

THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF ACCOUNTING

THE ECONOMIC EFFECTS OF TIME ZONES IN THE UNITED STATES, THE UNITED
KINGDOM, CHINA, AND AUSTRALIA

AMY LYNN BUCKLEY
SPRING 2015

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Accounting
with honors in Accounting

Reviewed and approved* by the following:

Robert A. Novack
Associate Professor of Supply Chain & Information Systems
Thesis Supervisor

Orie Barron
Professor of Accounting
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

The purpose of this thesis is to analyze the economic effects of the time zones of the United States, the United Kingdom, China, and Australia and to determine whether these countries' time zones are economically advantageous for them. This thesis explores the history of time zones and the reasoning behind the system of current time zones in the United States, the United Kingdom, China, and Australia. It studies the continuity effect, which derives economic benefit from service trade with distant economic time zones, and the synchronicity effect, which increases costs when goods and service trade occur in areas with large time zone differences because of coordination problems. It looks at the overall economic effect of the continuity and synchronization effects and analyzes how they impact the previously listed countries economically. This thesis also looks at specific benefits and costs each country experiences as a result of its time zone(s) and concludes on the overall economic effect of each country's system of time zones.

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES	iv
ACKNOWLEDGEMENTS	V
Chapter 1 Introduction	1
Chapter 2 Methodology	3
Chapter 3 History	4
Time Zones Overview	4
The United States	4
The United Kingdom.....	6
China	7
Australia	9
Chapter 4 Effects of Time Zone Differences	10
Synchronization Effect.....	10
Continuity Effect.....	11
Overall Effect.....	12
Implications for the United States, the United Kingdom, China, and Australia	14
Chapter 5 Benefits and Costs of Individual Country’s Time Zones	22
The United Kingdom.....	22
Benefits	22
Costs	23
The United States	24
Benefits	24
Costs	25
China	26
Benefits	26
Costs	27
Australia	29
Benefits	29
Costs	30
Chapter 6 Conclusion.....	32

WORKS CITED38

LIST OF FIGURES

Figure 1. Time Zones of the United States6

Figure 2. Time Zones of United Kingdom and Nearby Countries.....7

Figure 3. China's Single Time Zone8

Figure 4. Time Zones of Australia.....10

LIST OF TABLES

Table 1. Leading Exporters in Commercial Services, 2013.....	20
Table 2. Leading Exporters in Goods, 2013	21

ACKNOWLEDGEMENTS

I would first like to thank my thesis adviser, Dr. Robert A. Novack, without whom this thesis would not have been possible. Dr. Novack provided continuous support throughout my time working on my thesis, helping me to solidify my idea for my thesis, giving me insight on areas to research further to come to a conclusion for my paper and constantly providing me with feedback. Dr. Novack always responded to me in a timely manner and always had such a positive attitude when I met with him that he gave me confidence in my thesis and made writing it a great experience for me. I truly appreciate all of his support with my thesis and also as a professor over the years. I also would like to thank my honors adviser, Dr. Orie Barron. Dr. Barron helped me to come up with my idea for my thesis, and without him, I would have been lost as to a topic on which to write my thesis. Additionally, Dr. Barron stressed to me the fundamentals of writing my thesis and gave me guidance throughout the whole process, which I really appreciate. Finally, I would like to thank my family for all of their support. My parents were always there to support me when I needed it during my thesis-writing process and they inspired me to do my best work. My sisters gave me advice on writing my thesis from their experiences and were also incredibly supportive. I appreciate all of the support and help I received and the opportunity that the Schreyer Honors College gave me in writing my thesis.

Chapter 1

Introduction

Time zones play an important role in every individual's life, whether knowingly or not. Time zones affect sleep cycles, leisure time, and trade, among other quotidian experiences. Although time zones have sizeable political, economic, and social impacts, they have a short, and often unvisited, history, only existing since the advent of railroads in the late nineteenth century. At this time, a standard system of time zones was created, but individual governments retained the rights to establish their own time zones. As a result, time zones affect the entire world, but they affect all parts of the world differently. This governmental authority leads to an incongruent set of world time zones, with parallel countries placed in different time zones, large landmasses sharing a single time zone, and jagged time zones cutting through others.

Since time zones determine the timing of daylight in a country, they influence when a country's citizens rise and rest. This role leads to many different effects on humans, one of them being economic. Time zones affect all individuals and countries economically, whether adversely or positively. This thesis seeks to examine the economic effects of time zones and to determine if different time zones help or harm their inhabitants economically.

This thesis will examine the broad history of time zones, and it will specifically explore the formation of the time zones of the United States, the United Kingdom, China, and Australia. It will focus on the economic effects of time zones, such as the continuity effect and the synchronization effect, and study how they affect these specific time zones. It will then look further into specific, localized benefits and costs of each country's time zone or proposed new

time zone. Looking at these and other factors, it will conclude on whether the time zones of the United States, the United Kingdom, China, and Australia are an economic fit for their respective countries or if alternatives should be considered.

Chapter 2

Methodology

This thesis will begin by studying the history of time zones through different scholarly articles. Then, it will specifically focus on the evolution of time zones in the United States, the United Kingdom, China, and Australia. It will then explore broad economic effects of time zones, both negative and positive, through several studies and then assess the implications of these effects on the time zones of the United States, the United Kingdom, China, and Australia. Next, it will look at specific strengths and weaknesses of each of these countries' time zones through various newspaper and scholarly articles. Finally, it will conclude by assessing if each country's time zone is a positive fit for its economy.

Chapter 3

History

Time Zones Overview

Standard time zones were not created until the late nineteenth century. Before their creation, every town established its own time by setting its clocks to noon when the sun reached its highpoint. This system worked without conflict until the advent of railroads. With the popularization of trains, conflicts started arising from the existence of different times in different towns. As a result, in the late 1870s Sir Sandford Fleming, a Canadian engineer and railway planner, created a plan for a worldwide standard time, and, in 1884, twenty-seven nations met for the Meridian Conference, agreeing on a system of twenty-four standard meridians of longitude fifteen degrees apart, starting at the prime meridian in Greenwich (“Time Zones History”, 2014). Countries could still determine their own time zones, though, so some countries, like the United States, have several time zones, while others, like China, use only one time zone. Many countries also altered the meridians for their convenience, to avoid populated areas or follow border lines.

The United States

Before railroads, there was no standard time in the United States and all towns had authority over their own times. With the growth of railroads, the lack of standardized time

created many problems, such as the inability to create accurate train schedules and the occurrence of collisions since each train was traveling on its own time. On November 18, 1833, standard time zones were created for American and Canadian towns (Kimmel, 2009). While European countries implemented standard time by creating one time zone for the country based around the time in the capital, this system did not seem feasible for the United States as its landmass was much greater than those of the European countries. So, the railroads created a system of time zones that made each area's standard time align with its solar time. The railroads did not develop this system of time zones together, though, so there were different railroad times for different railroad companies. The problems which had accompanied non-uniform timing continued, since railroad stations had to show different clocks for each rail company. Townspeople did not accept the railroad companies' time zones at first and continued to keep track of time based on their towns' systems.

