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The economic impact of the Australia–United States free trade agreement *

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Abstract

The Australia–United States free trade agreement (AUSFTA) came into effect in 2005. It was the second preferential trade agreement that Australia signed, after its agreement with Singapore, and marked a departure from the primacy of Australia’s previous trade policy of unilateral and multilateral trade liberalisation towards preferential liberalisation. This paper assesses the economic effects of AUSFTA by applying the Productivity Commission’s gravity model of trade from its *Bilateral and Regional Trade Agreements* review. The evidence reveals AUSFTA resulted in a fall in Australian and US trade with the rest of the world — that the agreement led to trade diversion. Estimates also show that AUSFTA is associated with a reduction in trade between Australia and the United States.

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Keywords

Preferential trade agreements; Australia-US free trade agreement; trade diversion; investment agreements

JEL Classification

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Introduction

The opening up and liberalisation of the Australian economy has been key to its prosperity and competitiveness. Most of that trade liberalisation initially occurred unilaterally throughout the 1970s, 1980s and 1990s as Australia and other East Asian economies removed significant trade barriers without binding agreements. There was a recognition that a country benefitted from removing its own border- and behind-the-border-barriers to trade and that those benefits were compounded if others did so as well. This strategy contributed positively to the multilateral trading system by liberalising trade in a non-discriminatory manner, as unilateral trade liberalisation was bound through subsequent multilateral negotiation in the Uruguay Round. This concerted unilateral liberalisation slowly came to an end around the time of the Asian financial crisis in 1997/98 as much of the relatively easy-to-remove border barriers had been reduced and the region started looking to negotiate further liberalisation after the Uruguay Round.

Australia and East Asia eventually joined the global trend and started to sign preferential trade agreements that liberalise trade and investment on a preferential basis between agreement members. Before signing an agreement with Singapore in 2003, apart from the bilateral Closer Economic Relations (CER) agreement with New Zealand that was signed in another era, Australia had not been party to any preferential trade agreements (PTAs) since the era of British Imperial Preference. Although the Singapore agreement was a first for Australia, its economy was one of the most open internationally, it did not have an agricultural sector and it was not a major economic partner of Australia.

A more significant potential sign of departure from the primacy of non-discriminatory liberalisation occurred with the negotiation of the Australia-US free trade agreement (AUSFTA), which came into effect on 1 January 2005. Much controversy, therefore, surrounded the negotiation of the agreement in the lead up to its conclusion.

There was debate about the likely impact on the Australian economy, the implications for Australia's other trade and investment relationships and its use in promoting other non-economic and diplomatic interests (Ranald, 2009).

As a result of the agreement, 97 per cent of tariff lines covering Australia's non-agricultural exports to the United States (excluding textiles and clothing) became duty free subject to the meeting of the requirements of product-specific rules of origin, while 99 per cent of US manufacturing exports to Australia became duty free, again subject to origin rule requirements. All non-agriculture products will be free from duty by 2015 (DFAT, 2004). The agreement went well beyond tariff liberalisation. Investment from the United States came to enjoy preferential treatment in Australia's foreign investment screening regime.

AUSFTA included more stringent protections for intellectual property (IP) right holders, most notably US pharmaceutical companies and copyright holders. The agreement required changes to the Pharmaceutical Benefits Scheme, potentially impacting on the price and ability to sell generic medicines, and given that Australia was a net importer of IP meant the agreement was likely to result in increased transfers of IP rents to the United States. The fact that key US markets for Australian agricultural producers like beef and dairy were only partially liberalised, and not liberalised at all in the case of sugar, added to the controversy about the agreement.

Most *ex ante* studies estimated that AUSFTA would have little or no impact on the Australian economy. Andriamananjara and Tsigas (2003) estimated the FTA would have a miniscule effect, increasing Australia's welfare by only \$44 million. In a comprehensive study, Dee (2005) estimated an increase in Australian economic welfare of \$53 million a year and an increase in goods trade of around \$127 million. Other studies show results of a similar magnitude.¹ There were some studies that showed net negative effects from AUSFTA. Hilaire and Yang (2003) predicted that AUSFTA would shrink the economy by 0.03 per cent a year with US imports displacing more competitive imports from elsewhere — a result of the effects of 'trade diversion'.

A study by the Centre for International Economics (CIE) was commissioned by the Department of Foreign Affairs and Trade while it was negotiating the agreement: it showed significant gains from concluding AUSFTA. It was first estimated that A\$4 billion would accrue to Australia from liberalisation of the US sugar market. That later increased to A\$5.6 billion even after it became clear that the sugar market would not be liberalised, with the model results being driven by the assumption of a reduction in the equity risk premium (CIE, 2004, p. 78). This is the study that Ross Garnaut famously said does not pass the laugh test.²

Beyond the predicted aggregate effects, it was clear that there would be winners and losers, and that these would largely be determined by AUSFTA preferences and provisions. Australia's previous liberalisation efforts produced clear overall welfare gains, and there was a powerful argument that winners and losers were determined by market forces and competition. There was the important issue of the barriers to trade and investment for Australia's other trading partners becoming relatively higher as they fell for the United States only.

¹ See Brown, Kiyota & Stern (2005) and ACIL Tasman (2003), for example.

² See 'What's the FTA worth to us?', *The Age*, 22 June 2004; and 'Drug costs will rise with deal: US official', *Sydney Morning Herald* 11 March 2004.

³ See 'What's the FTA worth to us?' for full details of the agreement and 'Drug costs will rise with deal: US official', *Sydney Morning Herald* 11 March 2004.

This paper estimates the impact of the AUSFTA on merchandise trade flows between Australia and the United States, as well as on third countries. The next section discusses trading under a preferential agreement and the nature of trade creation and diversion. Then the Productivity Commission's report on *Bilateral and Regional Trade Agreements* model is introduced and the dataset updated in order to estimate the net merchandise trade creation and diversion of AUSFTA. The paper then discusses the investment effects of AUSFTA before concluding.

Trade creation and trade diversion

A stalled Doha Round of multilateral trade negotiations has been one reason given for the pursuit of narrower PTAs (incorrectly but commonly referred to as free trade agreements, or FTAs) that have been seen as a way to remove trade and other barriers among countries that are usually politically close. Most agreements are full of exemptions and carve-outs of sensitive sectors, including the exclusion of sugar in AUSFTA, demonstrating the limitations of this argument. In its review of Bilateral and Regional Trade Agreements, the Australian Productivity Commission concluded that economic benefits of FTAs are often overstated and that they are often more political than economic in nature (PC, 2010).

