Teaching Exchange Rate Modeling with a Classroom Project

This paper describes a project developed for an undergraduate International Economics course. Students are organized into groups, and each group is assigned one country. Each group must research basic facts about the country, collect data on its economy, and analyze the predictions from purchasing power parity and interest rate parity using the collected data. Students report their findings in writing and in a class presentation. This project gives students practical experience in collecting and analyzing economic data, teaches them about different countries, and facilitates new connections among students.

Evelyn Nunes†

†University of Essex

1. Introduction

Exchange rates can be a challenging concept for many undergraduate students. It is often taught alongside complex subjects such as arbitrage and monetary policy, and some students have never encountered it in practice. To facilitate learning and motivate students, this assignment helps them connect with the class material and test theoretical models using real-life data.

This paper describes an assignment conducted in an undergraduate International Economics course during Fall 2022 and Fall 2023 at Virginia Commonwealth University. The goal of the assignment is for students to gain a deeper, practical understanding of the theoretical foundations and key principles of Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP). Students need to conduct empirical research to examine how these models hold up in practice and explain deviations from their predictions. Students work in groups, each assigned a different country. Each group collects data on their country's economy, produces graphs, and analyzes the results. In the end, each group explains their findings in a classroom presentation and submits a written report. Instructors can provide students with guidelines and two FRED® blog posts as resources.

This assignment was successful among students. Based on a class survey, almost 90% of the students who answered the survey reported positive feedback on having to complete this assignment, and two-thirds reported that the assignment resulted in new friendships. Students scored higher on exams in the semesters when the project was implemented, but the difference was statistically significant only for lower-grade students.

Overall, this project facilitates student learning, by helping them connect theoretical models to the data, and allowing them to practice their analytical and social skills. The next section discusses the literature on this type of assignment, Section 3 explains the project's design, and Section 4 describes how the project can be implemented. The last section provides some final remarks.

2. Literature Review

The literature contains multiple assignments on international economics, several of which are on teaching comparative advantage (e.g. Haupert, 1996; Isgut et al., 2005; Atkeson and Burstein, 2007). Since this project is on exchange rate and its models, this section will focus on articles that describe assignments on that topic.

Butler and Kwok (1994) describes a foreign-exchange market simulation game. Students need to use arbitrage and interpret the impact of current events on foreign exchange rates. Hazlett and Ganje (1999) also has students assume the roles of foreign exchange traders, but in a developing country with two parallel markets for the domestic currency. Students learn about the effects of exchange rates on international trade and supply and demand, and the authors include suggestions for modifying it for different courses.

Johnson (2010) describes a computerized classroom experiment that replicates a standard two-good, two-currency trade model, in which students trade with each other while deciding prices and exchange rates. The author reports that students were enthusiastic about the game, and most teams improved on autarky outcomes.

Mitchell et al. (2009) describes an experiment that teaches students about the link between exchange rates and purchasing power parity, similar to my project. Students represent citizens from different countries and need to obtain currency through an auction to purchase

wheat. The goal is to buy as much wheat as possible, and different concepts can be added, like tariffs and non-tradable goods.

There aren't many examples of projects that teach about interest parity, but Marshall (2004) developed a simulation for teaching triangular and covered interest arbitrage, the latter by having students choose a bank to hold their deposit and then trade a forward contract. Students need to identify arbitrage opportunities.

Some projects in the literature span multiple classes. Johnson (2018) conducts an experiment in which students are split into teams that trade foreign currencies at the end of each class, with the balances carried over to the next class. The teams need to predict future exchange rate changes based on international events that happened between classes. While Faulk et al. (2010) describes a project that combines finance and exchange rates, and uses a 12-week simulation. Students receive an endowment to buy assets, and are encouraged to diversify across different countries. This leads to discussions on the PPP and the role of arbitrage.