Eventually, in 1882, the heads of all of the railroad companies met to create a unified time system, effective for the following year. They created four standard time zones, each fifteen degrees of longitude apart and an hour wide (Kimmel, 2009). While there was now one standard time system, Americans still did not accept the railroads' standard time and kept following their local times. Finally, the United States government made time zones a matter of law on March 19, 1918, and they were eventually accepted by Americans (Kimmel, 2009). These time zones can be seen in **Figure 1**.

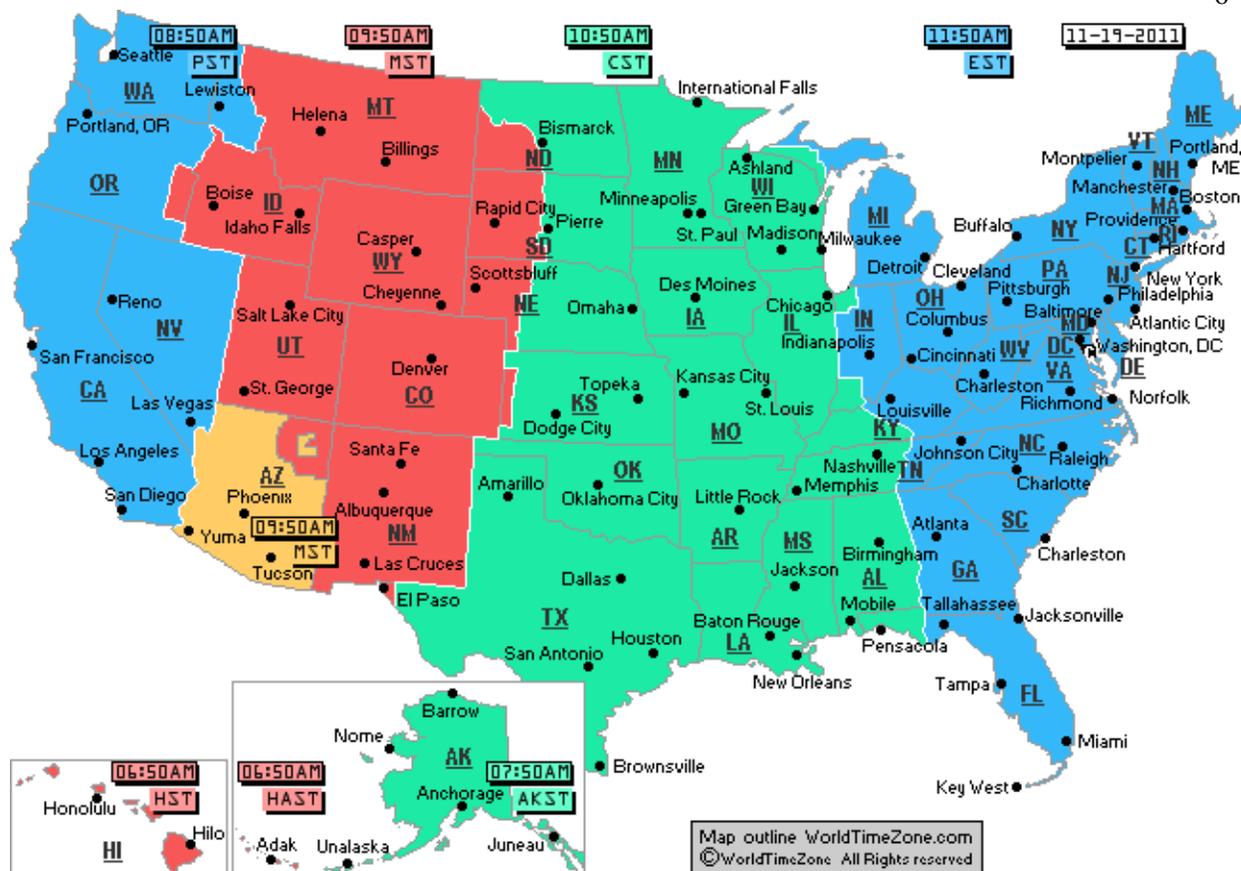


Figure 1. Time Zones of the United States

Source: WorldTimeZone.com

The United Kingdom

The history of time zones in the United Kingdom is similar to that of the United States, but simpler as it is a smaller country. The popularity of railroads, especially the Great Western Railway in Britain, created a need for a standard time system. In response to this need, the United Kingdom implemented standard time in Greenwich, which continues to be a center of time-keeping since the United Kingdom still uses Greenwich Mean Time (GMT). The time zones were made effective in the United Kingdom on August 2, 1880 with the “Statutes (Definition of Time) Act” (“Time Zones History”, 2014). Even though the United Kingdom

falls between the same meridians of longitude as France and Spain, it is in a time zone an hour behind them. This difference in time zone has caused some controversy and pushes for change in the United Kingdom. These can be seen in **Figure 2**.



Figure 2. Time Zones of United Kingdom and Nearby Countries

Source: WorldAtlas.com

China

While the history of time zones is similar for the United States and the United Kingdom, China's history tells a different story. The Republic of China was established in 1912 by Sun Yat-sen with five time zones, similar to the standard time zones in the United States

(Schiavenza, 2013). However, with the Communist Revolution in 1949, Mao Zedong, China's leader, introduced one time zone, using Beijing time as the standard time for all of China.

According to James Millward, a Xin-jiang scholar at Georgetown University, the reasoning behind the change was a longstanding imperial Chinese tradition where the emperor controls time because it has cosmological importance (Demick, 2009). Thus, Mao Zedong controlled the time for all of China. With Mao's change, China became the largest country in the world to have one single time zone and remains so to this day, as can be seen in **Figure 3** (Demick, 2009).



Figure 3. China's Single Time Zone

Source: www.pravmir.ru

Australia

Australia is unique from other countries in that it has a different number of time zones for each half of the year. From April to October, Australia has three time zones, while, for the other half of the year, it has six time zones. This change is a result of Daylight Savings Time, with some states practicing it while others do not. Additionally, instead of each time zone being one hour apart, Australia's middle time zone is ahead of its western time zone by one and a half hours and behind its eastern time zone by a half hour, as you can see in **Figure 4**. It is one of only seven places in the world that is on a half hour point from Coordinated Universal Time (UTC) (Back, 2015).

In 1895, South Australia, which is the lower half of the middle time zone, passed from local time to a time zone one hour behind the eastern states. In 1898, though, a bill was passed by Parliament to adjust the time zone to be a half hour behind the eastern Australian states. This strange time difference was a result of representations from commercial interests and can be seen in **Figure 4** ("Astronomical Society of South Australia", 2015).

