did not cause large biases in the other estimates. The estimate of *Treatment Effect* is not significant for the fourth specification, but this is likely due to the low number of observations. In short, the significant negative treatment effect on the number of commencing students in *Tier 1* disciplines is robust to variations in the sample and treatment period.

[16] See Chapter 6.3 for a further discussion of the common trends assumption.

Table 6.2.1 – Impact of Differentiated Tuition Fees on Number of Commencing Students for a Variation of Sample and Treatment Periods

	Treatment 1997-2000		***Treatment 1997-1999***	***Treatment 1997-1998***
Sample period	*1993-2000*	*1992-1995 1997-2000*	*1994-1999*	*1995-1998*
Tier 1	- 23,122.75***	- 19,511.75***	- 24,950.67**	- 26,532**
	(3778.69)	(1,966.64)	(4,898.85)	(3,308)
After (t=1)	19,791.96**	26,983.50**	16,086.10	7,606.88
	(8257.63)	(5,799.84)	(10,714.20)	(5,968.28)
Treatment	- 20,390.25**	- 24,001.25***	- 16,256.67*	- 11,029
	(5086.19)	(3,741.06)	(6,692.15)	(4,748.74)
Controls	*Yes*	*Yes*	*Yes*	*Yes*
Constant	165,561.60	167,796.30	123,320.70	- 314,226.40
	(114,815.40)	(91,556.41)	(187,963.70)	(181,359.80)
No. of Obs	16	16	12	8
R^2	0.96	0.98	0.96	0.99

*Robust standard errors in parentheses. The dependent variable used is commencing students per tier. For specification 1 and 2, 1997-2000 is used as the treatment period. For specification 1, 1993-2000 is used as the sample period and for specification 2 the sample period is 1992-1995 and 1997-2000, thus excluding 1996. For specification 3, data for 1994-1999 are used and specification 4 only uses data on 1995-1998. Tier 1 is a dummy variable indicating the treatment group, After indicates whether the differentiated fees have been implemented. The variable Treatment Effect is the variable of interest, this is the interaction effect of the treatment and time dummy (Tier 1 x After). GDP per Capita (in constant 2010 US dollars) and the Unemployment rate are included as control variables in all specifications. * Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.*

6.2.2 Domestic Enrolments

The new differentiated fee structure only applies to domestic students commencing January 1997 or later. Previously enrolled students keep paying the uniform tuition fees, indexed for inflation each year as given in Table 3.1. International students are not eligible for HECS contributions and pay institutional fees. They are therefore also not affected by the introduction of the differentiated fee structure. Unfortunately, data on the number of domestic commencing students is not available for the full sample period. I therefore indirectly check whether new enrolments by international students affected the results, by estimating an additional model with *Domestic Enrolments (*for *Tier j* in period *t)* as dependent variable.

The four specifications estimated are identical to the specifications of the main model. The first two specifications use data for 1989-2000 and specification 3 and 4 use data for 1989-2004. Specification 1 and 3 include controls for GDP per capita and unemployment. Again, the specifications with controls produce lower standard errors and a higher R-squared, so I focus on these results.

Column 1 reports the results for the first specification, including controls and using data on 1989-2000. The estimates for *Tier 1* are again significantly negative and the estimate for *After* is significantly positive. The estimate for *Treatment Effect* is -28,987.12 and significant at the one percent level. The introduction of the lower fees for *Tier 1* led to a total decrease in domestic enrolments for *Tier* 1 disciplines of approximately 29,000 during the period 1997-2000. The effect on domestic enrolments is larger than the effect on commencing students (estimate of roughly 26,000). This difference in magnitude may be due to the inclusion of international student data in the number of commencing students.

Results for specification 3, using the data up to 2004, are reported in the third column. The results for this specification are similar. Domestic enrolments are on average lower in the treatment group and total domestic enrolments are higher after the introduction of the new fees. The estimate of the treatment effect on domestic enrolments for 1997-2004 is -38,252.62 and significant at the one percent level. The differentiated fees thus led to a drop of 38,000 total in domestic enrolments for *Tier 1* disciplines, during the 7 years following the
introduction.

Contrary to the *Commencing students* results, the estimate of the treatment effect on domestic enrolments is larger for 1997-2004 than for 1997-2000. As previously discussed, there was an odd jump in enrolments from 2000 to 2001. This will have likely influenced the estimates. Therefore, not too much weight should be attributed to the results for 1997-2004.

In sum, I find that the negative treatment effect persists when *domestic enrolments* is used as a dependent variable. The estimates of the treatment effect are even larger for this model.

Table 6.2.2 – Impact of Differentiated Tuition Fees on Domestic Enrolments per Tier for 1997-2000 and 1997-2004

	Treatment 1997-2000		***Treatment 1997-2004***	
	Sample period 1989-2000		*Sample period 1989-2004*	
	(1)	(2)	(3)	(4)
Tier 1	- 40,064.88***	- 40,064.88**	- 59,755.63***	- 59,755.63***
	(4,778.09)	(10,877.18)	(5,012.69)	(6,348.56)
After (t=1)	29,170.37**	63,779.87***	18,787.60**	42,344.75***
	(10,429.13)	(10,093.14)	(6,067.95)	(7,348.88)
Treatment Effect	- 28,987.12***	- 28,987.12**	- 38,252.62***	- 38,252.62***
	(6,335.71)	(11,057.83)	(5,573.58)	(7,844.77)
GDP per Capita ($)	8.23***		4.16***	
	(1.61)		(0.95)	
Unemployment (%)	8,472.04***		4,064.46 **	
	(1,716.33)		(1,865.55)	
Constant	- 140,075.10*	235,378.10***	- 54,548.71	133,163***
	(67,747.91)	(9,901.99)	(50,431.32)	(6,218.71)
No. of Obs	24	24	32	32
R^2	0.96	0.82	0.97	0.94

*Notes: Robust standard errors in parentheses. Domestic enrolments per tier is used as dependent variable. Specification 1 and 2 use the 1989-2000 dataset and for specification 3 and 4, the 1989-2004 data is used. Tier 1 is a dummy variable indicating the treatment group, After indicates whether the differentiated fees have been implemented. The variable Treatment Effect is the variable of interest, this is the interaction effect of the treatment and time dummy (Tier 1 x After). In specification 1 and 3, GDP per Capita (in constant 2010 US dollars) and the Unemployment rate are included as control variables. * Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.*

6.2.3 Heterogeneity Analysis

Finally, I analyse whether there is heterogeneity across gender. I estimate the treatment effect separately for the male and female subsample, for both *Commencing students* and *Domestic enrolments.* For all specifications, data for 1989-2000 are used and controls for GDP and unemployment are included. Table 6.2.3. reports the results for this analysis.

Column 1 and 2 report the results for the specifications with *Commencing students* as the dependent variable. For the male population, the estimate for *Tier 1* is significantly negative, whereas it is significantly positive for females. This indicates that more females are enrolled in *Tier 1* disciplines than in *Tier 2* disciplines. For males, the number of commencing students is much higher for the control group, *Tier 2* disciplines. For both subsamples, *After* is significantly positive which shows that the number of commencing students is on average higher after the introduction of the fees. The estimate of *Treatment Effect* is -16,679.13 for males, and significantly negative at the one percent level. For the female sample, the estimated effect is -9,452.38 and significant at the five percent level. For both subsamples, GDP per capita and unemployment are positively correlated with the number of commencing students.

The results for the heterogeneity analysis of the effect on *Domestic* enrolments are reported in the third and fourth column of Table 6.2.3. These results follow a pattern very similar to the effects on *commencing students*, but for this specification, nearly all estimates are larger. The estimate for *Tier 1* is again positive for females, whereas this estimate is negative for the male sample. For both the male and female sample, domestic enrolments increased after the introduction of the differentiated fees. The treatment effect is estimated to be -20,817 for males, significant at one percent. For females, the treatment effect is -8,170.25 and significant at the five percent level.

From the estimates in Table 6.2.3, we can infer that the treatment effect is negative for both men and women. These estimates can, however, not be used to draw conclusions about the difference in effect size for men and women. As males and females have very different enrolment patterns, [17] differences in estimates of the absolute treatment effect cannot be used to compare the magnitude of the treatment effect for males and females.

[17] This can be inferred from the sign of the *Tier 1* estimates. Furthermore, the averages for *commencing students* and *domestic enrolments* of the two subpopulations indicate that *Tier 1* disciplines are clearly female-dominated, whereas fields of study in *Tier 2* are predominantly chosen by males. The number of females in all fields of study included in the analysis is greater than the number of males.