These projects have in common the fact that they use a classroom experiment in which students either trade currencies or try to predict exchange rates. The project presented here adds to the literature by having students develop their analytical, interpersonal, and data visualization skills. Students have to collect and interpret real-life data to compare with the predictions of exchange rate models such as the PPP and UIP. Students also acquire a more in-depth knowledge of the countries they are researching about, and practice team-work and verbal communication. The following section contains a detailed description of the project.

3. Project Design and Key Concepts

The goal of this project is to help students better understand exchange rates and their models, while analyzing real data. The assignment was designed as a group project, but it can be done individually depending on class size. One can split students into groups of 3-5 members, each representing a predefined country selected by the instructor. This can make grading more manageable and also provide students with the opportunity to interact with their peers and practice teamwork skills. The list of countries can change from one semester to another, and students can either self-select into the group they want or the instructor can create the groups. But there is a benefit to the instructor selecting the list of countries to ensure sufficient diversity.

In order to gain a more general knowledge of the economic context of their country, each group should collect some basic economic data, shown in Table 1.[1]

Table 1: Country's Data

Basic Information	Economy	International Trade
Continent	Exchange Rate Regime	Top Exports
Flag	GDP growth rate	Top Imports
Map	Inflation Rate	Top Trade Partners
Language	Unemployment rate	Balance of Trade
Currency	Interest Rate (official)	Exchange Rate

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[1]The instructor can suggest the OEC website (Simoes and Hidalgo, 2011) for the trade data.

In addition to the aforementioned information, each group should create a time-series graph with actual imports and exports. This step allows for discussions of trade surpluses and deficits, and whether they changed over time.

Absolute PPP states that a basket of goods must cost the same at home (H) and in a foreign (F) country when expressed in a common currency: $E_{H/F} \times P_F = P_H$.[2] This result only holds under the assumption of negligible transportation and trade costs, and perfect competition, so there is only empirical evidence of this parity in the long run. To test for this result, students need to collect several years of data on a price index for the foreign country and the US, as well as the exchange rate between them, and analyze the results.

Similarly, UIP states that the return on home deposits should equal the foreign return plus the expected depreciation of the home currency. This result can be approximated to $i_H = i_F + \%\Delta E_{H/F}^e$, where *i* is the interest rate on deposits. For this part, students need to collect data on interest rates as well.

The discussion of PPP and UIP exchange rate predictions should also use graphs, and it is beneficial to set an earlier deadline for preliminary feedback. To guide and facilitate this discussion, provide students with two posts from the Federal Reserve Economic Data (FRED) Blog. Faria-e Castro and Jordan-Wood (2022) discusses UIP between the Dollar and the Euro from 2000 to 2022, while Panizza (2022) discusses the evidence of PPP in the long run between Switzerland and the US. Alternatively, depending on the major and background of students, the instructor could ask for a time series of the exchange rate, with a discussion on how it connects to the exchange rate regime in the country. A lesson plan is provided in Appendix A that serves as a teaching guide to implement the project.

The FRED® website is a useful resource for this project since it gathers data from over 100 sources, and it allows you to compile a graph directly on its platform. It also allows for transformations (like division and inversion) using any data series. Students then benefit from learning a tool that can be useful in other courses, and even in their careers. Sample instructions can be found in Appendix B.

Lastly, all groups should prepare a written report to submit, and give a 5-minute presentation on their findings. The presentations could be skipped if class time is a constraint, but they provide practice in important skills and allow students to learn about the results of other countries as well.

4. Project Implementation

My international economics course used a hybrid modality with a video tutorial, an in-person class, and a homework assignment each week. There were also 4 exams throughout the semester, with the third exam covering all the material on exchange rates. In the first semester of the project (Fall 2022), Exam 3 occurred before the presentations, so it was unclear whether the project could affect students' performance. Some students started working on the project before the exam, but not all did. The second time the project was assigned (Fall 2023), the presentations scheduled before the third exam, with the goal of helping them prepare for it. This seems to be the best timing for the project.