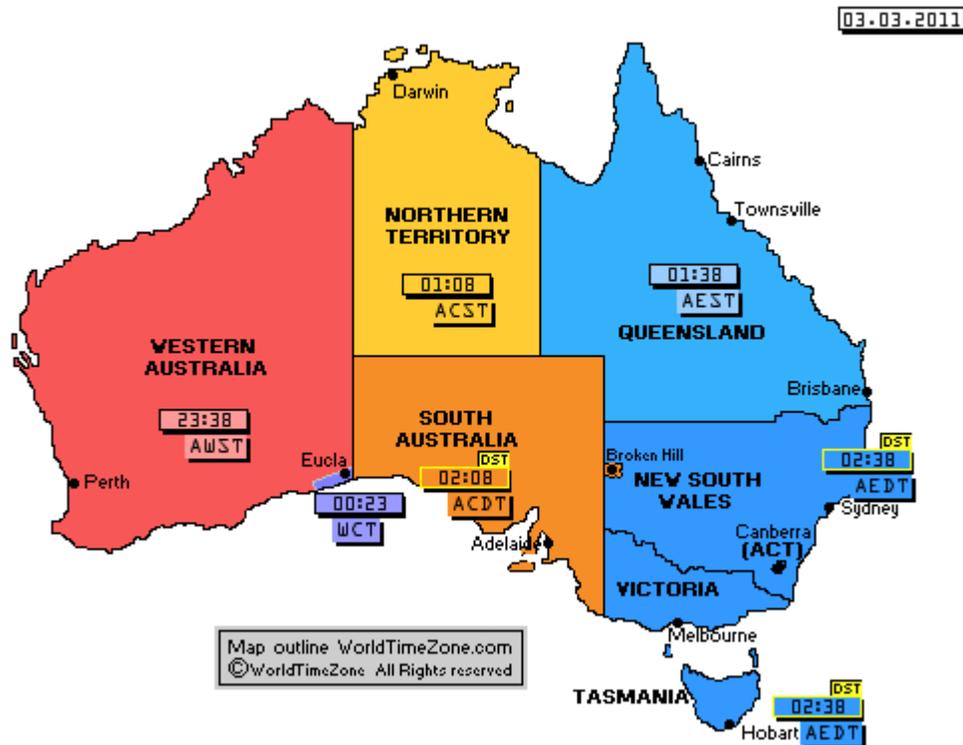


Figure 4. Time Zones of Australia

Source: WorldTimeZone.com

Chapter 4

Effects of Time Zone Differences

Synchronization Effect

One effect of time zone differences is the synchronization effect, which suggests that time zones have a negative economic effect. The synchronization effect occurs when there is no overlap in working hours between two office locations because of time zone differences.

So, in order to communicate, employees at one office must either come in early or stay later. This leads to increased labor costs and a negative time zone effect. According to a study on time restrictions on trade in the *International Economic Journal* by Bianka Dettmer, the synchronization effect causes time zones to “act as a barrier when coordination problems with sleeping business partners occur...even when electronic communication is an excellent substitute for face-to-face interaction” (Dettmer, 2014, p. 227). This effect occurs for companies with international office locations in both the goods and services industries, and suggests that both industries should have a negative time zone effect because of higher costs due to the synchronization effect (Tomasik, 2013). The synchronization effect would indicate that offices and support centers of a business should be located close to each other in order for employees at each location to interact at the same time.

Continuity Effect

In addition to the synchronization effect, the continuity effect exists because of time zone differences and suggests that larger time zone differences have a positive economic effect on service trade. The continuity effect occurs when time zone differences allow a company to work around the clock without having to compensate workers for non-ideal work hours (Tomasik, 2013). For example, a company’s call center, which operates in the service industry, could employ workers in several locations around the globe. Thus, if a customer calls at a non-regular work hour, it could be a normal working hour in a different time zone. The company would not have to pay employees for working more hours or working overtime and the time zone differences would create an economic benefit. Other types of service industries could

benefit from the continuity effect by having employees in one time zone work on a project, such as programming work or accounting work, during their normal office hours. Once their work day ends, the work day may be starting at the company's office in a distant time zone, so employees at that location can continue the work on the project during their normal office hours. According to a 2007 study by Marjit, "when production of a service is fragmented and takes two days to be finished, time can be saved if countries located in separate time zones engage in production, each performing one step" (Dettmer, 2014, p. 229). Research on the continuity effect by Kikuchi and Van Long finds that time zone differences should give companies that make use of time zone differences an advantage in service trade, since workers in all locations can work standard hours, but the company can operate for twenty-four hours a day (2010). According to Dettmer's study, "time zones can be a driving force of international service trade by allowing for continuous operation over a 24 hours business day (continuity effect) when a proper division of labor is feasible and countries are connected to electronic communications infrastructure (ICT)" (Dettmer, 227). However, this positive economic effect of time zones only exists for services industries, since goods cannot move through time zones as quickly.

Overall Effect

While both the synchronization and continuity effects influence trade in different time zones, a study by Rebecca Tomasik tested the combined effect of them on bilateral trade flows to determine the net economic effect of time zones. Since the continuity effect should only exist for services, previous studies had only tested the economic effects of time zones by

testing separately for goods and services. Tomasik's study combined goods and services exports in the same model, using OECD goods and services export data from 2000 to 2008, and tested for both the continuity and synchronization effects to determine the net economic effect of time zone differences. Tomasik included an interaction term between an indicator for service trade and the time zone variable to test for the continuity effect and the synchronization effect separately in the model.

Her results found that the time zone variable coefficient, which tested for the synchronization effect, was negative and significant, which coincides with previous research. The interaction term coefficient, which tested for the continuity effect, was positive and significant, implying, like previous research, that the continuity effect has a positive effect on time zone differences for companies trading services. Tomasik found that the overall time zone effect on goods trade was negative, showing that an increase in time zone differences of an hour would reduce goods trade by 56 million U.S. dollars. Since both the synchronization effect and the continuity effect impacted the service trade, Tomasik found that an increase in time zone differences of an hour reduced service trade by 56 million U.S. dollars through the synchronization effect, but also increased it by 50.6 million U.S. dollars through the continuity effect (2013). Thus, for the service trade, the study found that there was an insignificant net effect of time zone differences.

When looking at the overall time zone effect on trade without differentiating between the manufacturing and service industries, Tomasik found that the synchronization effect dominated the continuity effect to have an overall negative time zone effect on trade, which is consistent with the idea that the negative synchronization effect applies to both industries, while the positive continuity effect only applies to service trade.

Bianka Dettmer also researched the impacts of the synchronization and continuity effects on trade between distant time zones. While Dettmer did not study goods and services together, and thus did not study the synchronization and continuity effects together, her results were fairly similar to those of Tomasik. Dettmer cited a 2009 study by Head, Mayer, and Ries which found that the continuity effect outweighs the synchronization effect in cross border services trade (Dettmer, 2014, p. 229). The continuity effect also led time zone differences to have a positive impact on service FDI because larger time zone differences raised foreign affiliates' services sales more than with no time zone difference (Dettmer, 2014, p. 229). Her results also showed that countries needed to be connected to electronic communications infrastructure (ICT) in order to take advantage of the continuity effect on service trade. Dettmer found that "an improvement of ICT infrastructure will affect business service trade at long time zone distances significantly more than trade at short time zone distances" (Dettmer, 2014, p. 225).