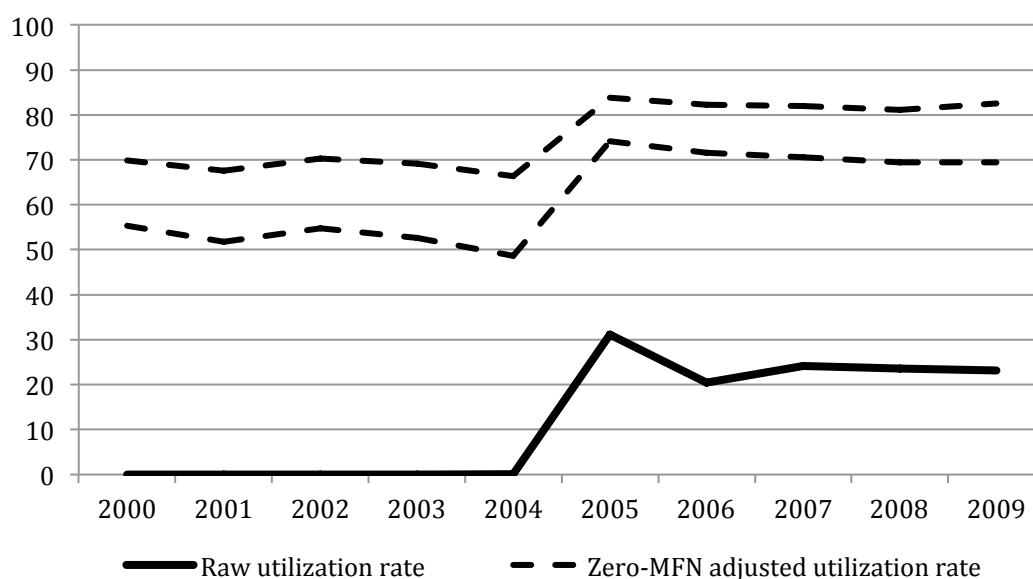
PTAs can go beyond trade in goods and services and investment into areas of domestic rules and regulations. Indeed AUSFTA was significant for the changes it required to Australian domestic regulations and institutions. One line of argument suggests that merchandise trade is not a very significant aspect of modern PTAs as many tariff lines are at or close to zero in developed countries. The benefits that CIE modelling predicted were driven by assumptions in areas outside of goods trade. Others have emphasised the 'deeper integration' aspects of AUSFTA (Stoler, 2003).

Yet trade in goods is closely linked to trade in services, investment and the rules, regulations, impediments and liberalisations introduced in PTAs. Moreover, goods trade (or merchandise trade) remains the overarching component of economic relationships between countries. Negotiating preferential market access among members on trade in goods is still central to most agreements. There is then the important question of whether preferential agreements create trade among members and the extent to which they divert trade from non-members.

Although border barriers in most countries, especially in the Asia Pacific, have been reduced with non-discriminatory most-favoured-nation rates (MFN) that are low or zero for a large range of products, significant border barriers remain. Yet rules of origin (ROOs) — which add to red tape, vary substantially between agreements and complicate trade due to different tariff rates being applied to a good or service depending on the country in which value was added — still affect trade and are a serious trade policy and regulatory issue.

In a study using disaggregated customs data, Pomfret et al. (2010) analyse the utilisation rates of preferences in Australian PTAs and find that AUSFTA exhibits the clearest evidence of a preferential trade effect (p.7) among Australian PTAs as of 2010. Figure 1 shows that 30 per cent of Australian imports from the United States utilised preferences (entered Australia at the preferential tariff rate below the MFN tariff rate) in 2005 with the utilisation rate falling to between 20 and 25 per cent for the following 4 years.

Figure 1 AUSFTA tariff utilisation rate, 2000-2009



Source: Pomfret et al. 2010.

The dashed line in Figure 1 is the percentage of imports entering Australia under the preferential tariff or the zero-MFN tariff rate — there are two dashed lines due to the difficulties in mapping the tariff and customs data to the trade data, which are the upper bound and lower bound of the authors’ estimates. In 2009, 20 to 30 per cent of Australian imports from the United States entered under a non-zero MFN tariff rate.

The authors note that it is surprising to see such evidence of preferential tariffs having an impact, given the focus of the PTA was on intellectual property rights issues and investment provisions, and that the agreement was thought to have been less about merchandise trade (Pomfret et al., 2010). With roughly a quarter of Australian imports of tariff items with non-zero MFN rates from the United States utilising preferences, it is important to see whether any trade has been diverted from non-PTA members due to AUSFTA.

The Mortimer Review of Export Policies and Programs in 2008 considered the bilateral deals with the United States, Thailand and Singapore. Two simple indices of trade intensity were used to give an indication of the effect of the PTAs. The first was

a share of Australian exports to each partner as a ratio of the partner's share of global imports, and the other was total Australian trade to each partner as a share of Australian GDP. This only covered 2005–07 for the US case, and for these years both indices fell from the pre-FTA years (Mortimer, 2008).

In measuring the effects of trade agreements on trade flows, the PC did not include AUSFTA as only 3 years of data were available since the agreement had come into effect, one of those years being significantly affected by the global financial crisis. Studies measuring the impact of AUSFTA have been thus far limited by the data, the global financial crisis significantly affecting US and global trade, as well as the difficulty in constructing a counterfactual.

A major concern with PTAs is the trade and investment that may be diverted from non-members when non-members are lower cost and more efficient suppliers. Strong preferences for PTA members that discriminate against non-members have the potential to divert trade away from an efficient and more competitive supplier in one country in favour of higher cost PTA partners. Indeed, the rationale for competitive liberalisation through PTAs is premised on there being trade or investment diversion away from non-members. There is the potential for global welfare reduction from preferential trade in the extreme case (Viner, 1950). Under AUSFTA, Australia may import products from the United States that it would otherwise have sourced elsewhere, even though the United States may not be the world's lowest cost producer.

Stoler (2009) and Farrell (2012) dismiss the possibility of there being any trade diversion from AUSFTA since Australian trade to East Asia continued to grow strongly after AUSFTA came into force in 2005. That observation fails to apply an appropriate benchmark which takes into account that trade between Australia and East Asian economies could well have grown more than they did without AUSFTA.

A proper counterfactual needs to be estimated to see whether AUSFTA diverted trade from non-AUSFTA members. The counterfactual to be estimated is trade post-2005 without AUSFTA, which will allow estimates of trade created and diverted by AUSFTA.