Table 6.2.3 – Heterogeneity Analysis of the Impact of Differentiated Tuition Fees on the Number of Commencing Students and Domestic Enrolments for 1997-2000

	Commencing Students		***Domestic Enrolments***	
	Sample period 1989-2000		*Sample period 1989-2000*	
	Male	Female	Male	Female
Tier 1	- 37,116.12***	19,734.63***	- 91,628.87***	51,564***
	(1,552.20)	(1,426.95)	(2,992.39)	(1,997.96)
After (t=1)	9,897.00**	6,389.72*	16,641.45**	12,528.92**
	(3,908.71)	(3,551.14)	(5,763.67)	(4,824.73)
Treatment	- 16,679.13***	- 9,452.38**	- 20,816.88***	- 8,170.25**
	(2,403.46)	(2,482.79)	(3,639.82)	(2,915.54)
GDP per Capita ($)	2.01**	2.69***	3.24**	4.99***
	(0.57)	(0.50)	(0.99)	(0.67)
Unemployment (%)	984.54*	994.33**	3,972.49**	4,499.55***
	(482.55)	(354.85)	(1,217.29)	(553.88)
Constant	- 19,679.46	- 68,866.31**	- 3,318.77	- 136,756.30***
	(22,483.61)	(18,345.53)	(44,226.45)	(2,5634.77)
No. of Obs	24	24	24	24
R^2	0.99	0.96	0.99	0.99

Notes: Robust standard errors in parentheses. Domestic enrolments per tier is used as dependent variable for the specification in column 1 and 2. For column 3 and 4 specification, the number of commencing students per tier is the dependent variable. For all four specifications, data for 1989 to 2000 is used. Tier 1 is a dummy variable indicating the treatment group, After indicates whether the differentiated fees have been implemented. The variable Treatment Effect is the variable of interest, this is the interaction effect of the treatment and time dummy (Tier 1 x After). GDP per Capita (in constant 2010 US dollars) and the Unemployment rate are included as control variables.
** Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level*

I therefore calculated the relative treatment effects for males and females, for both the number of commencing students and domestic enrolments. The relative treatment effects are calculated by taking the difference of relative enrolment increases[18] across *Tiers.*[19] The relative enrolment increases and treatment effects are given in Table 6.2.4. For the commencing students specifications, the relative treatment effects are smaller than for the analysis of domestic enrolments. The relative treatment effects are clearly much smaller for males (-18.7 and - 5.1 percentage-points respectively), than for females (- 34.8 and -21.2 percentage-points).

For both males and females, the introduction of the differentiated fees led to a large and significant decrease in the number of commencing students and domestic enrolments for *Tier 1* disciplines. The relative treatment effects indicate that the magnitude of the effect is significantly higher for females than for males. This shows that females responded much stronger to the introduction of the discounted fees for *Tier 1* disciplines.

Table 6.2.4 – Heterogeneity Analysis of Relative Effect Size on the Number of Commencing Students and Domestic Enrolments

	Commencing Students		***Domestic Enrolments***	
	Sample period 1989-2000		*Sample period 1989-2000*	
	Male	Female	Male	Female
Tier 1 Increase (%)	13.4	19.1	14.4	19.3
Tier 2 Increase (%)	32.1	53.9	19.5	40.5
Treatment Effect (pp)	- 18.7	- 34.8	- 5.1	- 21.2

Notes:. Domestic enrolments per tier is used as dependent variable for the specification in column 1 and 2. For column 3 and 4 specification, the number of commencing students per tier is the dependent variable. For all four specifications, data for 1989 to 2000 is used. The increases in enrolments in Tier 1 and 2 are given in percentages. The treatment effect is given in percentage-points and is calculated by taking the difference between the relative increase in Tier 1 enrolments and Tier 2 enrolments.

[18] The percentage increase of the average of enrolments from before (t=0) to after (t=1) introduction of the differentiated fees.
[19] See equation (6) in chapter 5.

6.3 Discussion of the Common Trends Assumption

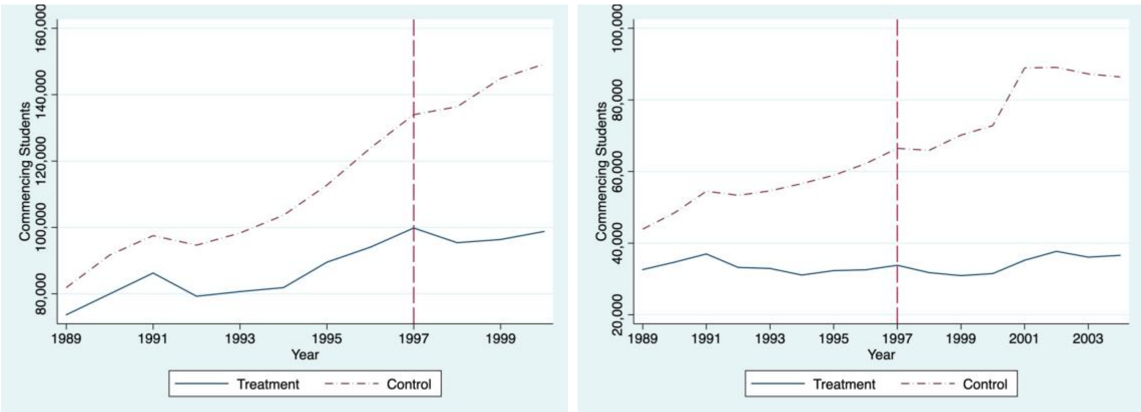
All the results suggest that the introduction of the differentiated fee had a significantly negative impact on *Tier 1* enrolments. These results rest on the assumption that the enrolment trends for *Tier 1* and *Tier 2* would be the same, had the three-tiered tuition fee structure not been implemented. Whether this assumption is plausible, can be assessed by looking at the pre-intervention trends. In the analysis, four different datasets were used: *commencing student*s data 1989-2000, *commencing students* data 1989-2004, *domestic enrolments* data 1989-2000 and *domestic enrolments* data 1989-2004. For each of these datasets, I test whether there were parallel trends prior to the implementation of the policy.

6.3.1 Commencing Students

Figure 6.3.1 gives a visual representation of the trend in commencing student numbers for the treatment (*Tier 1)* and control group (*Tier 2).* It is evident that for the 1989-2000 dataset, the common trends assumption is much more plausible than for the 1989-2004 data.

For the 1989-2004 data, the trend for the two tiers start to develop in different directions in 1991. The trend for the treatment group is slightly downward-sloping prior to the intervention, whereas there is a clear positive trend in new enrolments for the control group. Based on visual inspection, it can be concluded that the common trends assumption does not hold for the *commencing students 1989-2004* data.

Figure 6.3.1 – Common Trends for Commencing Students 1989-2000 & 1989-2004



Source: Own illustration

For the *commencing students 1989-2000* data, the common trends assumption seems plausible at first sight. Upon closer inspection, however, I found that the trend for the control group is slightly more upward sloping than the treatment group in 1993. In 1993 as well as 1995, there were minor HECS reforms. These were small changes in the discounts for paying up-front, repayment rates and income threshold for repayments (Parliament of Australia, 2003). These reforms may have caused small differences in the trend of the treatment and control group.

Whether the slight deviation from the common trend is problematic for the analysis and reliability of the results, can be formally assessed with a *lead test*. A lead test can be used to determine whether the trend of the control and treatment group differ significantly prior to the intervention. For each year before the intervention (1989-1996) a dummy is included as a lead. To formally test the common trends assumption, I estimate a model of the form:

$$Y_{jt} = \alpha + \rho T_j + \gamma t + \sum_{k=0}^{n} \beta_k D_{t+k} + e_{jt} \qquad (7)$$

Y_{jt} denotes the number of commencing students per tier *j* in year *t*. D_t is now an indicator of whether treatment was switched on in year *t*. If any of the coefficients β_k is significantly different from 0, the common trends assumption is violated. I estimate three specifications of this model, with a variety in the number of leads (*n*).

The results of this lead analysis are reported in Table 6.3.1. For both specification 1 and 2, the second, fourth and fifth lead are significantly different from zero. For specification 3, the second and third lead are significant as well. In 1992, 1993 (and 1994 in specification 3), the leads are significantly negative. For 1995, there is a significantly positive placebo treatment effect. For the construction of the treatment effect, the last few years prior to intervention are most important. It is therefore especially alarming that when we look at the specification 3, there are significant placebo effects for both 1994 and 1995. The magnitude of these significant coefficients is also quite large. This leads to the conclusion that for the *commencing student 1989-2000* data, the common trends assumption is also violated. This violation may cause bias and needs to be taken into careful consideration when interpreting the results.