Implications for the United States, the United Kingdom, China, and Australia

Since Tomasik's study found an aggregate negative effect of time zone differences on trade, it could be reasoned that China's single time zone benefits it more than the United States or Australia having multiple time zones. However, it is important to look at the service and manufacturing trades separately since time zone differences have an overall insignificant effect on the service trade, but the service trade can still benefit from the continuity effect, while time zone differences solely have a negative effect on the manufacturing trade.

Tomasik's study suggests that countries with multiple time zones would experience a greater advantage if they focused on trading in services with countries in different time zones

since they can take advantage of the continuity effect. Countries with time zones similar to that of the United States can already benefit from the continuity effect within their own country, since cities like San Francisco are three hours behind other cities, like New York. By trying to attract service trade with countries in even more time zones, they can further benefit from the continuity effect. Since the United States was the top exporter in world trade in services in 2013, as can be seen in **Table 1**, it would seem that the United States is taking advantage of its multiple time zones and using them for its benefit.

Additionally, Dettmer's study confirmed that "business service trade increases with time zone differences between business partners" (p. 230). The study also found that countries must have a strong electronic communications infrastructure to take advantage of this effect by testing an interaction term of time zone differences and electronic communications infrastructure (Dettmer, 2014, p. 230). Since the United States has high access rates to electronic communications infrastructure, along with most OECD countries, it is able to take advantage of the continuity effect. Dettmer's study, along with others previously cited, often used the United States' service industry's relationship with India as an example of the benefits of the continuity effect. It seems that when the United States was searching for developing countries to outsource service labor to India certainly benefited from its advantageous time zone difference with the United States. Kikuchi and Iwasa argue the benefits of the continuity effect by explaining how United States software industry employees will email programming problems to India at the end of their normal work day and an Indian programmer will be able to work on the problem while the office in the United States is closed (Dettmer, 2014, p. 227). Additionally, the relationship between the United States and India is advantageous for simultaneous interactions, as customers in any time zone in the United States who need support

at times outside the normal working day, such as late at night or early in the morning, can receive support from employees at a call center in India while they are working their regular hours. While the synchronization effect may cause large time zone differences to have a negative effect on goods trade in the United States, the continuity effect makes service trade in distant time zones beneficial for the United States, and it is taking advantage of this effect since it is the top world services exporter. Since Dettmer's study implies that the benefits of the continuity effect are higher when business service trade occurs at longer time zone distances, the United States is benefiting from its exportation of services to India, and it would be in its best interest to continue exporting business services to countries with which it has substantial time zone differences. To further take advantage of its system of time zones, the United States should focus on exporting business services, such as construction services, financial and insurance services, and computer and information services, since Dettmer found that the continuity effect and synchronization effect offset each other for commercial services, thus resulting in commercial services neither having an economic advantage or disadvantage from trade with large time zone differences.

The United Kingdom has a much smaller landmass than the United States, so it only elects to have one time zone. However, like the United States, it is a top worldwide exporter of services, ranking second in the world trade of commercial services and only eighth in the world trade of merchandise (see **Table 1** and **Table 2**). Like the United States, the United Kingdom can reap the advantages of the continuity effect when trading services with countries in other time zones. The United Kingdom has especially large service exports in the financial services industry, with a financial services and insurance trade surplus of 2.6 percent of GDP in the first half of 2011 ("Banged About", 2011). Additionally, the United Kingdom processes two-fifths

of global turnover in foreign exchange and is the top exporter of marine insurance and cross-border bank lending (“Banged About”, 2011). The continuity effect helps the United Kingdom to remain a top financial services exporter since the difference in time zones between the United Kingdom, Japan, and the United States accounts for London’s trading day starting around the close of Tokyo’s trading day and several hours before New York’s opens. According to Kevin Burrowes, a consultant with PricewaterhouseCoopers, “[London] remains the biggest foreign exchange market because of the ability to trade with east and west in the course of a normal business day” (Pooler, 2014). This time zone advantage cements London’s place as a world financial capital.

For China, which has only one time zone for its entire landmass, the study implies that its companies could experience an overall benefit from having smaller time zone differences since the aggregate effect of time zone differences is negative. It can also be assumed that China would benefit more from goods trade than from attracting more service trade with other time zones, since it would not receive the full potential benefit from the continuity effect of time zone differences that applies to the services industry, but would have reduced negative implications of the synchronization effect. Dettmer’s study found negative time zone effects for merchandise trade, stating that “merchandise trade significantly increases with the number of overlapping office hours between trading partners” (p. 240). So, when trading merchandise within the country or with nearby countries, China can use its single time zone to its advantage since office hours would be the same within the whole country and not far from those of surrounding countries in either direction. For instance, both employees at an office in the east of China and employees all the way in the west of China would experience a time difference of only an hour when communicating with someone at an office in South Korea to the east. China

also benefits from a weaker synchronization effect within its own country, since employees on either side of the country work the same hours, and do not have to make up for time zone differences by having an employee work late or come in early, which must be done between the East and West Coasts in the United States, incurring extra costs. Since China is the leading exporter in world merchandise trade (see **Table 2**), it is using its single time zone to its advantage. However, if China tried to increase service trade with countries in different time zones, it would not benefit as much from the continuity effect as it would had it been split into multiple time zones, since the benefits of the continuity effect increase with larger time zone differences. While China's single time zone may benefit it now as a complement to China's world rank as the top exporter of goods, if China wishes to avoid stagnation and keep up its economic growth by increasing its service trade, its time zone will impede it from reaping all of the potential benefits of the continuity effect.

The study impacts Australia in a similar way as it does the United States. Since Australia has multiple time zones, it could take advantage of time zone differences by trying to attract more service trade with countries in different time zones. The majority of Australia's economy comes from the services sector, but many of these services are commercial services, which do not receive as many benefits from the continuity effect as business services. However, Australia does have a sizeable business services sector, with the Australian Securities Exchange being the largest stock exchange in the South Pacific and having the ninth largest market cap in the world ("Listing on ASX", 2015). Thus, its multiple time zones would benefit its economy through the continuity effect if it increases its business services trade. Additionally, the study shows that daylight savings time differences also impact time zone effects. During certain times of the year, daylight savings time increases the time zone

differences between Australia and other countries. This would simply amplify the impact the continuity effect and synchronization effect had on time zone differences.