Model and data

The gravity model of trade is one of the most widely used empirical tools in international economics that examines the determinants of trade. The fundamental relationship is that on average, the larger and closer two trading partners are, the more they trade. There are numerous derivations of the gravity model from micro-foundations that are consistent with trade theory and which inform different specifications. The scale of economies matters as aggregate incomes and export supply determine the scale of trade. The further two trading partners are apart

geographically, the less they trade on average given the higher trade and transactions costs. The gravity model allows estimates of average effects of other trade inhibiting or facilitating factors while holding key trade determinants, like scale and distance, constant.

This paper uses the model employed in the Productivity Commission's report on *Bilateral and Regional Trade Agreements* (2010a, 2010b) given the extensive work undertaken by the PC, its credibility, the public process of review and transparency of the modeling. The model takes the form

$$E(\text{trade}_{ijt}) = \exp \left(\begin{aligned} & \beta_1 \ln(SGDP_{ijt}) + \beta_2 \ln(\text{sim}GDP_{ijt}) + \beta_3 \ln(\text{rel_inc}_{ijt}) + \sum_k \delta_1^k DI_{ijt}^k + \sum_k \delta_2^k D2_{ijt}^k \\ & + \sum_k \delta_3^k D3_{ijt}^k + \sum_{t=1} \psi^t T + \alpha_{ij} \end{aligned} \right)$$

where

$E[\text{trade}_{ijt}]$ is the expected trade between country i and j in year t

$sGDP_{ijt}$ is the sum of GDPs for countries i and j in year t

$\text{sim}GDP_{ijt}$ is the similarity of size of each country's economy in year t

rel_inc_{ijt} is the relative incomes in each country in year t

DI_{ijt}^k takes the value of 1 for countries i and j having an PTA in year t . The coefficient estimated for DI^k represents the time invariant estimated impact of membership of PTA k on flows between member countries of that PTA (PC, 2010b). A positive and significant coefficient would be evidence of trade creation from the FTA.

The coefficients for $D2_{ijt}^k$ and $D3_{ijt}^k$ represent the time invariant estimated impact of PTA membership on imports and exports, respectively, between members and non-members which capture trade diversion.

T is a time dummy and α_{ij} controls for asymmetric country fixed effects.

For a detailed description of the model, discussion around the variable choices and derivation of the model, see the PC's *Supplement to Research Report* (PC, 2010b).

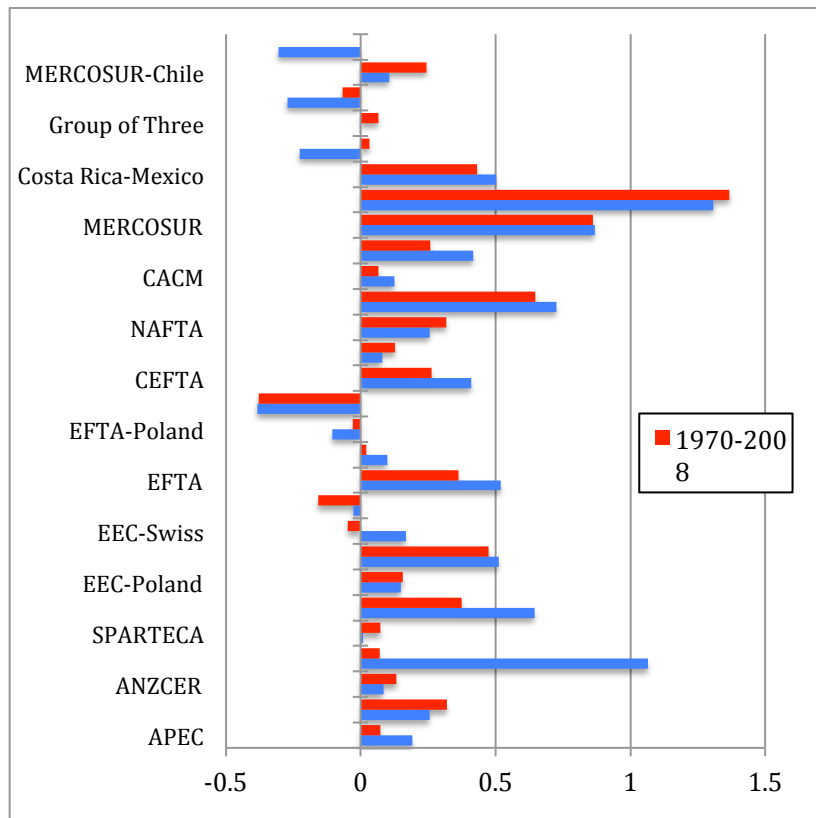
Other gravity model specifications estimate the effects of exporting and importing-country GDP separately, and also estimate the effect of distance on trade. Given the variables of interest here are the coefficient estimates of DI , $D2$ and $D3$, the PC model controls for scale and difference in income levels in the particular form above, and controls for distance without estimating its effects. This fixed effects method allows for all factors that are common between country-pairs over time to be controlled for even if they are not observable, but with the result that the effects of factors such as distance and common borders cannot be estimated. The purpose of including relative income between two trading partners is to control for the different structures of their economies.

The Productivity Commission’s dataset covered the period 1970 to 2008 and this study extends that dataset to 2012 using the same data sources and variable construction. Trade data are from the United Nations’ Comtrade database, GDP and GDP per capita data are from the World Bank’s World Development Indicators database and the PTA variables are taken from the WTO’s database of preferential trade agreements.

The large dataset of global trade flows between 140 countries contains bilateral trade relationships in some years that do not trade. The PC uses a Poisson estimator to minimise bias in the estimation of the model given the zero trade values in the dataset.

Figure 2 presents the estimated effects of agreements on intra-group trade flows. Results from the original PC study were replicated and are presented beside results with the updated dataset to 2012.³

Figure 2 Estimated effects of trade agreements on intra-group trade flows
Replication of original Productivity Commission dataset (1970–2008) and updated dataset (1970–2012)



Source: Author’s calculations. Estimates of the model using the 1970-2008 dataset are a replication of the Productivity Commission model (PC, 2010a; 2010b).

Note: Number of observations for the model with the expanded dataset is 1,388,006

³ Coefficients for all PTA variables for all agreements included here are significant at the 1 per cent level.

The estimated effect shows that AUSFTA is associated with a reduction in trade between Australia and the United States, as well as exports and imports between the two countries and the rest of the world. The coefficient estimate (in proportional change terms) for trade between the United States and Australia due to AUSFTA is -0.304. The estimates for the *D2* and *D3* variables for AUSFTA are -0.112 and -0.154, respectively, showing evidence of AUSFTA being associated with reduced trade between the Australia–United States grouping and the rest of the world.