Table 6.3.1. – Results Lead Test of the Common Trends Assumption

	Commencing Students			***Domestic Students***		
	Sample period 1989-2000			*Sample period 1989-2000*		
	(1)	(2)	(3)	(4)	(5)	(6)
Tier 1	-11,104.28**	-10,706.03***	-15,580.65***	-31,234.16***	-43,481.34	-52,575.29***
	(3,017.69)	(1,693.28)	(3,351.72)	(1,795.78)	(6,051.23)	(5,259.82)
After (t=1)	13,460.62	13,477.36	14,215.45	11,122.59*	11,545.78**	12,548.63**
	(11,189.12)	(10,196.41)	(9,862.66)	(5,312.15)	(5,326.93)	(5,639.85)
Treatment	-23,974.84**	-23,959.18**	-24,646.66**	-20,658.99***	-21,277.33***	-22,330.73***
	(7,261.99)	(6,621.19)	(6,344.49)	(3,640.96)	(3,518.35)	(3,815.48)
Lead 1 (1996)	-890.86	-908.80	-463.22	-6,574.61***	-6,108.46***	-5,360.29***
	(1,609.57)	(1,451.55)	(1,458.77)	(556.39)	(691.47)	(884.81)
Lead 2 (1995)	6,362.73**	6,434.55**	5,476.16**	2,026.84*	745.10	-1,143.44
	(2028.52)	(1,710.82)	(1,550.65)	(992.64)	(1,268.87)	(1,531.81)
Lead 3 (1994)	-862.90	-798.95	-8,298.63*	-1,412.03	-2,530.66**	-16,598.50**
	(2,056.13)	(1,767.40)	(4,028.20)	(939.14)	(1,153.02)	(5,062.26)
Lead 4 (1993)	-4,878.75**	-4,905.76**		-9,448.26***	-8,793.73***	
	(1,797.67)	(1,610.51)		(649.80)	(851.60)	
Lead 5 (1992)	-9,132.38***	-8,668.83**		-9,123.95***	-16,561.83**	
	(1403.40)	(2,777.55)		(908.41)	(6,735.60)	
Lead 6 (1991)	1,064.71			-13,079.71***		
	(3,223.74)			(2,102.23)		
Lead 7 (1990)	-96.43			-8,503.38***		
	(1,619.29)			(849.81)		
Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-129,311.30*	-130,513.50**	-105,444.30*	-16,7086.30***	-139,238.70***	-95,523.03**
	(61,738.28)	(54,823.80)	(56,740.16)	(22,779.90)	(32,961.80)	(44,942.86)
No. of Obs	24	24	24	24	24	24

*Notes: Robust standard errors in parentheses. For specification 1,2 and 3, the dependent variable is Commencing students. For specification 4 through 6, the dependent variable is domestic enrolments .Specification 1 and 4 include 7 leads, specification 2 and 5 include 5 leads. For specification 3 and 6, only 3 leads are included. * Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.*

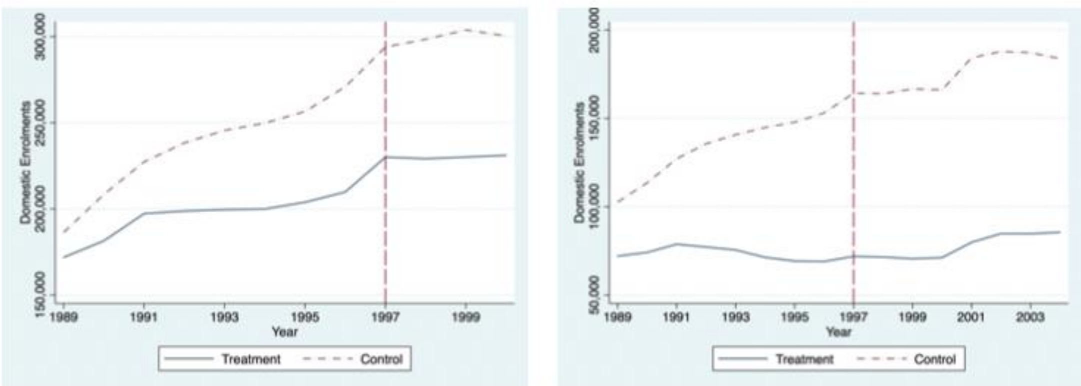
6.3.2 Domestic Enrolments

Figure 6.3.2 gives a visual representation of the common trend in domestic enrolments for 1989-2000 and 1989-2004. Again, for the 1989-2004 dataset it is very clear that the domestic enrolments patterns differ significantly for the two tiers. The common trends assumption is thus not plausible for *domestic enrolments 1989-2004* data.

For the *domestic enrolments 1989-2000*, the pre-intervention parallel trends seem plausible upon visual inspection (see the left panel in Figure 6.3.2) A closer look reveals that the trend for the control group slightly deviates from the trend of the treatment group in 1991 and 1992. I formally test whether these deviations are statistically significant. I estimate a model of the same form as equation (7), but with domestic enrolments per Tier *j* at time *t* as the dependent variable.

The results of these formal tests are reported in the last three columns of Table 6.3.1, as denoted by specification (4)-(6). For the fourth specification, I find significant negative placebo effects for 1996, 1993, 1992, 1991 and 1990. The estimates of the leads for 1993 and 1992 are also significant in specification five. Furthermore, I also find significant placebo effects for 1994 and 1996 for the specifications with 3 and 5 leads. For all significant coefficients, the estimates are negative and quite large. I therefore conclude that for the *domestic enrolments 1989-2000* data, there are also serious violations of the parallel trends assumption. The estimates of nearly all leads are all significantly negative and the estimate of the treatment effect on *domestic enrolments* may therefore be biased downwards. This needs to be taken into account when interpreting these results.

Figure 6.3.2 - Common Trends for Domestic Enrolments 1989-2000 & 1989-2004



Source: Own illustration

7 Discussion

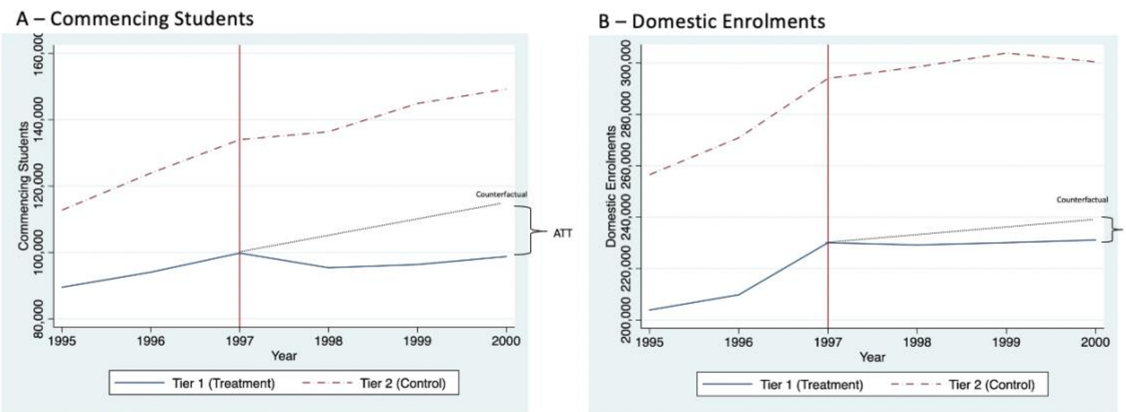
7.1 Interpretation of Treatment Effects

All the results suggest that the differentiated tuition fees had a significant, negative effect on the number of commencing students in *Tier 1* disciplines, the study programmes for which the student contributions were set at the lowest level. These results are similar for the domestic enrolments and robust to variations in the duration of the sample and treatment period. Although the negative treatment effect is significant for both men and women, the magnitude of the effect is greater for women.

It is, however, important to note that a negative treatment effect does not necessarily mean there was an absolute decrease in enrolments for *Tier 1.* When using a differences-in-differences design, the average treatment effect on the treated (ATT) is estimated by comparing the outcome of the treatment group to a counterfactual. The counterfactual is constructed by applying the control group trend to the pre-intervention treatment group outcomes. The intuition of the DiD treatment effect is depicted in Figure 7.1.1.[20]

After the implementation of the differentiated tuition fees (1997), the number of commencing students in *Tier 2* disciplines continued to grow at a rate similar to before the intervention (see Panel A in Figure 7.1.1). When looking at the number of commencing students in *Tier 1*, we see that new

Figure 7.1.1 - Visual Representation of the Average Treatment Effect on the Treated (ATT)



Note: The dotted line depicts the evolution of the enrolments in Tier 1, had the tuition fees not been discounted.
Source: Own illustration

[20] Figure 7.1.1, the visual representation of the treatment effect using DiD was adapted from an example by Angrist and Pischke (2014, p. 172).

enrolments increased from 1996 to 1997. The number of commencing students in 1998 is slightly lower than in 1997, but still higher than in 1996. From 1998 to 2000, there is a slight increase in the number of commencing students.