As mentioned in the previous section, students had to do a presentation and submit a report explaining their findings. Students did a good job researching their countries and discussing the trade data. However, not every group provided a clear explanation of whether

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[2] $E_{H/F}$ denotes the price of one unit of the foreign currency expressed in units of the home currency.

PPP or UIP held in the long run based on the data they presented. Moreover, even though they were provided with sample graphs from FRED® that they could customize and compare, not all graphs were correct. The second time the project was required for this course, there was an earlier deadline for students to submit only the graphs to get feedback sooner. The additional deadline did not eliminate the problem, but it did improve the final result. In addition to that, all groups benefited from each other's presentations and explanations, and many noticed their mistakes during the presentations and corrected their work before submitting the final report. A working example of a group report is provided in Appendix C. This report serves as a reference for a well-done project, even though the report was not perfect (some dates were missing and some explanations were not complete), it was clear, well-organized, had correct graphs, and included all the information requested.

In order to investigate the academic effects, if any, of the introduction of the project, both semesters where the project was assigned (Fall 22 and Fall 23) were compared with the previous one without it (Spring 22).[3] As Table 2 shows, Exam 3 grades had an overall improvement across the semesters. However, the midterm grades, which were their course average halfway through the semester and before Exam 3, were also higher for the semesters with the project.

Table 2: Summary Statistics

Semester	Class Size	Project	Midterm Average	Midterm Variance	Exam 3 Average	Exam 3 Variance
Fall 2023	38	Yes	79	215	76	283
Fall 2022	32	Yes	77	250	73	431
Spring 2022	25	No	70	240	70	398

Performing a two-sample t-test on the midterm average shows that the Spring 2022 average was statistically lower than Fall 2022 and Fall 2023 averages at 7% and 2% significance level, respectively, indicating that the former was a weaker cohort from the beginning. However, when Exam 3 averages are compared, the difference in means is not statistically significant across semesters, suggesting no effect from the project.

However, if we compare the students who received below 80% (C, D, and F grades), the result shows that Fall 2023 had a statistically significantly higher Exam 3 average than Spring 2022, while the difference in the midterm average between the groups was not significant. This finding suggests that the weaker students were similar across semesters, but performed better on Exam 3 when the project was added before the exam.

Figure 1 shows the grade distribution on the third exam while comparing Spring 2022 (no project done), Fall 2022 (project done after Exam 3), and Fall 2023 (project done before Exam 3). The share of A and B grades was similar across all semesters, but there was an increase in the share of Cs that resulted from a decline in D and F scores.[4] So even though the project didn't have a significant impact on the overall score, it helped the lower grade students.

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[3]All homework assignments were the same across these semesters, and Exam 3 was very similar, with just the numbers and the bonus question in Spring 22 being different.

[4]A/B means above 80%, C means between 70-79%, and D/F means below 69%

Figure 1: Exam 3 Grade Distribution
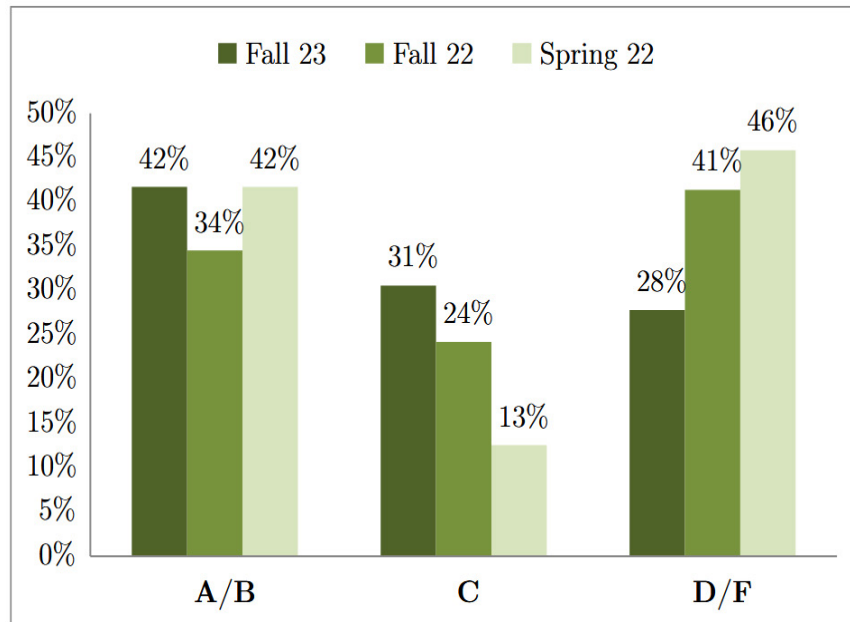
After the completion of the project, an anonymous survey was sent to all students. During Fall 2022 semester, there were 32 enrolled students, but only 9 replied (28% of the class). Among those students, only one (11%) would rather not have a group project, and 67% said they made new friends while working on the project. For Fall 2023, there was a 32% response rate, only 25% of the participants said they would rather not have the project, and 83% said they had made new friends. Based on the surveys, the project was overall successful among students.