Table 1. Leading Exporters in Commercial Services, 2013**Leading exporters and importers in world trade in commercial services, 2013***(Billion dollars and percentage)*

Rank	Exporters	Value	Share	Annual percentage change
1	United States	662	14.3	5
2	United Kingdom	293	6.3	2
3	Germany	286	6.2	8
4	France	236	5.1	10
5	China	205	4.4	7
6	India	151	3.2	4
7	Netherlands	147	3.2	12
8	Japan	145	3.1	2
9	Spain	145	3.1	6
10	Hong Kong, China	133	2.9	6
11	Ireland	125	2.7	8
12	Singapore ^a	122	2.6	4
13	Korea, Republic of	112	2.4	1
14	Italy	110	2.4	6
15	Belgium	106	2.3	7
16	Switzerland	93	2.0	5
17	Canada	78	1.7	0
18	Luxembourg	77	1.7	8
19	Sweden	75	1.6	6
20	Denmark	70	1.5	6

Source: World Trade Organization, 2014

Table 2. Leading Exporters in Goods, 2013**Leading exporters and importers in world merchandise trade, 2013***(Billion dollars and percentage)*

Rank	Exporters	Value	Share	Annual percentage change
1	China	2209	11.7	8
2	United States	1580	8.4	2
3	Germany	1453	7.7	3
4	Japan	715	3.8	-10
5	Netherlands	672	3.6	3
6	France	580	3.1	2
7	Korea, Republic of	560	3.0	2
8	United Kingdom	542	2.9	15
9	Hong Kong, China	536	2.8	9
	domestic exports	20	0.1	-11
	re-exports	516	2.7	10
10	Russian Federation	523	2.8	-1
11	Italy	518	2.8	3
12	Belgium	469	2.5	5
13	Canada	458	2.4	1
14	Singapore	410	2.2	0
	domestic exports	219	1.2	-4
	re-exports	191	1.0	6
15	Mexico	380	2.0	3
16	United Arab Emirates b	379	2.0	9
17	Saudi Arabia, Kingdom of	376	2.0	-3
18	Spain	317	1.7	7
19	India	313	1.7	6
20	Chinese Taipei	305	1.6	1

Source: World Trade Organization, 2014

Chapter 5

Benefits and Costs of Individual Country's Time Zones

The United Kingdom

Benefits

The United Kingdom's time zone gives it strength as a financial capital. Since London's trading day starts around the same time that Tokyo's day is ending but before New York's day begins, the United Kingdom has a distinct advantage over the U.S. because London can trade with both Tokyo and New York in a day, while New York can only trade with London.

According to Christian Meissner, global head of corporate and investment banking at Bank of America Merrill Lynch, "if you're doing business in Asia and the emerging markets, London is much more convenient [than New York]. It has the time zone and is the most global" (Pooler, 2014). Its geographical position between American and Asian time zones makes London a leading financial center.

While the United Kingdom's time zone is advantageous to London and the country as a whole, some Britons want to change the time zone to make it correlate more with central Europe, specifically France and Spain, who fall between the same meridians as the United Kingdom but are in a time zone an hour ahead of it. This change would have an insignificant effect on the benefits the current time zone gives London as a financial capital, since its time would change to eight hours behind Tokyo and five hours ahead of New York, still coinciding with each of their

trading days. However, one benefit that proponents of the United Kingdom's current time zone argue would be lost with the adoption of Central European Time is that outdoor workers in northern England and Scotland would have to start their day later in the morning in order to work during daylight due to a later sunrise with Central European Time ("Change UK Time Zone", 2014). In addition to farmers, Scottish Secretary Michael Moore stated that "the majority of business and industry leaders in Scotland are against a shift to Central European Time," inferring that the United Kingdom's current time zone benefits businesses in Scotland (Bennett, 2010).

Costs

The opposing side argues that adoption of Central European Time would be beneficial for the United Kingdom in that it would align them with the rest of Europe. They also argue that the extra daylight experienced in the evenings with the adoption of Central European Time would lead to lower greenhouse gas emissions, fewer car accidents, and economic benefits like a larger leisure and tourism industry, which would all boost the economy ("Change UK Time Zone", 2014). While politicians are currently fighting for a switch to Central European Time, the United Kingdom did switch the clocks forward to align with Central European Time in the past. In March 1968, clocks in the United Kingdom moved forward an hour as usual for British Summer Time, the United Kingdom's equivalent of Daylight Savings Time. However, instead of switching back in October as they normally would, Harold Wilson's government decided to implement British Standard Time for the whole year (Fyall, 2011). The clocks were not switched back until October 1971, and the country's time was more closely lined up with most of Europe for three years. Analysis of data after the time change experiment by the Department for

Transport found that there were more car accidents in the mornings since they were darker but less car accidents in the lighter evenings, and, overall, there were an estimated 2,500 fewer people killed or seriously injured during the first two years of the change (Fyall, 2011). The analysis found that those living in central England or southern Scotland saw the most advantages from the time change, but those living in northern Scotland were actually at a disadvantage, as they experienced a net increase in the number of people killed or seriously injured (Bennett, 2010). Since much of the United Kingdom saw a net benefit from the experiment, and because of the other benefits listed above, several members of Parliament are still arguing for a change but have faced opposition from other members of Parliament and the Scottish government, which believes it would have a negative effect on road safety since Scotland would experience darkness later in the mornings. Some farmers are open to the time change, though, and Scott Walker, the policy director at the National Farmers Union of Scotland, said they are not opposed to the time change but would need more relevant data (Bennett, 2011). While switching to Central European Time may be beneficial for some parts of the United Kingdom, it seems that neither that time zone nor the United Kingdom's current zone is ideal for all of its citizens.

The United States

Benefits

Since the contiguous United States has four time zones, it benefits by experiencing the continuity effect for services within its own country. If an employee is working on a service in New York City and the day ends, an employee at an office location in San Francisco can still work on it for another three hours without having to work beyond normal office hours.

Additionally, the United States' multiple time zones are beneficial since the East Coast of the United States has a smaller gap in time zones with European countries while the West Coast has a smaller gap in time than the East Coast with Asian countries, allowing it to have beneficial time zone differences with both areas on different sides of the country.

Costs

While many United States citizens may see the contiguous United States' four time zones as the most beneficial time zone system, there are other options that some people believe could be better for the United States. The United States could consider having fewer time zones or even one single time zone, like China, a similarly sized country. The United States practices Daylight Savings Time in all states but Arizona and Hawaii, yet there are many opponents of Daylight Savings Time. Some of these opponents propose not only eliminating Daylight Savings Time, but also eliminating two of the United States' time zones in the process, bringing it more on par with China's time zone system (Schrager, 2013). Allison Schrager, an economist and writer, believes that Americans would benefit by combining the time zones of Pacific Standard Time and Mountain Standard Time into one time zone and combining Central Standard Time and Eastern Standard Time into another time zone. Schrager, who commuted between New York and Austin for three years, believes that people living on Central Standard Time already do things at the same time as those living on Eastern Standard Time. According to Schrager, "I found that in Austin, everyone did things at the same time they do them in New York, despite the difference in time zone. People got to work at 8 am instead of 9 am, restaurants were packed at 6 pm instead of 7 pm, and even the TV schedule was an hour earlier. Research based on time use

surveys found American's schedules are determined by television more than daylight. That suggests in effect, Americans already live on two time zones" (2013). Additionally, many people already coordinate their work days around other time zones, such as Californian traders working around New Yorkers' schedules. Schragger also believes that two time zones could eliminate bi-coastal jet lag (2013). However, a 1996 study by Paulson found that jet lag symptoms only "become important with time zone changes of 5 hours or more" (Dettmer, 2014, p. 228), so jet lag from a time zone change of three hours may not be that much different than jet lag from a time zone change of one hour. While moving the United States from four time zones to two time zones could normalize some employees' work hours and make more convenient television schedules, it would also make the East Coast have a greater time gap with European countries and create misalignment between the United States and its neighbors. It seems that the costs of having four time zones are not as large as the costs of only having two time zones.