The original PC model found 5 of 27 agreements were associated with reduced trade between members (negative coefficient estimates on *DI*), which were the Europe–Israel, EEC–Egypt, Mercosur–Bolivia, EEC–Poland and EEC–Swiss agreements. In the estimations with the updated dataset, all of those agreements except the EEC–Swiss agreement are associated with reduced trade between members, with the addition of Chile–Colombia and AUSFTA (see Figure 2). While the estimated effects of nearly all agreements are consistent in their sign between the 1970–2008 and 1970–2012 datasets, the magnitudes vary. The coefficients estimate a long-run or cumulative effect of an agreement and one of the reasons that may change with an extended dataset is the lagged effect of a PTA due to the phase-in process of implementation (Baier and Begstrand 2007). The implied long-run cumulative effect may change over time depending on the sizes of trade flows and the phase-in or implementation effects of each PTA.

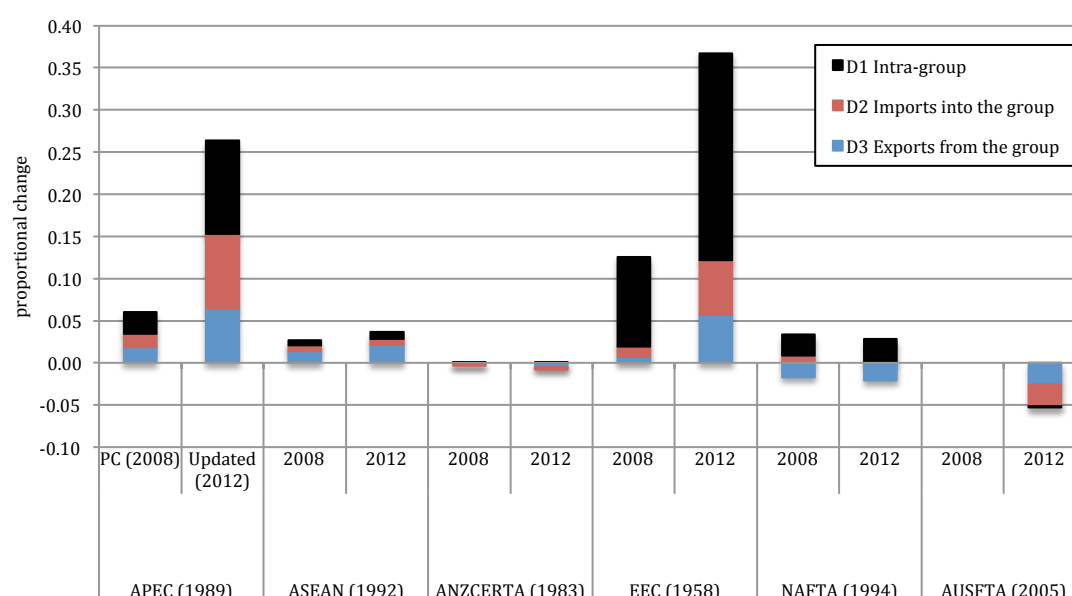
The Appendix explains some of the sensitivity tests and possible extensions.

The existence of trade diversion in AUSFTA suggests that trade between Australia and the United States would have fallen even further over the period without the signing of AUSFTA. The result of AUSFTA being associated with a fall in trade between the two members could be driven by the global financial crisis and collapse of US trade in 2008. But US trade with the rest of the world would have fallen and that will have been controlled for in the counterfactual which includes year and other country specific dummies. All these results are measures against a benchmark, or counterfactual, which control for trade determinants, year-specific events and all observable and unobservable characteristics between countries (country pair fixed effects).

Figure 3 shows the net effects of selected agreements for the year 2008 (which is a reproduction of the PC results) and 2012. The net effect takes into account the trade creation estimates from Figure 2 as well as trade diversion estimates and weights them by trade values. The net effects on global trade are therefore expected to be larger for the grouping of larger economies and trading relationships. Not all agreements are shown in Figure 3.

Arrangements which are not preferential in nature, such as APEC which is outward in its orientation (is not a preferential agreement), and other agreements such as ASEAN and the European Economic Community (EEC), do not show signs of trade diversion. NAFTA (as well as other agreements not shown in Figure 3) is associated with a reduction of exports from North America to the rest of the world associated with the agreement being in force (see Figure 3). The APEC and EEC groupings appear to be much more important to intra-group and inter-group trade flows in the extended dataset. A question for further investigation is whether certain trade arrangements have become more important after the global financial crisis or whether the effect of the crisis is properly controlled for.

Figure 3 Estimated net effects of trade agreements on global trade in 2008 and 2012



Source: Author's calculations. Estimates of the model using the 1970-2008 dataset are a replication of the Productivity Commission model (PC, 2010a; 2010b).

The dollar values of the effect of AUSFTA on intra-Australia-US trade and exports and imports between the two countries and the rest of the world are shown in Table 1. Magee (2008) and Baier and Bergstrand (2007) detail how the coefficient on a PTA calculated in this way is a long-run estimate, or cumulative effect. The effect in 2005 is large as there is an anticipatory effect before an agreement comes into force (Magee, 2008). In any year in Table 1, the effect given is the cumulative effect since AUSFTA came into force. The total estimated trade diverted from AUSFTA in 2012 (for both Australia and the United States) is US\$53.12 billion (37.5 + 15.62).

Table 1 Estimated effects of AUSFTA on Australia–US trade, US\$ billions

Year	Intra-group trade	Imports to the group	Exports from the group
2005	-9.15	-4.98	-18.80
2006	-10.09	-5.70	-20.59
2007	-10.89	-6.41	-24.28
2008	-12.99	-8.94	-29.07
2009	-10.78	-9.26	-23.66
2010	-11.96	-12.57	-29.11
2011	-14.82	-16.44	-35.66
2012	-16.11	-15.62	-37.50

Source: Author's calculations

Investment

Investment liberalisation was also a significant part of AUSFTA. It is more difficult to create a reliable counterfactual for FDI than it is for goods trade given the reliability of the investment data and its 'lumpiness' due to the nature of large foreign investment projects. Armstrong (2011) creates a counterfactual for Chinese FDI into Australia but undertaking a full analysis of investment flows is beyond the scope of this paper.