There is indeed no absolute decrease in the number of commencing students for *Tier 1* from 1997-2000. On the contrary, the average number of commencing students during this period is higher than prior to introduction of the differentiated fees. The negative treatment effect of -26,131.50 (specification 1, see Table 6.1.1) is caused by the continued fast growth of the number of commencing students for *Tier 2* disciplines. When comparing the *Tier 2* trend to the *Tier 1* commencing students (the dotted line in Figure 7.1.1), we see that the number of commencing students in *Tier 1* did decrease significantly *relative* to *Tier 2* new enrolments. In absence of treatment, the number of new enrolments in *Tier 1* disciplines would have grown at a higher rate and the total number of commencing students in *Tier* 1 from 1997 to 2000 would have been approximately 26,000 higher.

For the domestic enrolments (see Panel B in Figure 7.1.1), a similar pattern holds. The growth of domestic enrolments in *Tier 2* did slow down a little after 1997, but the trend is still upward sloping. For *Tier 1,* there is a small jump in domestic enrolments from 1996 to 1997 but the level of domestic enrolments remains stable from 1997 to 2000. The growth of *Tier 2* domestic enrolments is again higher than the observed growth in *Tier 1*. The estimated treatment effect is -28,987.12 (specification 1, Table 6.2.2). Had the fees not been discounted, then the total number of domestic enrolments from 1997-2000 in *Tier 1* disciplines would have been approximately 29,000 higher. The same intuition holds for the interpretation of the results from the other specifications and robustness checks.

7.2 Tuition Fee Signalling

The negative treatment effects are not caused by absolute decreases in (new) enrolments for *Tier 1,* but rather a decrease in *Tier 1* enrolments relative to *Tier 2* enrolments after the introduction of the differentiated fees. Nonetheless, these persistent negative results remain counterintuitive. Theory predicts that individuals invest more in human capital in discipline *n* if the subsidies for that discipline are high and tuition fees for that discipline are low (Jacobs and Van der Ploeg, 2006, p.559). *Tier 1* disciplines are subsidised at a higher rate and the tuition fees are lower than for *Tier 2*, one would therefore expect an increase in *Tier 1* enrolments relative to *Tier 2* enrolments.

Although there is no other empirical work on the enrolment effects of differentiating fees, there are many papers that study the effect of tuition fee changes on enrolments. Leslie & Brinkman (1987), for example, conducted a meta-study of twenty-five papers on student price responses in higher education. They found that increased tuition fees lead to reduced enrolments. In 1997, an update to the work of Leslie & Brinkman was published by Heller. In this paper, Heller reviewed studies on student demand for higher education that had come out since 1987. In his conclusion, he stated: ‘the evidence is very consistent and can be summarised in one sentence: as the price of college goes up, the probability of enrolment tends to go down’ (Heller, 1997, p. 649).

The findings are similar for more recent work. Neill (2009), for instance, studied the relationship between tuition fees and demand for university places in Canada. She found that a tuition fee increase of 1000 (Canadian) dollars, led to a 2.5 to 5 percentage-points decline in demand for higher education. For a similar study by Hübner (2012) in Germany, the estimates were nearly identical. All in all, economic literature provides compelling proof for a significant negative relationship between tuition fees and higher education enrolment rates.

My results suggest that this relationship is different when tuition fees are differentiated by fields of study, rather than set at the same level for all study programmes. When tuition fees are differentiated by field of study, determinants of study choice other than cost of a study programme are, apparently, more important. Three factors that could influence field of study choice are the quality of education, earnings potential and the status of certain degrees.

Educational quality and teaching performance are important to (prospective) students (Jacobs & Van der Ploeg, 2006, p. 553). Higher per student expenditure and higher instructional costs are often associated with higher quality. Therefore, students often expect programmes with higher tuition fees to be of higher quality (Drewes & Michael, 2006; Middaugh, Graham & Shahid, 2003).[21] Any negative effects of tuition fee increases may therefore be offset by increased (perceptions of) quality (Shin & Milton, 2006). There is some empirical support for the idea that higher tuition signal higher quality. Behrman, Kletzer, McPherson & Schapiro (1992) established a negative relationship between tuition fees and enrolment for the population as a whole. For the white population, however, their results show that an increase in tuition fees for four-year colleges led to an increase in enrolments in these programmes. They found that the price captured a quality effect, which could explain the unexpected positive relationship.

[21] Middaugh et al. (2003) show that higher quality is not necessarily correlated with higher instructional spending.

Return on investment is another important determinant of study choice. A study by Harvey-Beavis and Elsworth (1998) in Australia showed that earnings potential is one of the main factors that influence field of study choice. Shin & Milton (2006) found that changes in wage premiums have a much stronger effect on enrolments than tuition fee changes. They state that enrolments are not very sensitive to relatively small changes in tuition levels, because returns greatly exceed the cost of higher education.

Finally, the status associated with certain degrees and occupations may also influence field of study choice (Jacobs & Van der Ploeg, 2006). Harvey-Beavis and Elsworth (1998) found that, even though interest in the field is the most important factor, students do often pursue status. Within the field of study that interest them, students tend to choose study programmes with higher status. Typical examples of high-status disciplines are Law and Medicine (Wilkins, Shams & Huisman, 2013). Regardless of the exact field of study, tuition fees might also function as a signal of status. Higher fees are often associated with high-status fields. Lower fees might therefore also be associated with lower status.

In Australia, any combination of these three factors may have led to the relative enrolment decrease for *Tier 1* disciplines. The tuition fees differentiated by field signal differences in quality and status. As the height of the tuition fees was (partially) determined by earnings potential, this will also have increased awareness about the earnings potential of different fields. The reduced fees for Education and Arts, Humanities & Social Sciences signalled that these disciplines were of relatively lower quality, lower status and had limited earnings potential. If there were any positive enrolment effects of the discounted fees, these were likely crowded out by these negative signalling effects. As a result, there were sizeable negative enrolment effects for *Tier 1* disciplines.

This 'signalling argument' is supported by the continued growth of enrolments in *Tier 2.* Tuition fees for *Tier 2* increased considerably,[22] yet the number of commencing students grew at a rate similar to before the introduction of the differentiated fees (see the plots in Appendix B). The higher *Tier 2* fees signalled higher status, quality and return on investment. It is probable that these positive signalling effects crowded out any negative enrolment effects of the fee increase.

[22] For *Tier* 2 studies there was both an absolute fee increase, and an increase in price relative to *Tier 1* disciplines.

In the context of HECS, signalling effects may have been larger than they would have been in other higher education systems. Earlier research by Andrews (1999) indicates that the overall demand effects of HECS were relatively small. In other countries, tuition fee increases had a much larger impact on (total) enrolments. Andrews noted that because the contributions were deferrable and income-contingent, the demand response to the cost increase associated with (differential) HECS was likely muted. When financial barriers are higher and charges non-deferrable (like in the Netherlands), cost increases will likely play a larger role. The cost of discipline could then be a more important determinant of study choice than the status, educational quality or earnings potential associated with the tuition fee level. Tuition fee signalling is likely much less important when there are financial barriers that affect access to education. If so, the negative signalling effects of discounted fees might not be as large and could even be cancelled out by the positive effects of reduced cost. In that case, discounted fees might not have a negative effect on enrolments.

7.3 Limitations

This study is subject to several limitations. There are multiple issues with the data and methodology that may have led to inaccurate or biased estimates of the treatment effect.

First of all, it is important to note that not all existing fields of study are included in the analyses (see chapter 4.1 for a detailed description). Due to data issues, several large fields of study, such as Health and Law and Legal studies*,* could not be included. The analyses cover about 35-45% of the total student population.[23] As there is no data available for the excluded disciplines, it is not possible to check whether the differentiated fees affect enrolment behaviour for other fields in a similar way.

Fields of study and disciplines differ in immaterial returns, like status and symbolic value. Jacobs and Van der Ploeg (2006) suggest that Education could be a field with high symbolic value. If the immaterial returns for a degree are high, demand for this degree will be less sensitive to changes in the initial required investment (tuition fee). As Education is only one of two fields of study in *Tier 1*, this could have partially driven the negative results. The *Tier 1* disciplines which are excluded from the analyses might be more sensitive to cost changes. This relatively higher cost sensitivity might cancel out any negative signalling effects. It could be the case that enrolments for excluded *Tier 1* disciplines did increase after the introduction of the differentiated fees. The data exclusion issues therefore severely

[23] This estimate is computed by adding up the new (domestic) enrolments of the included *Tier 1* and *2* broad fields of study and then dividing this number by the total number of new (domestic) enrolments.

reduce external validity of results. On the other hand, Education is the field that is most relevant to evaluate the Dutch case. The results can therefore still be used to draw policy implications for the Netherlands.