5. Final Remarks

The goal of this project was to help students develop a deeper understanding of exchange rates and the theoretical concepts behind PPP and UIP. It also provided students with an opportunity to develop their data analysis, group work, and presentation skills. Students gained practical experience in collecting and analyzing international data, learned about different countries, and cultivated new friendships.

Nevertheless, the performance and understanding were not uniform, and some students would benefit from more detailed explanations of the graphs, which can be given in-class or during office hours. Also, a few countries presented challenges in terms of data availability, and some groups struggled to coordinate meetings in a timely fashion.

Overall, the project was a positive addition to the course. This is a relatively low-cost intervention that can provide academic benefits and enhance students' experience with the course and subject matter.

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Appendix A. Lesson Plan

Lesson Plan: Teaching Exchange Rate Modeling with a Classroom Project

Target Audience: Undergraduate students in International Economics or related courses

College Board Advanced Placement Topic: AP Macroeconomics

Unit: Open Economy-International Trade and Finance

Topics: Exchange rates and the foreign exchange market, Real interest rates and international capital flows

Objectives: Enable students to connect theoretical concepts of PPP and UIP with real-world data; Develop students' ability to collect, analyze, and interpret economic data; Foster teamwork and collaborative research skills

Materials Needed: Access to data sources (e.g., FRED, OEC website, Google), Graphing tools/ software (Excel, Google Sheets, FRED, etc.)

Lesson Duration: Multi-week project (spread across 2-4 weeks, depending on class frequency)

Direct Instruction

1. The instructor can divide students into groups of 3-5, each representing a predetermined country (select countries with different currencies and economic status). Alternatively, have students self-select into the groups.

2. The instructor should explain the project outline, deliverables, and deadlines. A sample of my own instructions can be found in Appendix B.

3. During class, the instructor will cover the basics of exchange rates, present the concepts of PPP and UIP using examples, and discuss long-run predictions.

4. The instructor should define a date for presentations following the course content schedule.

Guided Practice

1. The instructor should discuss the articles Panizza (2022) and Faria-e Castro and Jordan-Wood (2022), and use their graphs as an example of how to create graphs to analyze exchange rate predictions of PPP and UIP.

Independent Practice

1. Each group collects basic economic data for their country (see Table 1), trade data, and creates a time series graph on real imports and exports.

2. Students should read Panizza (2022) and Faria-e Castro and Jordan-Wood (2022) to understand practical applications of PPP and UIP, and how to create the graphs.

3. Students submit preliminary graphs for instructor feedback at least 1 week before presentations.

4. Groups plan a presentation of their findings and prepare written report.

Conclusion

1. Each group presents their findings, including their time series graphs and analysis of PPP and UIP. Each group has 5 minutes for the presentation.