China

Benefits

China's time zone differs from most countries around the globe in that it has a single time zone for a large land mass. Proponents argue that there is good reason for utilizing only one time zone. One benefit it provides is transportation schedule uniformity, which makes traveling more seamless as companies and travelers do not have to worry about time differences. Additionally, business and governmental coordination increases efficiency across the country as everyone is experiencing the same time zone and working the same hours. For political reasons, China benefits from one time zone by enforcing the authority of the central government. According to

Hassid and Watson (2014) who studied the effects that time zones and other symbols had over centralization in China, “control over time zones represents an example of ‘symbolic centralization,’ the degree to which the central state concentrates intangible or symbolic resources that reinforce and assert state control, often invisibly, over people’s everyday lives”. The Chinese Communist Party uses its control of the time across the entire country to show how powerful it is. By using Beijing time across the whole country, it reinforces that Beijing, and the capital, control all of China. The government also increases nationalism by having everyone fall into one standard time zone, instead of certain areas of the country differing in time from others. Hassid and Watson found that “hourly reinforcement in the countryside and in distant cities alike of Beijing’s temporal primacy helps reinforce national unity under an all-powerful central government”, showing that the benefits to the Chinese government of their country’s single time zone may be more political than economic.

Costs

While China’s single time zone increases uniformity across the country, this uniformity causes multiple issues. Since there is only one time zone across a vast area, set to Beijing time in the East, inhabitants in the western part of China have to get up before the sun rises and go to sleep before it sets during most parts of the year in order to satisfy a regular work day (Schiavenza, 2013). Citizens in the far west of China experience sunrise three hours later than in Beijing, while citizens in the easternmost part of the republic experience it an hour earlier than Beijing, yet all of these areas share the same time. This difference in sunrise could pose a problem to farmers who wish to work their land during natural hours of daylight or cause sleep

problems by forcing people to adapt unnatural sleep patterns. Some towns which experience no correlation between timing and sunlight because of Beijing time even choose to run their day on a different schedule, starting work at 10 am, for instance (Demick, 2009).

Many economic effects are avoided by towns' adaptation of their working days to a different schedule than the normal 9-to-5 work day. However, China's single time zone also faces political criticism. Some minority groups feel that the forced single time zone takes away their culture and undermines their local autonomy, so they choose to follow their own time. In Xinjiang province, in the northwest of China, the Uighurs, a large minority of Muslim people, opposed following Beijing time, as it would have them waking long before the sun rose and going to sleep before the sun set. So, they follow their own unofficial time, two hours before that of Beijing time, which aligns them more with the sun. A former Uighur inhabitant of Xinjiang, Alim Seytoff, described the use of Beijing time in Xinjiang as being "as ridiculous as having Los Angeles follow New York time" (Demick, 2009). Inhabitants of the province, and cities within it such as Kashgar, use one of two time zones, Beijing time or Xinjiang time. Although there are two time zones two hours apart in one city, most say it is not confusing. The majority of government-run programs and transportation systems use Beijing time, although many buses use Xinjiang time (Schiavenza, 2013). Most Uighurs do not communicate with the Han Chinese population since there are cultural differences in addition to a time zone divide between them. If they do meet with the Chinese, local Uighurs say they tell them to meet at Beijing time and tell Uighurs to meet at Xinjiang time (Demick, 2009). However, the independent time zone has caused political issues in the past. In 1968, the Communist Party secretary for Xinjiang ordered Uighurs to use Beijing time and not their own time. However, the Chinese government could not implement the law and conceded that the unofficial time could be used in a 1986 notice (Demick,

2009). Since many Uighurs feel repressed, as the government restricts their practice of Islam and studying in their language, many look at the use of their own time as a “psychological tool for independence”, according to writer Ruth Ingram (Schiavenza, 2013). Most Chinese adapt to their unitary time zone, either running their work day on a different schedule than is standard or, in the Uighurs’ case, creating their own time system. Thus, the single time zone does not bring many economic costs to China, since its citizens often incur political costs for the country.

Australia

Benefits

Since some Australian states practice Daylight Savings Time while others do not, Australia has three time zones for half of the year and six time zones for the other half. Some critics believe that Australia should relieve itself of Daylight Savings Time, but others argue that there are benefits to Daylight Savings Time. Proponents of it believe that Daylight Savings Time increases tourism, since the extra hour of daylight makes people stay out later and spend more. The government of New South Wales, which practices Daylight Savings Time, reported that “an extra four weeks of Daylight Savings Time would boost retail and tourism” (Back, 2015).

Additionally, Australia’s time zone benefits from its closeness in time to China and other Asian countries. While Australia was vying for the 2022 World Cup, its opponents believed it to be a weak contender as its large time difference with Europe and the United States would cause games to be played while Europeans and Americans were sleeping. However, Asian countries would be in waking hours while the games were being played, and the growing Asian markets rival the European ones. A study that Australia commissioned from PricewaterhouseCoopers for

the potential World Cup found that “India’s and China’s burgeoning middle classes will be four times larger than that of the United States by 2020, and that there is a direct correlation between growth in a middle class and sponsorship, satellite TV subscriptions and purchasing power” (Silkstone, 2010). Additionally, it found that the continent where the 2006 World Cup was most viewed was Asia (Silkstone, 2010). While this time zone difference has more to do with geography than the formation of time zones, Australia’s time zones may benefit from the growing Asian markets, regardless of Daylight Savings Time or its odd half-hour time zone differences.

Costs

Australia’s time zones are full of quirks, with half hour time-zone differences and inconsistent daylight savings time changes. Because of these inconsistencies, many Australians wish to change their time zones to eliminate confusion. The South Australian Premier, Jay Weatherill, has proposed looking into changing the state’s time zone (Back, 2015). The South Australian time zone, with a half-hour difference from the eastern states and an hour-and-a-half difference with Western Australia, costs South Australia both socially and economically. The time zone gives residents minor social inconveniences, such as spoiling television shows or delaying sports games. More importantly, though the time zone inconveniences businesses. According to Martin Hamilton-Smith, the South Australian Minister for Investment and Trade, the time zone causes issues as “businesses doing business in the eastern states do find some difficulty with [the] half hour time gap. Some investors have raised this with us from overseas,

that it just seems odd, why aren't we either lined up with the eastern states or, alternatively, lined up with a one hour meridian" (Back, 2015).

Another consequence of Australia's time zone which it experiences is the time differences between it and Europe. Although this issue relates more to the distance between Australia and Europe than Australia's quirky time zones, it does cost the country. The large time difference between the countries means much of Europe is asleep during Australia's waking hours. Thus, when Australia bid for the 2022 World Cup, this time zone difference was thought to hurt Australia's chances, as much of Europe would be asleep while the games were being played. During the 2006 World Cup, the last before the bidding took place, Europe had been the largest TV market in dollar terms (Silkstone, 2006). Not being able to air the games during reasonable times for the European market would then hurt the revenues of the World Cup.