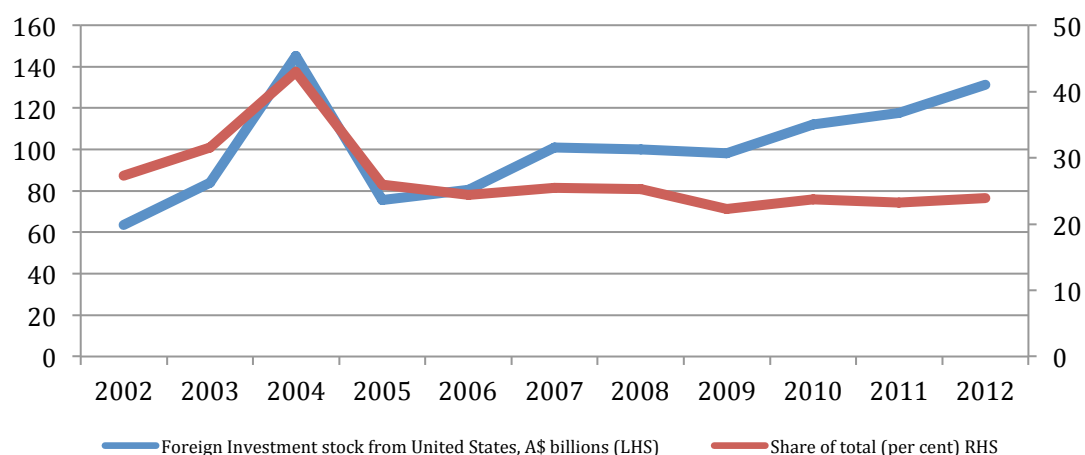
One important provision in AUSFTA raised the minimum threshold for which US FDI could enter Australia without review by the Foreign Investment Review Board (FIRB). Under the agreement, FDI from the United States under A\$800 million was not to require screening by FIRB whereas FDI from other countries was required to undergo screening for proposals over around A\$200 million.⁴ This threshold is indexed and is currently at A\$1.078 billion. The United States was the only country to have a higher threshold until 2013, when the threshold was lifted for investment from New Zealand under an Investment Protocol added to the Australia–New Zealand (CER) agreement. Australia has now agreed to lift the threshold to the same level as investment from the United States and New Zealand for South Korea and Japan under the bilateral PTAs that have been concluded with these countries.

The preferential treatment of investment from the United States created a precedent and unleashed unintentional piecemeal reform of Australia's foreign investment regime (Armstrong, Reinhardt and Westland, 2014). It is difficult to establish the effect of the preferential liberalisation of investment screening on investment flows. The Australian foreign investment regime is one of the most open globally (Armstrong, 2011) with the FIRB screening process working to facilitate foreign investment into Australia, not to stop it (Drysdale, 2011). Yet the lifting of the threshold could have had a signalling effect, as some bodies, such as the OECD,

⁴ It was only in 2010 that a unified threshold was created for all other countries, at A\$219 million.

consider the FIRB to be a restrictive measure within Australia’s foreign investment regime that dissuades investment proposals.⁵ Only three non-real estate investment proposals, one American, have been rejected in the last decade.

Figure 4 US FDI stock in Australia (A\$ billions) and share of total FDI stock (per cent), 2002-12



Source: OECD.stat (<http://stats.oecd.org/>) from ABS Cat. 5352.0

The US FDI stock in Australia reached more than A\$145 billion in 2004 with a sudden spike in inward FDI. The next year when the PTA came into force, there was significant disinvestment and the FDI stock fell to A\$75 billion. US FDI has been rising since then in absolute terms, and the United States is still the largest investor in Australia by stock with A\$131 billion in 2012. But the share of US FDI in total inward FDI stock in Australia has remained fairly steady between 2005 and 2012, albeit declining slightly from 26 per cent in 2005 to 24 per cent in 2012. This is the period of larger FDI flows into Australia from China and Japan during the commodity price boom.

The fall in US FDI stock in Australia from 2004 to 2005 (see Figure 4) demonstrates the difficulty in analysing FDI flow data as FDI inflows can be negative in some years, as was the case with US FDI into Australia in 2005 at negative A\$59.75 billion.

The liberalisation of screening rules afforded to FDI from the United States caused an increase in inward FDI from *all* sources into Australia, according to Kirchner (2012). Kirchner advances a model explaining total inward FDI into Australia before the signing of AUSFTA and uses that to predict what total inward FDI would likely have been without AUSFTA. Actual total FDI is shown to be higher post-2005 than what that the model would predict, thus leading the author to attribute higher FDI inflows

⁵ The FIRB appears to be restrictive to foreign investment according to the *OECD FDI regulatory restrictiveness index* — where Australia ranks as more restrictive than the global average and much more restrictive than the OECD average.

to AUSFTA. This analysis fails to make the case for why liberalisation in screening rules towards the United States increased total FDI inflows — especially when the significant share of FDI growth was from China — a country with which Australia does not have an investment treaty. The spike in American FDI in 2004 (see Figure 4) is not explained in the model.

It is difficult to make assessments of the effects of AUSFTA on FDI from the United States without more comprehensive analysis. There was significant preferential liberalisation towards US investment that increased the relative barriers for all other potential investors. An increase in US FDI resulting from AUSFTA would be an argument for unilateral non-discriminatory threshold liberalisation rather than liberalisation toward ‘preferred’ partners in bilateral agreements. Without the preferential treatment under AUSFTA in the screening of American FDI, the US share of total Australian FDI stock may have fallen instead of remained steady at around a quarter.

Further analysis on the effects of AUSFTA on services trade and foreign direct investment, controlling for differences in treaty provisions, such as whether ISDS is included or not, would give a complete picture of the impact of the agreement but would require an extension of the gravity model approach employed in the present paper, and considerably more data analysis. A careful counterfactual would need to be modelled in order to benchmark investment as well as services trade.

Conclusion

Ten years after AUSFTA came into force, there is enough data to estimate the effects of the agreement on trade flows and their economic impact. The evidence from a large panel dataset using the gravity model of trade deployed by the Productivity Commission suggests that Australian and US trade with the rest of the world fell — that there was trade diversion — due to AUSFTA after controlling for country-specific factors. Estimates also suggest trade between Australia and the United States fell in association with the implementation of AUSFTA — also after controlling for country-specific factors. The existence of trade diversion suggests that trade between Australia and the United States could well have fallen even further without AUSFTA. These results add to the evidence about whether or not preferential trade agreements increase net trade — with the body of evidence currently suggesting that they do not and if anything lead to a contraction.

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Appendix

Various robustness tests were conducted, including preliminary investigation into the effects of the Singapore–Australia PTA (SAFTA) and Thailand–Australia PTA (TAFTA) agreements on trade.

SAFTA shows similar effects on trade as AUSFTA and is associated with reduced trade between Australia and Singapore as well as trade between the Australia-Singapore bloc and the rest of the world. The results for TAFTA are quite the opposite with a large and positive effect on trade between Australia and Thailand as well as on trade between the two countries and the rest of the world. The opposite effects of these agreements on trade are worth further investigation but are beyond the scope of this paper.