Another concern is the violation of the common trends assumption. This violation might have partially driven the negative results. As discussed, the estimation of the treatment effects is based on the assumption that trends are parallel. If, however, the direction of enrolment trends already differs prior to intervention, it is very unlikely that the trends would have run parallel during the treatment period. As discussed in chapter 6.3, the common trends assumption is violated for all samples. There are several significant placebo treatment effects in the years prior to the intervention for both *commencing students* and *domestic enrolments.* It is also evident from the plots (see Figure 6.3.1 and 6.3.2) that the general enrolment trend is more upward sloping for *Tier 2* disciplines, whereas it is more stable for *Tier 1.* As the *Tier 2* trend is more upward-sloping than for *Tier 1* before 1997*,* this will likely also be the case after 1997. This would mean that the DiD estimates are biased downward; in absence of treatment the *Tier 1* enrolments would likely not be as high as the results suggest.

Finally, the violation of SUTVA may have also led to bias. Spillovers of treatment on the control group hinder the comparison of enrolments in *Tier 1* and 2 and therefore bias the estimates. As discussed in the previous section, it is feasible that signalling effects caused enrolments in *Tier 2* to grow further, despite the increased fees for these fields of study. If the discounted fees for *Tier 1* did indeed lead to decreased enrolments for *Tier 1* and increased enrolments for *Tier 2*, the treatment effect is overestimated.

In conclusion, there are several concerns with regard to the accuracy of the estimates. They are, however, all significant and quite large. Even though the effect may be overestimated, my results still provide sufficient evidence for a negative relationship between the discounted *Tier 1* fees and enrolments in *Tier 1* fields of study.

7.4 Policy Implications

My results have several implications for policy. The first and foremost is that reducing fees is likely not an effective policy for increasing enrolments. Theory suggests that increasing subsidies and lowering fees promotes human capital formation. My results indicate that this might not hold when fees are differentiated by field of study. When fees are differentiated by discipline, tuition fee signalling could affect enrolment behaviour. If so, the height of the tuition fee functions as a signal of the relative quality, return on investment and status of a study programme. Relatively lower fees could signal low quality, status and earnings potential, whereas higher fee levels might be associated with higher quality, status and return on investment. Although there may be other motives for implementing a multi-tiered fee structure, governments likely should refrain from using differentiated fees as an instrument for encouraging or discouraging human capital formation in certain fields of study.

There is a second policy implication for the Netherlands in particular. My results suggest that the discounted fees for teacher training programmes could lead to a decrease in enrolments for these programmes. The Dutch government, might, however still be able to prevent such negative effects. In Australia, the justification for differentiation of the fees was the difference in earnings potential across disciplines (Parliament of Australia, 2003). This emphasis on earnings potential increased awareness of lower return on investment for *Tier 1* studies, possibly causing the decreased enrolments. The Dutch government should therefore be very careful in its communication regarding the lower fees for the field *Education.* Any associations with low status or low earnings potential should be avoided. Instead, the government should emphasize that teachers are very valuable to society and therefore receive increased subsidies.[24] Although it is not guaranteed that this will fully reverse the effect, it might prevent enrolment decreases similar to those in Australia.

[24] Moreover, promoting the status of teachers in the Netherlands will likely be a much more effective method for attracting more students to Education studies.

8 Conclusion

In this thesis I set out to answer the question "What is the effect of tuition fees differentiated by field of study on enrolments in higher education?" Previous empirical work studied the relationship between uniform fees and enrolments, but did not consider enrolment effects of variation in tuition fees between disciplines. Some economists have advocated differentiated subsidies and tuition fees. They argue that efficiency requires differentiated subsidies, because the costs of provision and externalities created are different for each field of study (e.g. Jacobs & Van der Ploeg, 2006, and Rosen & Gayer, 2014). Their hypothesis is that differentiation of subsidies and tuition fees could be effective in promoting or discouraging human capital formation in certain disciplines.

I study the introduction of a three-tiered tuition fee structure in Australia, using a differences-in-differences design. I find that the implementation of the differentiated fees had a large and significant negative effect on the number of new and domestic enrolments in the disciplines with the lowest fees (*Tier 1*). These results are robust to variations in the treatment and sample period. Furthermore, the negative treatment effect on *Tier 1* enrolments holds for both the male and female populations, but the magnitude of the effect was greater for women.

My results are not in line with the majority view in the literature, which states that there is a negative relationship between tuition fees and enrolments in higher education (Leslie & Brinkman, 1987; Heller, 1997; Neill, 2009; and Hübner, 2012). Moreover, my findings contradict the expectations that follow from theory.

The negative effects of discounted fees could be explained by the signalling value of tuition fees. Research has shown that educational quality, earnings potential and status are important determinants of field of study choice (Harvey-Beavis & Elsworth, 1998; Drewes & Michael, 2006; Shin & Milton, 2006). In a setting with differentiated fees, the disciplines with relatively lower fees may be associated with lower quality, earnings potential and status. For *Tier 2* and *3* fields of study, the higher fees might signal that these fields have more prestige, higher educational quality and higher return on investment. Any positive enrolment effects for *Tier 1* due to the decreased cost of education, were likely crowded out by the negative signalling effects. The continued growth of enrolments for disciplines with higher fees (*Tier 2*) support the signalling interpretation.

Although my results provide sufficient evidence for a negative relationship between discounted tuition fees and *Tier 1* enrolments, the estimates are quite rough. Several issues may have led to an underestimation of the treatment effects, such that my estimates represent the lower bound of the true effects. Further research is therefore warranted.

A closer examination of the effect of the differential HECS fees could already lead to further insights. My analysis includes only a selection of the fields of study from *Tier 1* and *2*, and no *Tier 3* fields of study. A study of enrolments in all fields of study for all three tiers, would lead to more accurate estimates. With *Tier 3* data, one could also test how the even higher fees for this tier affected enrolments. This would also show whether the 'tuition fee signalling' argument holds. Furthermore, it would be interesting to know whether the enrolment effects are similar for all fields of study. A further analysis of how the differentiated fees affected *Tier 1, 2* and *3* enrolments by students of socio-economic status would also be relevant to policy. The necessary data for these extensions were, unfortunately, not available to me.

Finally, further research should also examine the effect of differentiated fees in other countries with different funding systems. In Australia, the financial barriers to higher education are quite low because student contributions are deferrable and income-contingent. In countries where the financial obstacles are greater, signalling effects might be smaller. In such a setting, the effect of differentiated fees on enrolments may be different.

The Dutch higher education system is quite different from the Higher Education Contribution Scheme. Nevertheless, my results clearly show that discounted fees are not as effective in promoting enrolments as theory suggests. Enrolments for disciplines with reduced fees might even decrease due to signalling effects. By emphasizing that teachers are valuable to society, the Dutch government might be able to prevent negative enrolment effects from occurring in the Netherlands. All in all, it is not very feasible that the discounted fees will lead to an increase in enrolments for teacher training programmes in the Netherlands.

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Appendix A

Table 3.2.1 – HECS Student Contributions 1989 – 2003

	Student Contributions ($)
1989	1 800
1990	1 882
1991	1 993
1992	2 250
1993	2 328
1994	2 355
1995	2 409
1996	2 442
1997	2 478
1998	2 520
1999	2 560
2000	2 600
2001	2 644
2002	2 702
2003	2 764

Note: Annual contributions; For 1997-2003 two sets of rates exist, because the introduction of the differential tuition fees applied only to commencing students.

Table source: Parliament of Australia (2013)

Table 3.3.1 – HECS Contributions for Students Commencing after 1 January 1997

	Student Contributions ($)		
	Tier 1[a]	**Tier 2**[b]	**Tier 3**[c]
1997	3 300	4 700	5 500
1998	3 356	4 779	5 593
1999	3 409	4 855	5 682
2000	3 463	4 932	5 772
2001	3 521	5 015	5 870
2002	3 598	5 125	5 999
2003	3 680	5 242	6 136

Notes: Annual contributions; a) Tier 1 includes the study programmes Arts & Humanities; Justice, Legal studies; Social Science & Behavioural Science; Visual and Performing Arts; Education; and Nursing. b) Tier 2 includes the study programmes Mathematics & Computing; other Health Sciences; Agriculture & Renewable resources; Built Environment & Architecture; Science; Engineering & Processing; and Administration, Business & Economics courses. c) Tier 3 includes the study programmes Law; Medicine and Medical Science; Dentistry & Dental Services; and Veterinary science.

