

Thoughts on Tests and Testing: What are we trying to achieve?

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Brief preface to Carol Osler's essay, *Teaching and Testing Analysis Skills*

For many faculty members, exams and tests represent an unavoidable feature of their courses. It is worth taking a moment to reflect on what we aim to achieve with exams and tests – and what we might do differently.

Grant Wiggins and Jay McTighe, authors of the classic education book *Understanding by Design*, ask: ***What should students know, understand, and be able to do?*** I suspect that most faculty who give tests would especially like to determine what our students understand and are able to do – but it is difficult to reach these goals via in-class tests. First, there are time and pressure constraints; can our students really demonstrate understanding and skills in an hour or two, when under pressure to perform? Second, it is difficult to create tests that allow students to demonstrate understanding and skill, especially tests that are readily gradable.

A number of Brandeis faculty members have found ways to give tests that allow students to truly demonstrate understanding and skill. In this essay, Carol Osler, of the International Business School, presents a very interesting method for helping her Master's Macroeconomics students show their best work on tests. During the semester they practice a variety of data analysis skills in class and on homework. Then, 24-48 hours before an exam, Carol gives the students a packet of macroeconomic data about a country that they have not yet studied; students examine these data to prepare for the test. They walk into the test having pored over the data and practiced applying the skills that they learned during the semester – but not knowing what questions will be on the test. Carol's tests include questions that assess students' knowledge of basic facts and concepts – but by giving the students the raw data ahead of time, her tests are able to focus especially closely on assessing students' understanding and analytical skills.

I am confident that Carol's methods can be applied to courses in many other fields. Carol and I will be very interested to hear how others make use of her method for testing students.

Teaching and Testing Analysis Skills

Carol Osler

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I. Teaching Analysis Skills

What do we hope to achieve in a university course? Ideally our students emerge ready to evaluate complex professional situations and make wise choices as citizens and parents. A few will even generate new concepts on their own.

Unfortunately, the real rarely meets the ideal, and few students can actually do all this upon completing a university course. Indeed, research shows that bright students are even befuddled by slight changes of context.¹

This observation defines one of the central challenges facing educators today. We must help students “transfer” knowledge to unfamiliar situations.

To promote transfer, we must show students how fundamental principles apply in real settings.² Fortunately, such illustrations from reality serve many additional purposes. I outline these with illustrations from my field, macroeconomics, where we teach students that inflation is caused by rapid money growth:

- They implicitly confirm the importance of those fundamental principles. To illustrate: Yes, rapid money growth brings rapid inflation every time and in every kind of economy.
- They teach students about dynamics. How long does it take money growth to influence inflation?
- They teach students about magnitudes: In reality, what is normal? What is big? Is 10% inflation big or does it depend on the country’s stage of development?
- They help students connect concepts to data. In macroeconomics, for example, students learn how to focus on overall trends, ignoring the noise that inevitably arises from imperfect measurement.

Real-world illustrations elicit the students’ best efforts because they are inherently interesting. This “make[s] the game worth playing,” one of the seven key principles outlined by Perkins for excellence in education.³ Motivation is also enhanced by examples in which students play a “‘junior’ version of ‘the whole game,’” because students thereby gain “[an] opportunity to see the ‘big picture’ of the activity.”

Real-world examples can be used before, during, and after concepts are presented.

¹ Mazur, Eric, *Confessions of a Converted Lecturer* presentation at: <http://mazur.harvard.edu/search-talks.php?function=display&rowid=2612&szrowids=&searchURL=function%3Drecent>

² In macroeconomics, for example, there examples can be found of fundamental principles in action from every corner of the inhabited world.

³ See Perkins, David, *Making Learning Whole*, How Seven Principles of Teaching Can Transform Education (Jossey-Bass; 2010)

A. Applications Before Concepts

An application of broad general interest, when presented *before* outlining a key principle, provokes interest or concern. It also frames the concepts as answering important questions rather than ends in themselves.⁴

- In macroeconomics, for example, principles of money demand, which are of little interest in themselves, help explain why inflation sometimes surges to extreme levels
- In physics, principles of electricity can help students understand solar power or smartphones; Newton's laws are tools for understanding popular amusement park rides
- In psychology, principles of neuroscience help understand common psychoses including schizophrenia.

B. Applications During Concept Explanations

Short applications during the presentation of concepts in class keep the relevance of the material in focus, foster clarity, and help students develop the ability to transfer knowledge to specific applied contexts. If clickers and student-to-student interactions are incorporated, common confusions can be addressed quickly.

C. Applications in Homework Assignments

Transfer can also be enhanced by including application problems in homework assignments. Initially, a given principle can be examined in isolation and then in more complex situations where multiple principles operate simultaneously.