The inclusion of SAFTA and TAFTA in the model causes the effects of AUSFTA to change slightly with the D1, D2 and D3 coefficient estimates changing from -0.304 , -0.112 and -0.154 to -0.394 , -0.120 and -0.180 , respectively. These changes, although small, are significant enough to demonstrate possible multicollinearity between the PTA dummy variables and other events which are not controlled for adequately in the model. The obvious starting point is the major economic event of the global financial crisis which is controlled for and tested with a number of year and region-year specific dummy variables but warrants further investigation.

Similar to the PC study, a sensitivity test was implemented with a benchmark model with zero trade flows included and a model with only positive flows. However, different from the PC study, this study finds that the estimated coefficients are quite sensitive to inclusion and exclusion of zero trade flows. While some estimated coefficients are smaller, many estimates of PTA variables are larger with inclusion of zero trade flows. This evidence is consistent with a common expectation in gravity model literature that exclusion of zero trade flows may lead to downward bias in the estimated impact of regional and bilateral PTAs. It is notable that the estimates of AUSFTA, SAFTA and TAFTA change little with the regression on positive trade flows.

Another sensitivity test was conducted with the regression of the benchmark model on the dataset for different periods, from 1970-2005 to 1970-2012. The sensitivity of estimated coefficients of PTAs over different time periods are examined. While the time periods are different from the ones examined in the PC study, the findings are quite consistent in the sense that a number of PTAs have different trade effects over time. Particularly, some bilateral PTAs such as AUPNG, SAFTA, EEC-Swiss have opposite effects over different periods. This could be possible as the impact of agreements is year-specific. Key explanatory variables, including the sum of two trading partners' GDP, differences in economy sizes and incomes have a quite stable impact on bilateral trade flows.

It is notable that AUSFTA has a robust and significant negative effect on bilateral trade flows, which is in contrast with that of SFTA. The TAFTA also has robust, but strong trade-creating effect.

It should be noted that the estimation results for the period 1970-2008 is consistent with the previous PC estimation results.

Appendix Table: Estimation Results

Variables	Base model		Different time periods		
	PC Study	This Study	1970-2005	1970-2008	1970-2012
SGDP_current	1.452*** 0.00002	1.385*** 0.00001	1.292*** -0.00002	1.428*** -0.00002	1.385*** -0.00001
SIMILAR_current	0.710*** 0.00001	0.699*** 0.000010	0.724*** -0.00002	0.716*** -0.00001	0.705*** -0.00001
RFAC_current	-0.191*** 0.000009	-0.126*** 0.000007	-0.154*** -0.00001	-0.193*** -0.000009	-0.126*** -0.000007
APEC_1	0.074*** 0.00002	0.192*** 0.00002	0.102*** -0.00002	0.079*** -0.00002	0.187*** -0.00002
APEC_2	0.079*** 0.00002	0.255*** 0.00002	0.077*** -0.00002	0.083*** -0.00002	0.255*** -0.00002
APEC_3	0.093*** 0.00002	0.225*** 0.00002	0.107*** -0.00002	0.095*** -0.00002	0.222*** -0.00002
ASEAN CEPT_1	0.319*** 0.00005	0.255*** 0.00005	0.346*** -0.00005	0.332*** -0.00005	0.264*** -0.00005
ASEAN CEPT_2	0.124*** 0.00003	0.078*** 0.00003	0.162*** -0.00003	0.128*** -0.00003	0.085*** -0.00003
ASEAN CEPT_3	0.236*** 0.00003	0.220*** 0.00003	0.245*** -0.00003	0.224*** -0.00003	0.198*** -0.00003
ANZCER_1	0.133*** 0.0003	0.084*** 0.0003	0.159*** -0.0003	0.142*** -0.0003	0.027*** -0.0003
ANZCER_2	-0.075*** 0.0001	-0.106*** 0.00010	-0.069*** -0.0001	-0.059*** -0.0001	-0.104*** -0.0001
ANZCER_3	-0.147*** 0.0001	-0.106*** 0.00010	-0.143*** -0.0001	-0.140*** -0.0001	-0.194*** -0.0001
AU-PNG_1	0.070*** 0.0007	1.065*** 0.0006	-0.015*** -0.0007	0.071*** -0.0007	1.052*** -0.0006
AU-PNG_2	0.056*** 0.0001	0.180*** 0.0001	0.047*** -0.0001	0.062*** -0.0001	0.185*** -0.0001
AU-PNG_3	-0.167*** 0.0001	0.019*** 0.0001	-0.175*** -0.0001	-0.163*** -0.0001	-0.009*** -0.0001
SPARTECA_1	0.073*** 0.0003	0.008*** 0.0003	0.087*** -0.0003	0.074*** -0.0003	0.022*** -0.0003
SPARTECA_2	-0.044*** 0.0001	-0.032*** 0.0001	-0.026*** -0.0001	-0.043*** -0.0001	-0.032*** -0.0001
SPARTECA_3	-0.183*** 0.0001	-0.145*** 0.0001	-0.172*** -0.0001	-0.181*** -0.0001	-0.132*** -0.0001
EEC_1	0.374*** 0.00003	0.644*** 0.00003	0.386*** -0.00004	0.361*** -0.00003	0.644*** -0.00003
EEC_2	0.065*** 0.00003	0.210*** 0.00002	0.060*** -0.00003	0.064*** -0.00003	0.210*** -0.00002
EEC_3	0.048*** 0.00003	0.245*** 0.00003	0.071*** -0.00003	0.047*** -0.00003	0.247*** -0.00003
EEC-Poland_1	0.156***	0.149***	0.208***	0.165***	0.150***