Table source: Parliament of Australia (2013)

Appendix B

Table 4.1.1 - Broad Fields of Study and Corresponding Tuition Fee Tiers 1989-2000 and 2001-2004

1989 - 2000 Broad Fields of Study		2001 - 2004 Broad Fields of Study	*Tuition Fee Tier 2001-2004*
Tier 1	Arts, Humanities and Social Sciences	Society and Culture	*Multiple*
		Creative Arts	*Tier 1*
	Education	Education	*Tier 1*
Tier 2	Agriculture & Animal Husbandry	Agriculture Environmental and Related Studies	*Tier 2*
	Architecture & Building	Architecture and Building	*Tier 2*
	Business, Administration, Economics	Management and Commerce	*Tier 2*
		Society and Culture	*Multiple*
	Engineering & Surveying	Engineering and Related Technologies	*Tier 2*
	Science	Natural and Physical Sciences	*Tier 2*
		Information Technology	*Tier 2*
Tier 3	Veterinary Science	Health	*Multiple*
Multiple	Law, Legal Studies	Society and Culture	*Multiple*
	Health	Health	*Multiple*

Notes: Tier 1: 'Arts, Humanities & Social Sciences' is divided over the fields 'Society & Culture' and 'Creative arts'. The field 'Society & Culture' also includes tier 2 and 3 studies. Hence, this category cannot be included in the analysis for 1989 - 2004. | Tier 2: 'Business, Administration and Economics' is divided over the broader fields 'Society & Culture' and 'Management and Commerce', these fields also include programmes unrelated to the original broad field of study. Hence, this category cannot be included in the analysis for 1989 - 2004. Furthermore, 'Science' is split into 'Natural and Physical Sciences' and 'Information Technology', but the sum of these two fields can be matched to the pre-2001 field 'Science'.| Tier 3: Veterinary Science is a relatively small field (less than 2000 total enrolments) and is therefore not be included in the formal analysis.

Summary Statistics

Table 4.2.2 – Descriptive Statistics 1989 – 2004

	Obs.	*Mean*	*Std. Dev.*	*Min*	*Max*
Total Enrolments					
Total Enrolments[a]	16	671,596.20	155,793.90	441,074	944,977
Commencing Students					
Total Commencing	16	267,331.10	60,111.42	181,092	362,116
Tier 1 Studies[b]	16	33,767	2,196.94	30,940	37,722
Tier 2 Studies	16	66,229.56	14,962.09	43,910	890,80
Domestic Enrolments					
Total Domestic[c]	16	585,149.50	89,194.40	419,962	719,398
Tier 1 Studies	16	75,453.44	5,709.14 0	68,995	85,528
Tier 2 Studies	16	154,335.40	26,072.52	102,600	187,840
Controls					
GDP per Capita[d]	16	40,372.35	45,06.08	35,034.53	47,926.75
Unemployment Rate[e]	16	7.79	1.74	5.39	10.87

Notse: a) Total enrolments, total commencing enrolments and total domestic enrolments are the total numbers for Australia for all fields of study, including the fields not included in the analysis. The numbers for the Tier 1 and 2 studies are only for the fields included in analysis. b) For 1989-2004, Tier 1 only includes the broad field of study Education. c) For 1989-2004, Tier 2 includes the fields Agriculture & Animal Husbandry , Architecture and Building, Science, Engineering & Surveying. d) GDP per Capita is measured in constant 2010 US dollars; e) Unemployment rate as percentage of the total labour force.

Table 4.2.3 – Means of Domestic Enrolments and Commencing Students 1989-1996 and 1997-2000

	Tier 1 Study Programs[a]			*Tier 2 Study Programs*[b]			*Total Enrolments*
	All	Male	Female	All	Male	Female	
Commencing Students							
1989-1996	81920.67	25144.78	56775.89	97339.67	60901.56	36438.11	219966.50
	(7103.29)	(1885.19)	(5248.49)	(15495.72)	(7828.02)	(7686.23)	(24776.16)
1997-2000	97594.25	28840.75	68753.50	141107.30	82636	58471.25	273738
	(2054.29)	(845.32)	(1486.57)	(7144.42)	(3709.30)	(3457.59)	(9134.13)
Domestic Enrolments							
1989-1996	192701	58101	134600	228253	146648.1	81604.89	516564.40
	(14018.01)	(3585.14)	(10515.88)	(33325.21)	(16794.03)	(16594.14)	(53288.24)
1997-2000	230106	67055.75	163050.30	299158	179501.5	119656.5	599639.30
	(790.97)	(904.82)	(1532.44)	(4121.46)	(1340.22)	(3461.03)	(2986.70)

Notes: a) Tier 1 study programs are the study programs included in the broad field of study Education and Arts, Humanities & Social Sciences; b) Tier 2 study programs includes study programs from the broad fields of study: Agriculture & Animal Husbandry; Architecture & Building; Science; Engineering & Surveying and Business, Administration & Economics; Standard errors in parentheses.

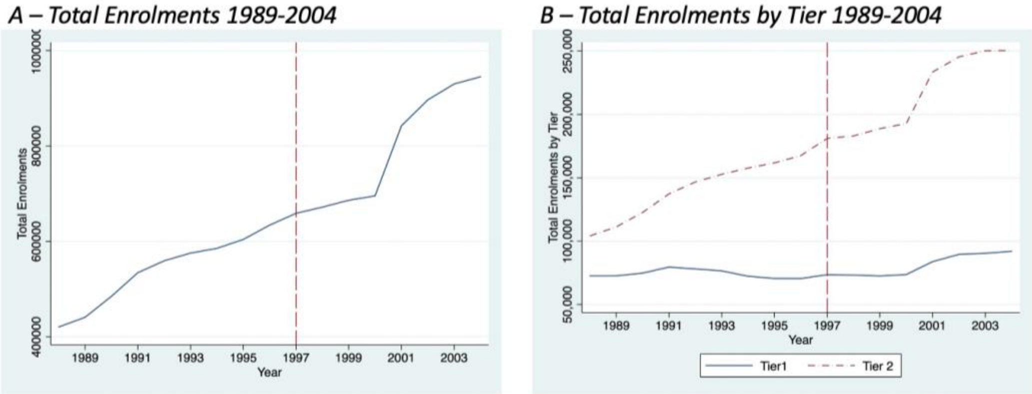
Table 4.2.4 – Means of Domestic Enrolments and Commencing Students 1989-1996 and 1997-2004

	Tier 1 Study Programs[a]			*Tier 2 Study Programs*[b]			*Total Enrolments*
	All	Male	Female	All	Male	Female	
Commencing Students							
1989-1996	33316.13	9286.13	24030	54079.13	36529.63	17549.50	219966.50
	(1791.06)	(648.07)	(1190.15)	(5754.53)	(3342.25)	(2430.08)	(24776.16)
1997-2004	34217.88	9274.63	24943.25	78380	52023.38	26356.63	314695.60
	(2582.64)	(1084.13)	(1506.79)	(10447.34)	(7434.424)	(3054.93)	(44736.22)
Domestic Enrolments							
1989-1996	73407.38	19882.25	53525.13	133163	91371	41792	516564.40
	(3613.08)	(1187.94)	(2489.10)	(17589.17)	(10215.70)	(7416.18)	(53288.24)
1997-2004	77499.50	19569.63	57929.88	175507.80	115178.90	60328.88	653734.60
	(6871.80)	(1985.29)	(4935.46)	(11075.60)	(6783.06)	(4332.29)	(58790.72)

Notes: a) Tier 1 study programs are the study programs included in the broad field of study Education; b) Tier 2 study programs includes study programs from the broad fields of study: Agriculture & Animal Husbandry; Architecture & Building; Science and Engineering & Surveying; Standard errors in parentheses.