Chapter 6

Conclusion

Time zones have a brief existence and, since they first began being formulated, towns, cities, and, ultimately, countries have attempted to discover the ideal time zones for their areas in a political, social, and economic sense. While a standard set of meridians exists around the globe, each country still has its own authority over its system of time zones, which explains why the resulting world time zones are often jagged and incongruent. This thesis sought to study the time zones of the United States, the United Kingdom, China, and Australia, and to determine their economic effects through broad economic research on trade between different time zones and specific research on the strengths and weaknesses of each individual country's time zone, concluding on whether or not each country's time zone was the best economic fit for it. Since political authority determines time zones, most of the advantages or disadvantages that citizens observed regarding their countries' time zones were more political or social than economic. Economic implications of the time zones mainly consisted of global effects from trade in time zone differences found in economic research. The synchronicity effect and the continuity effect greatly impact goods and/or services trade in different time zones and thus influenced each of the targeted countries.

Overall, most of the examined countries' time zones are economic fits for them, although future economic changes or political and social implications may cause different time zones to be better overall choices for these countries. The current time zone system in the contiguous United States of four standard time zones fits its economy by allowing it to take full advantage of the

continuity effect when exporting services, of which it is the world's largest exporter. Opponents of the United States' time zones encourage a switch to two time zones to allow standard work days to be more similar on opposite coasts and schedules in neighboring time zones to coordinate more. This proposed change may enable some employees on the West Coast who must often communicate with those on the East Coast to work more normal hours, but it would lessen the advantages the United States reaps from the continuity effect, since the most noticeable benefits of this effect come through exporting service work to countries with which the United States has larger time zone differences. Additionally, making the schedules the same between neighboring time zones in each half of the country would give inhabitants social benefits such as aligned television schedules, but would have minimal economic benefits. As the United States has moved in the past century from less of a manufacturing-based economy to more of a service and technology based economy, its economy should be more concerned with the implications of the continuity effect on time zones, which only applies to services, than the synchronicity effect of time zones, which applies to both goods and services. While the synchronicity effect infers that increased time zone differences have a negative effect on goods trade, the continuity effect brings an overall positive economic effect to increased time zone differences in services trade. The United States' multiple standard time zones allow it to benefit from the synchronicity effect in its significant international trade of services. It is taking advantage of this effect through the exporting of its services to countries with which it experiences large time zone differences, like India, and should look to trade services with more countries in distant time zones to further benefit from this effect.

Of all the time zones studied, the United Kingdom's time zone seems to be the most beneficial to its country. London, its capital, is one of the leading financial centers of the world,

and it could be argued that this would not be the case if not for its advantageous time zone. The United Kingdom's time zone is fairly distant from the time zones of Asian countries and the United States, but not distant enough that it would not share working hours with them.

Fortunately, the United Kingdom's time zone makes it so that the beginning of London's trading day coincides with the ending of the trading day in Tokyo, another world financial center, and falls a few hours before the opening of the trading day in New York, the other largest financial center. London is the only one of these three cities that shares a trading day with both of the others, so it experiences a gain from its time zone. Because of London's standing as a world financial capital, the United Kingdom is a large exporter of financial services. Since the United Kingdom has large time zone differences with many countries it exports to, it can take advantage of the continuity effect when exporting its services.

While the United Kingdom's time zone aids its capital city in remaining a world financial center and rewards it with the economic benefits of the continuity effect, some citizens and politicians wish to switch their time zone an hour forward to Central European Time, aligning it with the time zones of France and Spain, among other of its European Union peers. This change would still allow the United Kingdom to share a trading day with both Tokyo and New York, and to experience large enough time zone differences with trading partners to benefit from the continuity effect. The small switch of an hour would give most of the United Kingdom extended daylight in the evenings, which could lead to lower electricity bills and increased spending in leisure and tourism, giving the economy a boost. It could also result in fewer deaths from car accidents, as the United Kingdom experienced a minimal decrease in these deaths when it experimented with the change in the late 1960s. However, it would also cause a later sunrise in parts of northern England and Scotland, hurting the productivity of outdoor workers in these

areas of the United Kingdom. Even if the benefits of a switch to Central European Time outweigh the costs of it, the economic implications of the United Kingdom switching its time zone are minimal, and its current time zone is still advantageous economically. British hesitation to change time zones may be more political than economic, though. Keeping its time zone sets the United Kingdom apart from much of the rest of the European Union and cements its place as a world power, since all of the standard meridians of time are based off of the Prime Meridian in the United Kingdom. A switch away from Greenwich Mean Time would remove the United Kingdom from its place as the center of time-keeping and bring it minimal economic benefits, if any.

China's single time zone, while different than that of similar-sized countries, such as the United States, is currently an economic fit for it since its economy is also different from that of the United States. Because China is more of a goods exporter than a services exporter, its international trade would experience more of the synchronicity economic effect from time zone differences than the continuity effect. The synchronicity effect has a negative effect on both goods and services trade as time zone differences increase, whereas the continuity effect brings a positive effect to increased time zone differences in services trade. Since China only has one time zone for the whole country, time zone differences between it and another country are smaller than they would be for the United States and an equidistant trading partner, since the United States has to account for time zone differences within its own country. China's unitary time zone allows it to be closer in time to its neighbors on either side of its large land mass. This means Chinese businesses will experience less coordination problems with sleeping business partners since their working hours are closer to each other, leading to reduced costs from the synchronicity effect. Most developing economies, like China, start out with a manufacturing-

based economy and evolve to increase their trade of services, like the United States. If China's economy develops into a more service-based economy, their system of time zones will have a less positive economic effect. They will still benefit from decreased negative implications of the synchronicity effect, but will see little positive implications of time zone differences in services trade from the continuity effect. The continuity effect makes large time zone differences overall favorable for services trade, and China's economy will find itself unable to take full advantage of these benefits since its single time zone will make time zone differences smaller with its trading partners than they would be if it developed its system of time zones off of the standard meridians. Economically, if China's economy increases its services trade, it would do well to consider altering its time zone system. However, economic implications are not the only considerations behind China's time zone. The Chinese government also has political motives for sustaining its single time zone, and many of the negative effects observed by citizens are political. While Beijing time causes political tension for minority groups in cities distant from the capital, using the capital's time for the entire country emphasizes the Chinese Communist Party's central authority, and could cause China to sustain its single time zone system even if multiple time zones would be more beneficial for the economy in the future.