Ultimately, students can be asked to apply key principles to complex real-world situations on exams, as discussed below. This is educational in itself and it also serves as an assessment tool.

II. Applications in Examinations: Testing Analysis Skills

Incorporating applications into examinations is a way to test whether students can apply the principles learned in a course to analyze complex real-world situations. It also provides students additional examples of how concepts transfer to reality. To carry out such an analysis, however, students need time to simply absorb the outlines of the situation in question, and on a timed test this takes time away from the actual analysis. I address this challenge by providing students the needed background information in advance.

The rest of this note describes my approach to testing analysis skills. I frame the discussion in terms of Bloom's taxonomy of critical thinking (revised version⁵). This taxonomy has two key dimensions: Knowledge and Cognitive Processing. Each dimension has multiple subdimensions. Within Knowledge the subdimensions are: Factual, Conceptual, Procedural (or equivalently Skills), and Metacognitive. Within Cognitive Processing the subdimensions are: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating (or synthesizing).

My exam questions follow a specific structure that potentially draws on the student's familiarity with all four subdimensions of knowledge and can potentially demand that they apply all six subdimensions of cognitive processing. The exam requires students to transfer learning from one context to another.

⁴ Additional illustrations, presented after the principle itself has been outlined, can show the principle's broader applicability.

⁵ <http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy>

The tests described here have advantages for pedagogy as well as assessment. Students learn about the real world. It is important for students to learn not just theories but also about important innovations in science, important events in economic history, or important forms of psychosis. Students also learn that the fundamental principles of a discipline apply consistently across situations with superficially different structures. All current students see these principles at work in the current exam's focus situation. Diligent students who study old exams see those principles at work in many other real-world situations.

The approach outlined here shares much in common with the case analyses ubiquitous in business schools. This is not accidental, since they share similar goals. Case analyses, however, are intended to help students derive the fundamental principles on their own. The exams described here assume, to the contrary, that the principles have been taught already. The exams evaluate whether students actually understand those principles and can apply them to an unfamiliar setting.

The rest of this section outlines the approach to examinations and provides examples of individual questions. (Example are presented in a **distinct font**.) The appendix provides a complete exam following these principles.

A. Students receive information about a specific real-world situation in advance

The information is provided in advance because real-world situations are invariably complex. Students need time to absorb the structure of the situation and familiarize themselves with key facts and patterns in the data.

- The information is distributed electronically a day or two before the test
- Information is provided in various formats:
 1. A verbal description of the situation (250 – 500 words)
 2. A package of charts and tables showing key variables
 3. Pictures
- Information includes material not directly relevant to the exam questions
- Students are allowed, indeed, encouraged, to learn more about the situation from outside sources. They are also encouraged to discuss this information with other students so they can, as Perkins recommends, 'learn from the team.'

B. Exam questions assess lower-level thinking skills first

The first part(s) of each question tests the lowest levels of thinking and the lowest levels of information as described in Bloom's Taxonomy: Students must Remember, Understand, and perhaps Apply basic facts and concepts. This provides reassurance to students who experience test anxiety or who struggle with the higher-level dimensions of the work. Further, mastery at these levels is essential for mastery at higher levels.

- Illustration of the general structure of lower-level questions:

Write out Principle X carefully and explain it intuitively. Be sure to define key terms, identify units, label axes, etc.

The remaining parts of each question test higher cognitive processes: Applying, Analyzing, and occasionally even Evaluating and Creating. Creating amounts to having students use multiple core concepts to understand something conceptually new. These questions test the students' ability to Transfer knowledge gained in one context to a new context.

- Illustrations of the general structure of higher-level questions

Analysis: Use Principle X to explain why the designers (policymakers) of real-world situation ABC chose to do JKL

Evaluation: Using Principle X, identify the best response for designers (policymakers) in real-world situation ABC

Creating new ideas (Synthesis): Situation ABC differs from standard situations analyzed in class. Identify this difference. Using Principles X and Y plus the description of situation ABC provided in advance, explain this difference

C. Sample questions to test students' ability to analyze practical situations

Sample questions below cover Macroeconomics principles, since that is the context in which the exams were developed

Example 1

Define a nominal anchor. Explain why a country might want one. (Lower-level question)

The Gold Standard and money-growth rules have both been used as nominal anchors at different times by different countries. Explain why they are no longer used in practice. (Higher-level question)

Example 2

Explain how Kazakhstan's GDP shares for consumption, investment (specifically gross fixed capital formation), and government spending differ from those for the US. (Lower-level question)

The value of Kazakhstan's currency, the tenge, has faced strong upward pressure for most of the period since 1999, and the central bank has intervened actively to resist that pressure.