Enrolment Plots

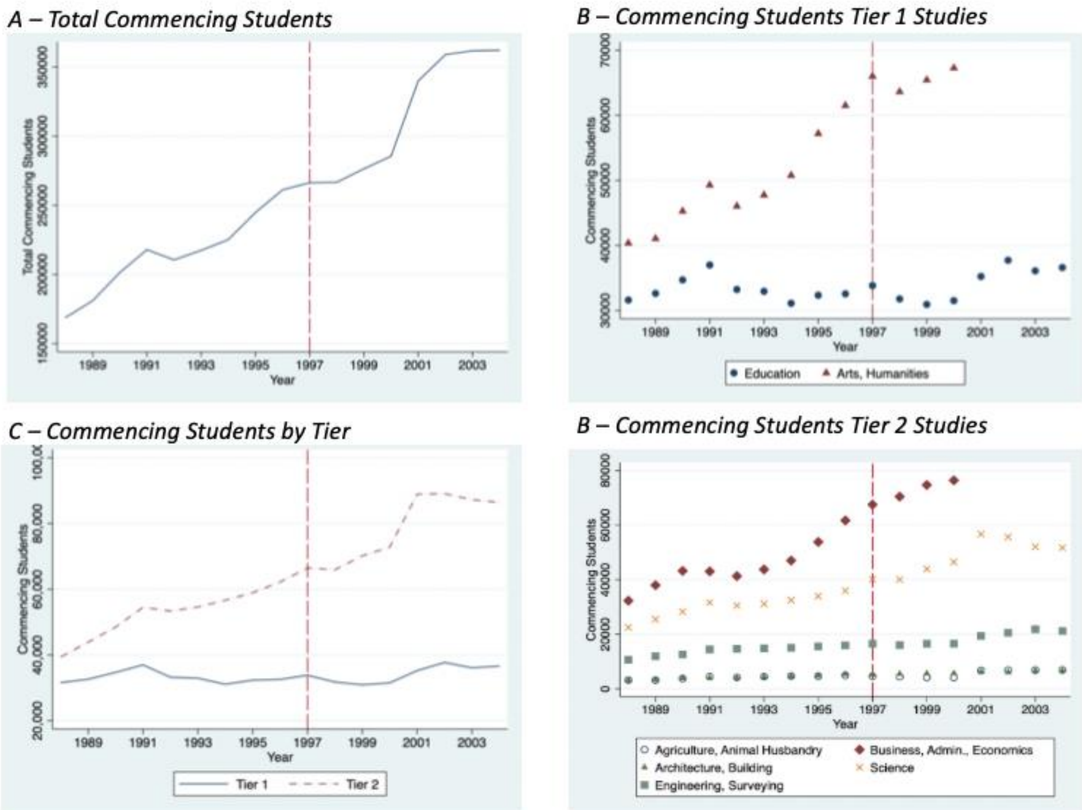
Figure 4.2.1 – Total Enrolments and Total Enrolments by Tier 1989-2004



Notes: The vertical reference line indicates the introduction of the differentiated fees in 1997. Fields of study included - Tier 1: Education; Tier 2: Architecture & Building, Agriculture & Animal Husbandry, Engineering & Surveying, Business, Administration & Economics, Science

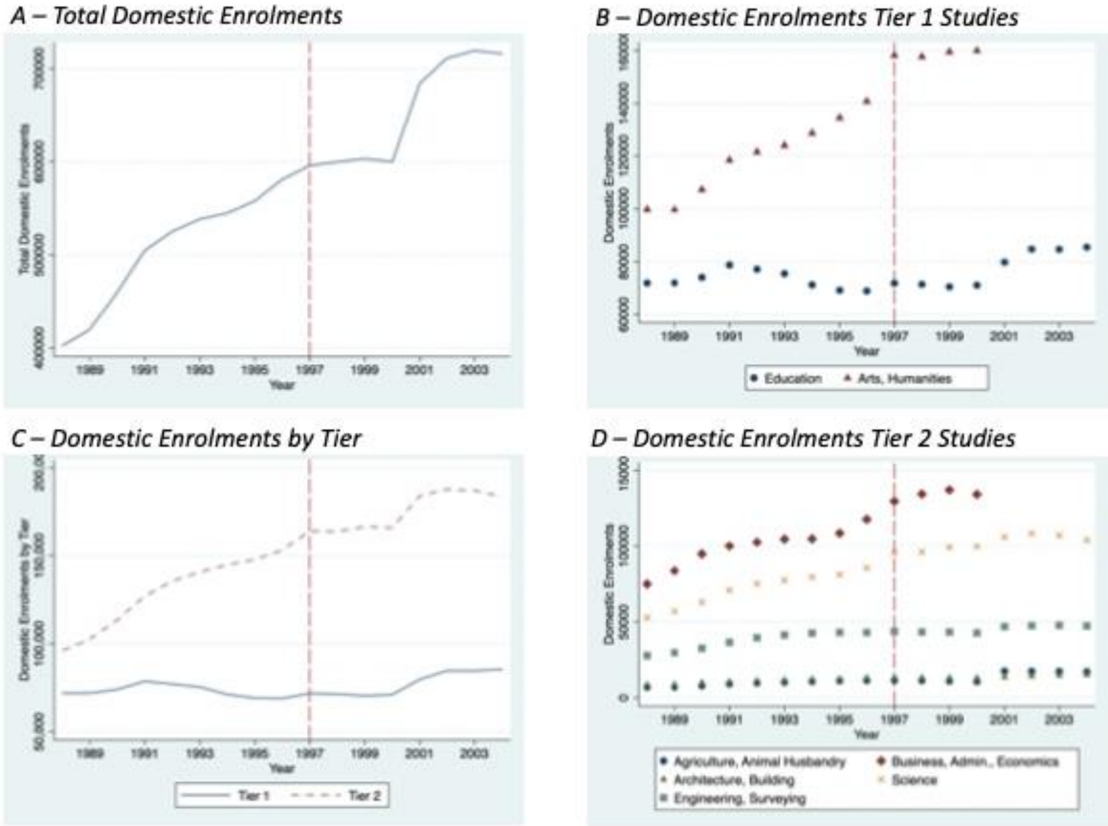
Source: Own illustration

Figure 4.2.2– Commencing Students Overview 1989-2004



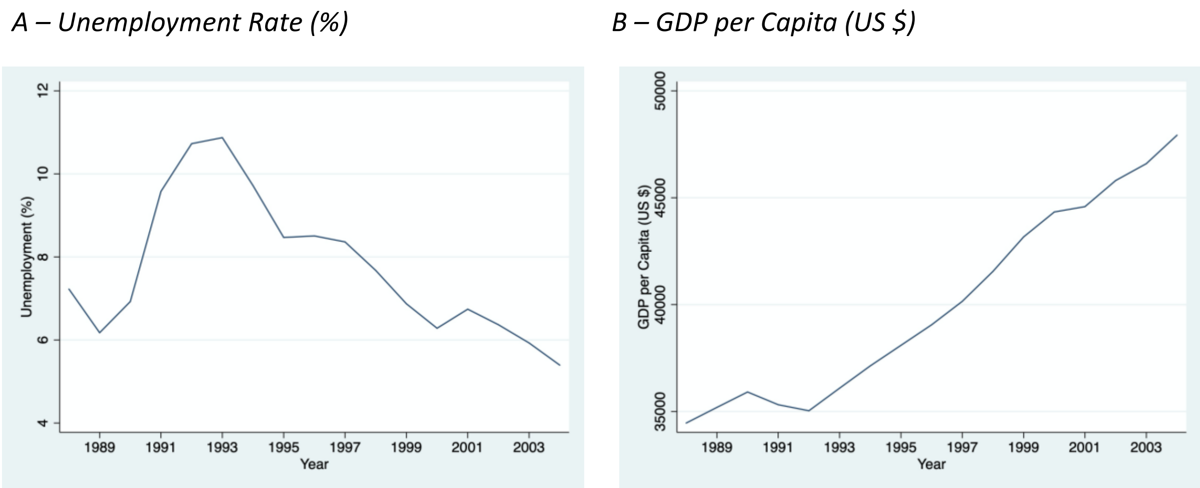
Notes: The vertical reference line indicates the introduction of the differentiated fees in 1997. Panel C: Fields of study included - Tier 1: Education; Tier 2: Architecture & Building, Agriculture & Animal Husbandry, Engineering & Surveying, Business, Administration & Economics, Science.
Source: Own illustration

Figure 4.2.3 - Domestic Enrolments Overview 1989-2004



Notes: The vertical reference line indicates the introduction of the differentiated fees in 1997. Panel C: Fields of study included - Tier 1: Education; Tier 2: Architecture & Building, Agriculture & Animal Husbandry, Engineering & Surveying, Business, Administration & Economics, Science
Source: Own illustration

Figure 4.2.4 – Unemployment and GDP per Capita 1989-2004



Notes: Unemployment as a percentage of the total labour force; GDP per Capita in constant US 2010 dollars.
Source: Own Illustration