2. Each group submits a written report on their findings as well.

3. The instructor can conduct a survey to evaluate student perception and project impact.

Assessment

Participation and engagement in group activities. Quality and accuracy of data collection and analysis. Effectiveness of presentations and ability to explain findings clearly.

1. Data Collection & Accuracy (25%)

   Completeness and relevance of data.

2. Graphical Analysis (25%)

   Quality of graphs and interpretation of PPP/UIP trends.

3. Report Quality (30%)

   Clarity, structure, and depth of analysis.

4. Presentation Skills (20%)

   Effective communication and teamwork.

Appendix B. Project Instructions

Groups of 3-4 students - A 5-minute presentation for each group.

1. Choose a country from the list, and assign yourself to that group on the LMS by [DATE].

2. Collect general information about this country (latest available).

    • name, continent, map, flag, language, currency, exchange rate regime

    • GDP growth rate, inflation rate, unemployment rate, interest rate (official)

    • Top export and import merchandise, top trade partner, balance of trade, exchange rate with the US dollar

3. Create one graph with real imports and real exports data (20y). Surplus or deficit?

4. Read the FRED post on UIP and create a similar graph (customize) for your chosen country's currency and the US Dollar (last 20 years if available).

5. Read the FRED post on the PPP and create a similar graph for your chosen country.

6. First draft of graphs due on [DATE].

7. Prepare a written document to submit on the LMS - due on [DATE].

8. Prepare a class presentation - due on [DATE].

9. Make sure you include the following:

    • Cite your sources - only in-text needed for slides (APA style)

    • Include timing for the data (e.g.: X% inflation in 2022, Y% in December 2022)

    • For the UIP, compare short run differences with long run ones. What does the theory predict?

    • For the PPP, calculate the percentage change for both indexes for the whole period. Was the result different? If so, can you think of a reason why based on the theory?

10. Ask for help if you have questions!

Appendix C. Project Report Example

Australia

Basic Facts	
Continent	Australia
Language(s)	English
Currency	Australian Dollar
Exchange Rate Regime	Floating

Economy	
GDP Growth Rate	2.2% Annual Change
Inflation Rate	2.8%
Unemployment Rate	6.5%
Interest Rate (official)	4.1%

| International Trade	
Top Exports	Iron Ore, Coal Briquettes, Petroleum, Gold, Wheat.
Top Imports	Refined Petroleum, Automobiles, Broadcasting Equipment and Computers.
Top Trade Partners	China, Japan, South Korea, United States
Balance of Trade ($)	+ 98B USD (macrotrends.net)
Exchange Rate (with the U.S. dollar)	1 AUD = 0.64 USD

GDP GRAPH:
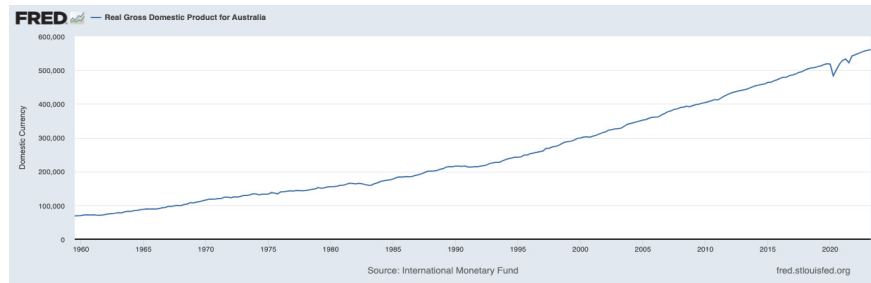
IMPORT/Export Data:
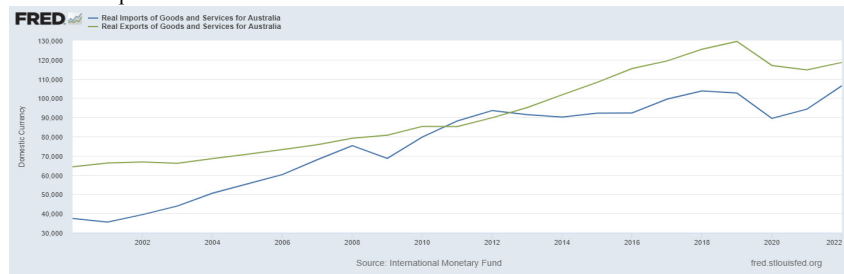
In the 21st century Australia has generally maintained a trade surplus. The surplus has grown significantly in the latter half of the 2010's as Australia has begun to produce more iron and other raw metal products that it is sending to east Asia and the United States.