- a. List three reasons why the tenge has tended to appreciate as Kazakhstan has developed. (Higher-level question: Application, Analysis)
- b. USE SIMPLE BALANCE SHEETS to explain why Kazakhstan's foreign exchange reserves and money base have largely moved in parallel (Chart X). (Higher-level question: Application, Analysis)

Example 3

Define an "optimal currency area" (OCA). (Lower-level question)

Botswana could choose to peg its currency to the USD or the South African Rand.

Evaluate whether Botswana should peg to one or the other using the optimum currency area framework. (Higher-level question: Evaluation of policy choices)

Example 4

Consider the Bank of Botswana's balance sheet (Table 2). The asset side differs dramatically from what we typically find for central banks in developed countries. State the difference. Explain why Botswana's is different [a clue is provided in the opening text]. (Higher-level question: Synthesis of concepts to identify a new type of situation)

D. For context: Standard macroeconomics exam questions

Here are some examples from a standard macroeconomics exam. They do not draw on real data, which limits the questions' ability to teach and test transfer. In addition, the questions test only the low levels of knowledge and application.

Example 1⁶

Assume an economy has a natural rate of unemployment of about 5%, which means that unemployment cannot be lower than 5% without creating inflation. Assume the economy is in macroeconomic equilibrium with 10% unemployment. If the Federal Reserve increases the money supply by 15% then roughly the following will happen:

- a) the economy will grow to full employment and prices will rise by 15%.
- b) employment will remain stagnant and prices will rise by 15%
- c) employment will rise by 15% and prices will not rise.
- d) prices will decline and the economy will grow by 10%.
- e) the economy will grow to full employment and prices will rise by 10%

Example 2⁷

Using first the aggregate supply and demand framework, and then the expectations-augmented Phillips Curve, show the effects of an initially unexpected, once-and-for-all increase in a. The level of the money supply (using AD-AS), and b. The rate of growth of the money supply (using PhC). In both cases, starting from the long-run equilibrium shown in the diagrams, show where the economy goes in the diagram, in both the short run and in the long run, clearly labeling both the location of the economy and any shifts of curves. In addition, in the spaces beneath the diagrams write a short paragraph describing what happens and why. Be sure to explain the role of expectations in the adjustment process in both cases.

⁶http://www.austincc.edu/gandron/gandron/ACC_Courses/Macro/Macro_tests/S11%20MacroExams/S11MacroEx2/S11MacroEx2.pdf

⁷ <http://www.docstoc.com/docs/21053641/SPPEcon-556-Macroeconomics-Final-Exam---Answers>

Appendix

A complete exam excluding cover page. Pages at the end, highlighted in blue are distributed during the exam period. Earlier pages are distributed a day or two in advance.

Welcome to Botswana!