Australia benefits economically from having multiple time zones as it can take advantage of the continuity effect when trading services. Australia should have several time zones separating the western, central, and eastern parts of the country, but it should alter its time zones so it uses time zone differences of an hour instead of a half-hour or ninety minutes. These unique current time zone differences hurt Australia economically by causing confusion with businesses and foreign investors, impeding business. Changing to time differences of an hour would make it easier for both foreign investors and domestic companies to do business in Australia. Australia's

time zone has led to negative economic effects in the past for reasons outside of the government's control, since Australia's geographic location causes it to have large time differences with European countries and the United States. As Asian countries continue to develop, Australia could take advantage of its time zone by increasing goods trade with these countries. Since it has a small time zone difference with these countries, it would see decreased negative synchronization effects of trade. Conversely, Australia can use its multiple time zones to its benefit by increasing service trade with countries in further time zones and taking advantage of the positive continuity effect. By taking advantage of these opportunities and switching to time zone differences of an hour, Australia could see positive economic effects of its time zones.

WORKS CITED

- "Astronomical Society of South Australia." *A Brief History*. 1 Jan. 2015. Web. 23 Mar. 2015
- Back, Alexandra. "Explainer: South Australia Time Zone Change." *ABC Broken Hill*. N.p., 05 Feb. 2015. Web. 15 Feb. 2015
- "Banged About; London as a Financial Centre. (The Past and Future of the City)." *Economist* 29 Oct. 2011. Print.
- Bennett, Magnus. "A Question of Time: Changing the Clocks." *BBC News*. BBC, 29 Oct. 2010. Web. 03 Apr. 2015.
- "Change UK Time Zone." *GreenwichMeanTime.com*. 9 Apr. 2014. Web. 23 Mar. 2015.
- Demick, Barbara. "Clocks Square off in China's Far West." *Los Angeles Times* 31 Mar. 2009. Print.
- Dettmer, Bianka. "International Service Transactions: Is Time a Trade Barrier in a Connected World." *International Economic Journal* 28.2 (2014): 225-54. Print.
- Fyall, Jenny. "Mixed Results from 1968 Experiment." *The Scotsman* 29 Oct. 2011: 5. Print.
- Hassid, Jonathan, and Bartholomew C. Watson. "State of Mind: Power, Time Zones, and Symbolic State Centralization." *Time Society* (n.d.): n. pag. 6 Mar. 2014. Web. 5 Apr. 2015.
- Kikuchi, T., and N. Van Long. "A Simple Model of Service Offshoring with Time Zone Differences." *North American Journal of Economics and Finance* (2010): 217-27. Web. 5 Feb. 2015.

Kimmel, Leigh H. "Time Zones." *Historical Encyclopedia of American Business*. Vol. 3.

Pasadena, CA: Salem, 2009. 853-54. *Gale Virtual Reference Library*. Web. 15 Feb. 2015.

"Listing on ASX." ASX. Australian Securities Exchange, 2015. Web. 5 Apr. 2015.

Pooler, Michael. "New York and London Vie for Crown of World's Top Financial Centre."

Financial Times 1 Oct. 2014. Print.

Schiavenza, Matt. "China Only Has One Time Zone—and That's a Problem." *The Atlantic*.

Atlantic Media Company, 05 Nov. 2013. Web. 01 Apr. 2015.

Schrager, Allison. "Daylight Saving Time Is Terrible: Here's a Simple Plan to Fix It." *The*

Atlantic. Atlantic Media Company, 01 Nov. 2013. Web. 01 Apr. 2015.

Silkstone, Dan. "Australia Parries Time-zone Argument with Cold, Hard Stats Showing Asia Is

the Plum." *The Sydney Morning Herald* 1 Dec. 2010: n. pag. Print.

"Time Zones History." *Time Zones History*. N.p., 09 April 2014. Web. 15 Feb. 2015.

Tomasik, Rebecca. "Time Zone-related Continuity and Synchronization Effects on Bilateral

Trade Flows." *Review of World Economics* (2013): 321-42. Print.

ACADEMIC VITA

AMY L. BUCKLEY

alb5713@gmail.com

(484) 798-5821

118 W. Nittany Ave.
State College, PA 16801

634 Marydell Dr.
West Chester, PA 19380

EDUCATION

The Pennsylvania State University, Smeal College of Business University Park, PA
Schreyer Honors College Class of 2015
Bachelor of Science and Master of Science in Accounting; Minors in French and International Business
Study Abroad, IES Paris: French Studies Program Paris, France
Fall 2012

WORK EXPERIENCE

PricewaterhouseCoopers, Assurance Intern New York, NY
Jan 2014 – Mar 2014

- Assisted two engagement teams on insurance clients with their filings of Form 10-Ks
- Completed testing of claims, premiums, intercompany accounts, accounts payable, and accounts receivable
- Prepared lead sheets, legal letters, and client interview questions
- Worked with client in interviews to obtain supporting documentation for testing

Independence Blue Cross, Intern Philadelphia, PA
Jun 2013 – Aug 2013
Jun 2012 – Aug 2012

- Aided in creating a new template to expand current deferred billing process
- Implemented new system to calculate Medical Loss Ratio premiums data
- Completed monthly account reconciliations, journal entries, and pre-funded billing write-offs using PeopleSoft software
- Collaborated with fellow interns to develop and present a more efficient check authorization process

A.P. Lubrano & Company, Intern Lionville, PA
May 2011 – Aug 2011

- Created presentations and spreadsheets detailing retirement plans for 12 companies
- Designed an informational pamphlet for use in recruiting potential clients
- Demonstrated communication skills through participation in conference calls updating companies on retirement plans

CubeSmart, Customer Service Agent Wayne, PA
May 2011 – Aug 2011

- Answered phone calls from CubeSmart's 400-plus national locations
- Utilized customer service skills and knowledge of organization to efficiently provide information and increase sales
- Implemented company's methods and protocol to resolve customer issues independently

ACTIVITIES

Schreyer Honors Orientation, Mentor University Park, PA
Aug 2011 – Present

- Organized registration activities for all incoming scholars
- Guided 15 incoming honors freshmen through orientation activities and led question-and-answer sessions for these students

Delta Sigma Pi Professional Fraternity, Member University Park, PA
Feb 2011 – Present

- Marketed business fraternity to potential members through student activity fairs and private rush events
- Improved professional and networking skills through mock interviews, resume workshops, and corporate events
- Participated in service events, including a free vaccine clinic at local animal shelter, spaghetti dinner fundraiser for local charity, and Penn State Dance Marathon fundraising

Global Business Brigades, Member University Park, PA
Aug 2010 – Present

- Raised money to pay for eight-day trip to Panama through fundraisers such as bake sales and online drives
- Developed accounting systems and marketing campaigns for local Panamanian restaurant and convenience store
- Worked through cultural barriers to teach business skills and explain new systems to Tulé speaking local inhabitants

Penn State Dance Marathon Operations Committee, Member University Park, PA
Oct 2010 – Feb 2012

- Planned and carried out strategies to raise approximately \$4,000 for pediatric cancer
- Displayed effective time management by efficiently preparing Bryce Jordan Center for event and cleaning the venue afterwards
- Oversaw building maintenance and cleanliness with a team of thirty students during the 46 hour dance marathon
- Organized committee's creation of mail to inspire children during event

Sapphire Leadership Program, Member University Park, PA
Aug 2010 – Present

- Asked to apply and accepted to 80-member organization, representing top 8% academically of Smeal class
- Completed professional development, leadership development, fundraising, and community service events every semester