Appendix C

Stata Code

****COMMENCING STUDENTS MAIN ANALYSIS (6.1)****

```
**A: Main Specification with 1989-2000 data**
 (using dataset: Commencing Students to 2000.dta)

*Make a graph for treatment and control group*
 *Total enrolment by Tier*
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==0) (line
CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )

**DO DIFF IN DIFF REGRESSION
gen Treatment = After*Tier1

*Without Controls
reg CommencingStudents Tier1 After Treatment if Gender==0 & Year >1988, robust

*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1988, robust


**B:  Secondary Specification with 1989-2004 data**
 (using dataset: Commencing Students to 2004)

*Make a graph for treatment and control group*
 *Total enrolment by Tier*
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==0) (line
CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )

**DO DIFF IN DIFF REGRESSION
gen Treatment = After*Tier1

*Without Controls
reg CommencingStudents Tier1 After Treatment if Gender==0 & Year >1988, robust

*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1988, robust
```

COMMENCING STUDENTS TIME VARIATION CHECK (6.2.1)

```
*Excluding 1996 for anticipation effects: 1992-1995|1997-2000
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1991 & Year!= 1996, robust
*4 years before, 4 years after: 1993-1996|1997-2000
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1992, robust
*3 years before, 3 years after:1994-1996|1997-1999*
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1993 & Year < 2000, robust
*2years before, 2 years after: 1995-96|1997-98
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1994 & Year < 1999, robust
```

DOMESTIC ENROMENTS ANALYSIS (6.2.2)

```
**A: Main Specification with 1989-2000 data**
(using dataset: Domestic Students to 2000.dta)

*Make a graph for treatment and control group*
 *Total enrolment by Tier*
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==0) (line
DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )

**DO DIFF IN DIFF REGRESSION
gen Treatment = After*Tier1

*Without Controls
reg DomesticEnrolments Tier1 After Treatment if Gender==0 & Year >1988, robust

*With controls
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==0 &
Year >1988, robust


**B:  Secondary Specification with 1989-2004 data**
(using dataset: Domestic Students to 2004)
*Make a graph for treatment and control group*
 *Total enrolment by Tier*
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==0) (line
DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )
```

**DO DIFF IN DIFF REGRESSION
gen Treatment = After*Tier1

*Without Controls
reg DomesticEnrolments Tier1 After Treatment if Gender==0 & Year >1988, robust

*With controls
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==0 & Year >1988, robust

HETEROGENEITY ANALYSIS (6.2.3)

COMMENCING STUDENTS

A: Main Specification with 1989-2000 data
(using dataset: Commencing Students to 2000.dta)

*Male Sample (Gender==1)

Male enrolment - Graph Treatment and control group
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==1) (line CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==1), legend(lab(1 "Treatment") lab(2 "Control"))

***DO DIFF IN DIFF REGRESSION
*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==1 & Year >1988, robust

**Female Sample (Gender==2)

Female enrolment - Graph Treatment and control group
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==2) (line CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==2), legend(lab(1 "Treatment") lab(2 "Control"))

***DO DIFF IN DIFF REGRESSION FEMALES
*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==2 & Year >1988, robust

```
**B: Specification with 1989-2004 data**
(using dataset: Commencing Students to 2004.dta)

*Male Sample (Gender==1)
 *Male enrolment - Graph Treatment and control group*
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==1) (line
CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==1),  legend(lab(1
"Treatment") lab(2 "Control") )

***DO DIFF IN DIFF REGRESSION
*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==1 &
Year >1988, robust


**Female Sample (Gender==2)

*Female enrolment - Graph Treatment and control group*
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==2) (line
CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==2),  legend(lab(1
"Treatment") lab(2 "Control") )
***DO DIFF IN DIFF REGRESSION FEMALES
*With controls
reg CommencingStudents Tier1 After Treatment GDPperCap Unemployment if Gender==2 &
Year >1988, robust
```

DOMESTIC ENROLMENTS

```
**A: Main Specification with 1989-2000 data** (using dataset: Domestic Students to
2000.dta)

*Male Sample (Gender==1)
 *Male enrolment - Graph Treatment and control group*
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==1) (line
DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==1),  legend(lab(1
"Treatment") lab(2 "Control") )

**DO DIFF IN DIFF REGRESSION
*With controls
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==1 &
Year >1988, robust
```

*Female Sample (Gender==2)
Female enrolment - Graph Treatment and control group

```
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==2) (line DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==2),  legend(lab(1 "Treatment") lab(2 "Control") )
```

**DO DIFF IN DIFF REGRESSION
*With controls

```
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==2 & Year >1988, robust
```

B: Secondary Specification with 1989-2004 data
(using dataset: Domestic Students to 2004)

*Male Sample (Gender==1)
Male enrolment - Graph Treatment and control group

```
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==1) (line DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==1),  legend(lab(1 "Treatment") lab(2 "Control") )
```

**DO DIFF IN DIFF REGRESSION

*With controls

```
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==1 & Year >1988, robust
```

*Female Sample (Gender==2)
Female enrolment - Graph Treatment and control group

```
twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==2) (line DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==2),  legend(lab(1 "Treatment") lab(2 "Control") )
```

**DO DIFF IN DIFF REGRESSION

*With controls

```
reg DomesticEnrolments Tier1 After Treatment GDPperCap Unemployment if Gender==2 & Year >1988, robust
```

PARALLEL TRENDS CHECK (6.3)

VISUAL CHECKS

```
twoway (line CommencingStudents Year if Tier1==1 & Year >1988 & Gender==0) (line
CommencingStudents Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )

twoway (line DomesticEnrolments Year if Tier1==1 & Year >1988 & Gender==0) (line
DomesticEnrolments Year if Tier1==0 & Year > 1988 & Gender==0),  legend(lab(1
"Treatment") lab(2 "Control") )
```

FORMAL CHECKS WITH LEADS
*FIRST STEP *Generating Leads for testing Common Trends*

```
**Leads
*L-1 (1996)
gen Treatmentminus1 =.
replace Treatmentminus1 =1 if Year >1995 & Tier1==1
replace Treatmentminus1 =0 if Year <1996
replace Treatmentminus1=0 if Tier1==0
replace Treatmentminus1=. if Year==.

*L-2 (1995)
gen Treatmentminus2 =.
replace Treatmentminus2 =1 if Year >1994 & Tier1==1
replace Treatmentminus2 =0 if Year <1995
replace Treatmentminus2 =0 if Tier1==0
replace Treatmentminus2 =. if Year==.

*L-3 (1994)
gen Treatmentminus3 =.
replace Treatmentminus3 =1 if Year >1993 & Tier1==1
replace Treatmentminus3 =0 if Year <1994
replace Treatmentminus3 =0 if Tier1==0
replace Treatmentminus3 =. if Year==.

*L-4 (1993)
gen Treatmentminus4 =.
replace Treatmentminus4 =1 if Year >1992 & Tier1==1
replace Treatmentminus4 =0 if Year <1993
replace Treatmentminus4 =0 if Tier1==0
replace Treatmentminus4 =. if Year==.
```

```
*L-5 (1992)
gen Treatmentminus5 =.
replace Treatmentminus5 =1 if Year >1991 & Tier1==1
replace Treatmentminus5 =0 if Year <1992
replace Treatmentminus5 =0 if Tier1==0
replace Treatmentminus5 =. if Year==.

*L-6 (1991)
gen Treatmentminus6 =.
replace Treatmentminus6 =1 if Year >1990 & Tier1==1
replace Treatmentminus6 =0 if Year <1991
replace Treatmentminus6 =0 if Tier1==0
replace Treatmentminus6 =. if Year==.

*L-7 (1990)
gen Treatmentminus7 =.
replace Treatmentminus7 =1 if Year >1989 & Tier1==1
replace Treatmentminus7 =0 if Year <1990
replace Treatmentminus7 =0 if Tier1==0
replace Treatmentminus7 =. if Year==.



*SECOND STEP* Running Regression with Leads and Lags of Treatment*

**FOR COMMENCING STUDENTS**

*7 Leads*
reg CommencingStudents Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 Treatmentminus4 Treatmentminus5 Treatmentminus6 Treatmentminus7 GDPperCap Unemployment if Gender==0  & Year>1988, robust
*5 leads*
reg CommencingStudents Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 Treatmentminus4 Treatmentminus5 GDPperCap Unemployment if Gender==0  & Year>1988, robust
*3 leads*
reg CommencingStudents Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 GDPperCap Unemployment if Gender==0  & Year>1988, robust
```

FOR DOMESTIC ENROLMENTS

7 leads
reg DomesticEnrolments Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 Treatmentminus4 Treatmentminus5 Treatmentminus6 Treatmentminus7 GDPperCap Unemployment if Gender==0 & Year>1988, robust
5 leads
reg DomesticEnrolments Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 Treatmentminus4 Treatmentminus5 GDPperCap Unemployment if Gender==0 & Year>1988, robust
3 leads
reg DomesticEnrolments Tier1 After Treatment Treatmentminus1 Treatmentminus2 Treatmentminus3 GDPperCap Unemployment if Gender==0 & Year>1988, robust