	0.0001	0.0001	-0.0001	-0.0001	-0.0001
EEC-Poland_2	-0.144***	-0.070***	-0.166***	-0.144***	-0.068***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
EEC-Poland_3	-0.150***	-0.052***	-0.219***	-0.145***	-0.051***
	0.0001	0.0001	-0.0002	-0.0001	-0.0001
EEC-Romania_1	0.475***	0.511***	0.756***	0.472***	0.511***
	0.00007	0.00007	-0.0001	-0.00007	-0.00007
EEC-Romania_2	0.053***	0.144***	-0.019***	0.049***	0.145***
	0.0001	0.0001	-0.0002	-0.0001	-0.0001
EEC-Romania_3	0.015***	0.130***	-0.175***	0.011***	0.130***
	0.0001	0.0001	-0.0002	-0.0001	-0.0001
EEC-Swiss_1	-0.048***	0.168***	-0.050***	-0.050***	0.168***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
EEC-Swiss_2	-0.150***	0.139***	-0.154***	-0.146***	0.139***
	0.0002	0.0001	-0.0002	-0.0002	-0.0001
EEC-Swiss_3	-0.044***	0.264***	-0.080***	-0.040***	0.263***
	0.0001	0.0001	-0.0002	-0.0001	-0.0001
EEC-Egypt_1	-0.158***	-0.026***	-0.184***	-0.159***	-0.027***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
EEC-Egypt_2	0.263***	0.457***	0.232***	0.265***	0.456***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
EEC-Egypt_3	0.200***	0.516***	0.121***	0.201***	0.516***
	0.0003	0.0003	-0.0004	-0.0003	-0.0003
EFTA_1	0.362***	0.520***	0.382***	0.356***	0.519***
	0.00007	0.00007	-0.00007	-0.00007	-0.00007
EFTA_2	0.143***	0.204***	0.147***	0.137***	0.203***
	0.00003	0.00003	-0.00003	-0.00003	-0.00003
EFTA_3	0.054***	0.177***	0.074***	0.049***	0.176***
	0.00003	0.00003	-0.00004	-0.00003	-0.00003
EFTA-Hungary_1	0.021***	0.098***	-0.003***	0.025***	0.098***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
EFTA-Hungary_2	0.198***	0.175***	0.283***	0.201***	0.175***
	0.00006	0.00006	-0.00008	-0.00006	-0.00006
EFTA_Hungary_3	0.185***	0.135***	0.400***	0.186***	0.134***
	0.00007	0.00006	-0.00009	-0.00007	-0.00006
EFTA-Poland_1	-0.030***	-0.104***	0.098***	-0.026***	-0.105***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
EFTA-Poland_2	-0.041***	-0.089***	0.058***	-0.043***	-0.090***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
EFTA-Poland_3	-0.169***	-0.218***	-0.072***	-0.174***	-0.219***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
EFTA-Israel_1	-0.378***	-0.382***	-0.355***	-0.379***	-0.382***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
EFTA-Israel_2	-0.039***	-0.081***	-0.018***	-0.041***	-0.084***
	0.00008	0.00007	-0.00008	-0.00008	-0.00007
EFTA-Israel_3	0.120***	0.142***	0.107***	0.120***	0.141***
	0.00008	0.00008	-0.00008	-0.00008	-0.00008

CEFTA_1	0.264***	0.410***	0.269***	0.273***	0.412***
	0.00008	0.00008	-0.0001	-0.00008	-0.00008
CEFTA_2	0.136***	0.157***	0.176***	0.147***	0.159***
	0.00004	0.00003	-0.00005	-0.00004	-0.00003
CEFTA_3	0.088***	0.110***	0.081***	0.103***	0.112***
	0.00004	0.00004	-0.00005	-0.00004	-0.00004
US-Canada_1	0.127***	0.079***	0.078***	0.119***	0.082***
	0.00004	0.00004	-0.00004	-0.00004	-0.00004
US-Canada_2	0.028***	-0.046***	-0.005***	0.020***	-0.045***
	0.00003	0.00003	-0.00003	-0.00003	-0.00003
US-Canada_3	0.023***	-0.030***	-0.014***	0.014***	-0.031***
	0.00003	0.00003	-0.00003	-0.00003	-0.00003
NAFTA_1	0.317***	0.256***	0.363***	0.364***	0.271***
	0.00003	0.00003	-0.00003	-0.00003	-0.00003
NAFTA_2	0.059***	0.003***	0.055***	0.075***	0.009***
	0.00002	0.00002	-0.00002	-0.00002	-0.00002
NAFTA_3	-0.196***	-0.174***	-0.155***	-0.129***	-0.156***
	0.00002	0.00002	-0.00002	-0.00002	-0.00002
ANDEAN_1	0.648***	0.726***	0.790***	0.639***	0.729***
	0.0002	0.0001	-0.0003	-0.0002	-0.0001
ANDEAN_2	0.046***	0.292***	-0.021***	0.050***	0.293***
	0.00008	0.00006	-0.0001	-0.00008	-0.00006
ANDEAN_3	0.126***	0.422***	-0.079***	0.122***	0.423***
	0.00007	0.00006	-0.0001	-0.00007	-0.00006
CACM_1	0.065***	0.125***	0.066***	0.067***	0.126***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
CACM2	0.360***	0.345***	0.324***	0.359***	0.343***
	0.00010	0.00009	-0.0001	-0.0001	-0.00009
CACM3	-0.020***	0.028***	-0.021***	-0.016***	0.028***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
LAIA_1	0.258***	0.418***	0.219***	0.252***	0.417***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
LAIA_2	-0.058***	0.049***	-0.061***	-0.058***	0.049***
	0.00005	0.00005	-0.00005	-0.00005	-0.00005
LAIA_3	0.227***	0.333***	0.223***	0.227***	0.332***
	0.00005	0.00005	-0.00005	-0.00005	-0.00005
MERCOSUR_1	0.861***	0.867***	0.828***	0.865***	0.870***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
MERCOSUR_2	0.177***	0.162***	0.160***	0.178***	0.161***
	0.00005	0.00004	-0.00005	-0.00005	-0.00004
MERCOSUR_3	-0.065***	-0.054***	-0.111***	-0.065***	-0.054***
	0.00004	0.00004	-0.00004	-0.00004	-0.00004
Bolivia-Mexico_1	1.367***	1.308***	1.273***	1.311***	1.295***
	0.002	0.002	-0.002	-0.002	-0.002
Bolivia-Mexico_2	0.602***	0.611***	0.619***	0.603***	0.611***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
Bolivia-Mexico_3	0.178***	0.343***	0.083***	0.153***	0.337***