Uncovered Interest Parity (UIP)
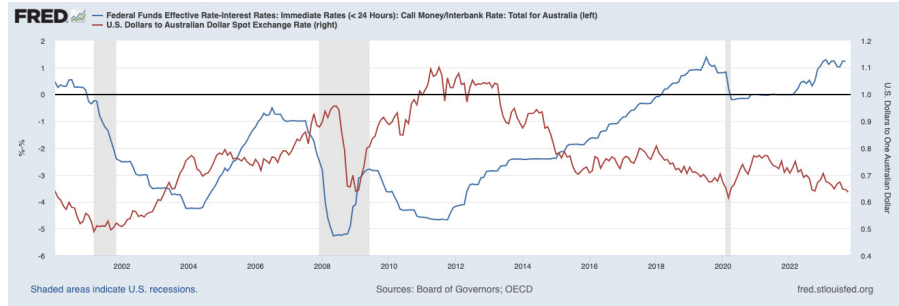
From 2018-2023 the US dollar appreciated compared to the Australian dollar because Australia's interest rate was lower than the US interest rate. The inverse could be seen from 2002-2018 meaning that the US dollar depreciated due to lower interest rate in the US compared to Australian interest rate. The UIP theory predicts that a drop in interest rate would increase the spot exchange rate in the short run, which is shown in the graph from 2002 through 2004 and 2010 and 2012. In the long run, the interest rate should recover and both that and the spot exchange rate return to equilibrium as seen from 2005-2008 and 2014-2016. There is an inverse relationship between the interest rates and spot exchange rate in the short run but they tend towards equilibrium in the long run, as explained by the UIP theory.

Purchase Power Parity (PPP)
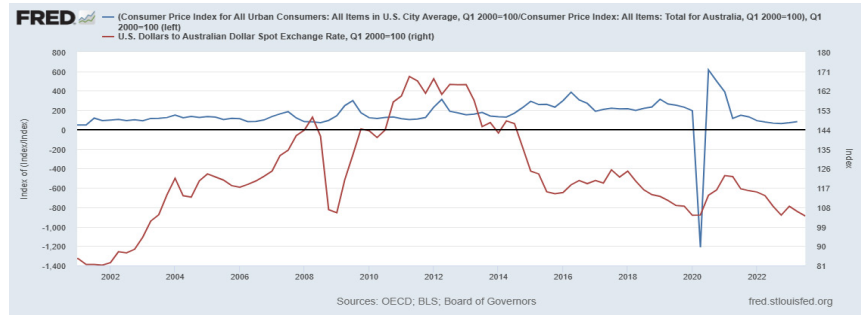
Price index in the US should Equal to Exchange rate times the Price index in Australia in order for the Absolute Purchasing Power Parity to be true.
P(us) = E($/A$) * P(aus). To compare with this graph, theoretically the nominal exchange rate should equal to the price ratio of US to Australia. However, the deviation can be seen due to differences in inflation rates of two countries. In 2nd quarter of 2020 Australia's CPI decreased 1.9% from falling oil price and government assistance in childcare making it essentially free during the height of the pandemic. Resulting in a drastic drop in ratio as US inflation rate steady climbing due to increase in US CPI. Overall, the Price ratio change of 15.84% was matched by 28.8% dollar depreciation in the 20 year data between 2002 and 2022. (the exchange rate changes in reaction to price ratio changes).

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