	0.0002	0.0002	-0.0002	-0.0002	-0.0002
Costa Rica-Mexico_1	0.432***	0.502***	0.440***	0.400***	0.496***
	0.0006	0.0006	-0.0006	-0.0006	-0.0006
Costa Rica-Mexico_2	0.034***	0.082***	0.016***	0.042***	0.083***
	0.0002	0.0001	-0.0002	-0.0002	-0.0001
Costa Rica-Mexico_3	0.337***	0.416***	0.357***	0.330***	0.415***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
Chile-Columbia_1	0.032***	-0.226***	0.198***	0.032***	-0.228***
	0.0005	0.0005	-0.0006	-0.0005	-0.0005
Chile-Columbia_2	0.261***	0.086***	0.301***	0.255***	0.083***
	0.00010	0.00009	-0.0001	-0.0001	-0.00009
Chile-Columbia_3	-0.171***	-0.206***	-0.061***	-0.167***	-0.207***
	0.00009	0.00009	-0.0001	-0.00009	-0.00009
Group of Three_1	0.065***	-0.002***	-0.090***	0.055***	-0.004***
	0.0002	0.0002	-0.0002	-0.0002	-0.0002
Group of Three_2	-0.308***	-0.299***	-0.296***	-0.300***	-0.298***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
Group of Three_3	-0.113***	-0.243***	-0.079***	-0.111***	-0.241***
	0.00005	0.00005	-0.00006	-0.00005	-0.00005
MERCOSUR-Bolivia_1	-0.068***	-0.272***	-0.167***	-0.059***	-0.268***
	0.0003	0.0003	-0.0003	-0.0003	-0.0003
MERCOSUR-Bolivia_2	-0.604***	-0.734***	-0.529***	-0.601***	-0.733***
	0.0003	0.0003	-0.0004	-0.0003	-0.0003
MERCOSUR-Bolivia_3	-0.276***	-0.493***	-0.129***	-0.248***	-0.487***
	0.0003	0.0003	-0.0004	-0.0003	-0.0003
MERCOSUR-Chile_1	0.245***	0.106***	0.199***	0.239***	0.109***
	0.0001	0.0001	-0.0002	-0.0001	-0.0001
MERCOSUR-Chile_2	-0.133***	0.018***	-0.211***	-0.127***	0.019***
	0.0001	0.0001	-0.0001	-0.0001	-0.0001
MERCOSUR-Chile_3	0.334***	0.326***	0.114***	0.325***	0.329***
	0.0001	0.00010	-0.0001	-0.0001	-0.0001
D_AUSFTA_1		-0.304***	-0.439***	-0.386***	-0.394***
		0.00006	-0.0002	-0.00008	-0.00006
D_AUSFTA_2		-0.112***	-0.036***	-0.066***	-0.120***
		0.000010	-0.00002	-0.00001	-0.00001
D_AUSFTA_3		-0.154***	-0.260***	-0.213***	-0.180***
		0.00001	-0.00003	-0.00001	-0.00001
D_SAFTA_1			0.009***	0.007***	-0.050***
			-0.0002	-0.0001	-0.0001
D_SAFTA_2			-0.116***	-0.148***	-0.203***
			-0.00004	-0.00003	-0.00002
D_SAFTA_3			-0.044***	-0.075***	-0.100***
			-0.00004	-0.00003	-0.00002
D_TAFTA_1			0.851***	0.887***	1.058***
			-0.0003	-0.0002	-0.0001
D_TAFTA_2			0.205***	0.172***	0.215***
			-0.00006	-0.00003	-0.00003

D_TAFTA_3			0.253***	0.256***	0.324***
			-0.00006	-0.00003	-0.00002
year==1971	-0.064***	-0.058***	-0.047***	-0.061***	-0.058***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1972	-0.103***	-0.074***	-0.061***	-0.098***	-0.075***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1973	-0.135***	-0.125***	-0.059***	-0.124***	-0.126***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1974	-0.006***	0.025***	0.089***	0.007***	0.023***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1975	-0.140***	-0.103***	-0.026***	-0.124***	-0.105***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1976	-0.135***	-0.090***	-0.012***	-0.118***	-0.091***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1977	-0.182***	-0.136***	-0.037***	-0.161***	-0.137***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1978	-0.284***	-0.232***	-0.112***	-0.259***	-0.233***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1979	-0.298***	-0.233***	-0.101***	-0.269***	-0.235***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1980	-0.317***	-0.250***	-0.101***	-0.286***	-0.252***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1981	-0.305***	-0.233***	-0.091***	-0.274***	-0.235***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1982	-0.352***	-0.282***	-0.141***	-0.322***	-0.284***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1983	-0.380***	-0.315***	-0.166***	-0.350***	-0.316***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1984	-0.340***	-0.274***	-0.119***	-0.309***	-0.274***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1985	-0.379***	-0.310***	-0.147***	-0.346***	-0.310***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1986	-0.537***	-0.470***	-0.278***	-0.499***	-0.471***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1987	-0.581***	-0.508***	-0.300***	-0.539***	-0.509***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1988	-0.597***	-0.516***	-0.300***	-0.553***	-0.517***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1989	-0.654***	-0.619***	-0.343***	-0.607***	-0.618***
	0.00006	0.00005	-0.00006	-0.00006	-0.00005
year==1990	-0.715***	-0.673***	-0.384***	-0.666***	-0.672***
	0.00006	0.00006	-0.00006	-0.00006	-0.00006
year==1991	-0.766***	-0.723***	-0.428***	-0.716***	-0.722***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1992	-0.828***	-0.775***	-0.481***	-0.775***	-0.774***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1993	-0.838***	-0.786***	-0.493***	-0.785***	-0.785***

	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1994	-0.818***	-0.774***	-0.481***	-0.780***	-0.776***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1995	-0.844***	-0.798***	-0.487***	-0.801***	-0.800***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1996	-0.860***	-0.809***	-0.498***	-0.818***	-0.811***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1997	-0.812***	-0.760***	-0.452***	-0.771***	-0.763***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1998	-0.806***	-0.759***	-0.446***	-0.765***	-0.762***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==1999	-0.814***	-0.766***	-0.448***	-0.772***	-0.769***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2000	-0.733***	-0.682***	-0.365***	-0.691***	-0.686***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2001	-0.771***	-0.720***	-0.402***	-0.730***	-0.724***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2002	-0.806***	-0.752***	-0.428***	-0.763***	-0.756***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2003	-0.857***	-0.792***	-0.458***	-0.810***	-0.796***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2004	-0.864***	-0.797***	-0.437***	-0.807***	-0.793***
	0.00006	0.00006	-0.00007	-0.00006	-0.00006
year==2005	-0.865***	-0.753***	-0.397***	-0.779***	-0.755***
	0.00006	0.00006	-0.00007	-0.00007	-0.00006
year==2006	-0.862***	-0.741***		-0.774***	-0.744***
	0.00007	0.00006		-0.00007	-0.00006
year==2007	-0.919***	-0.791***		-0.829***	-0.794***
	0.00007	0.00006		-0.00007	-0.00006
year==2008	-0.946***	-0.810***		-0.855***	-0.813***
	0.00007	0.00006		-0.00007	-0.00006
year==2009		-1.017***			-1.020***
		0.00006			-0.00006
year==2010		-0.952***			-0.955***
		0.00006			-0.00006
year==2011		-0.934***			-0.938***
		0.00006			-0.00006
year==2012		-0.974***			-0.978***
		0.00006			-0.00006
No. observations	1,139,283	1,388,006	1,009,187	1,139,283	1,388,006

Note: * p<0.10, ** p<0.05, ***p<0.01