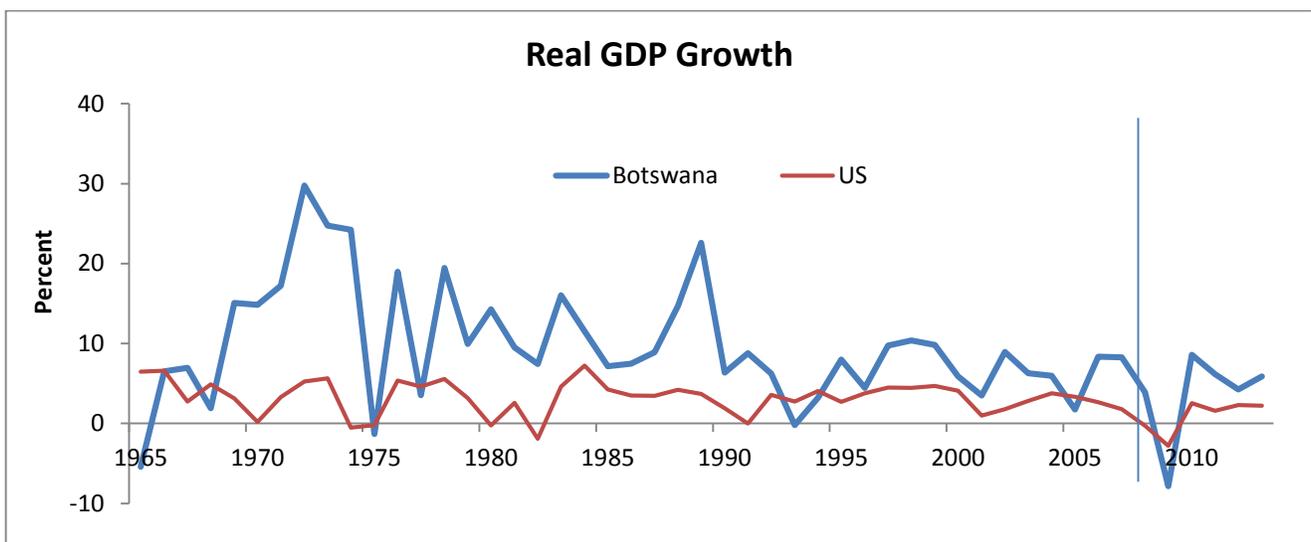
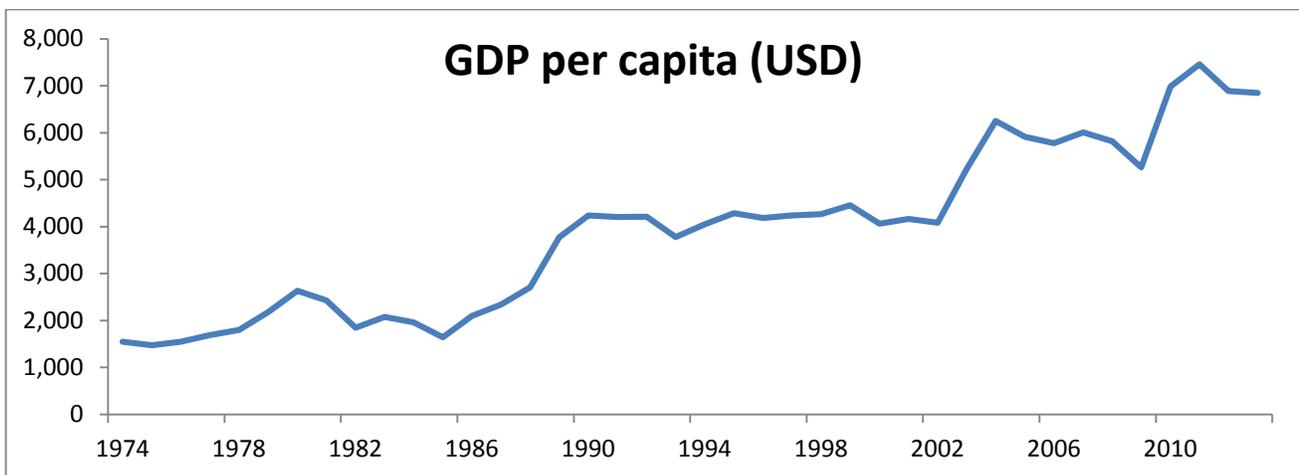


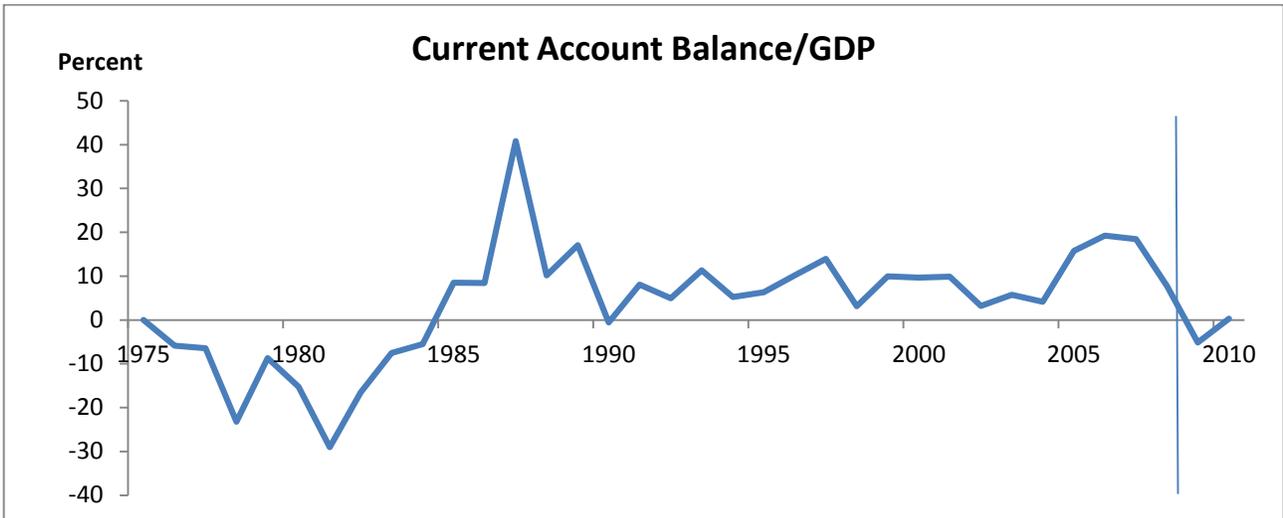
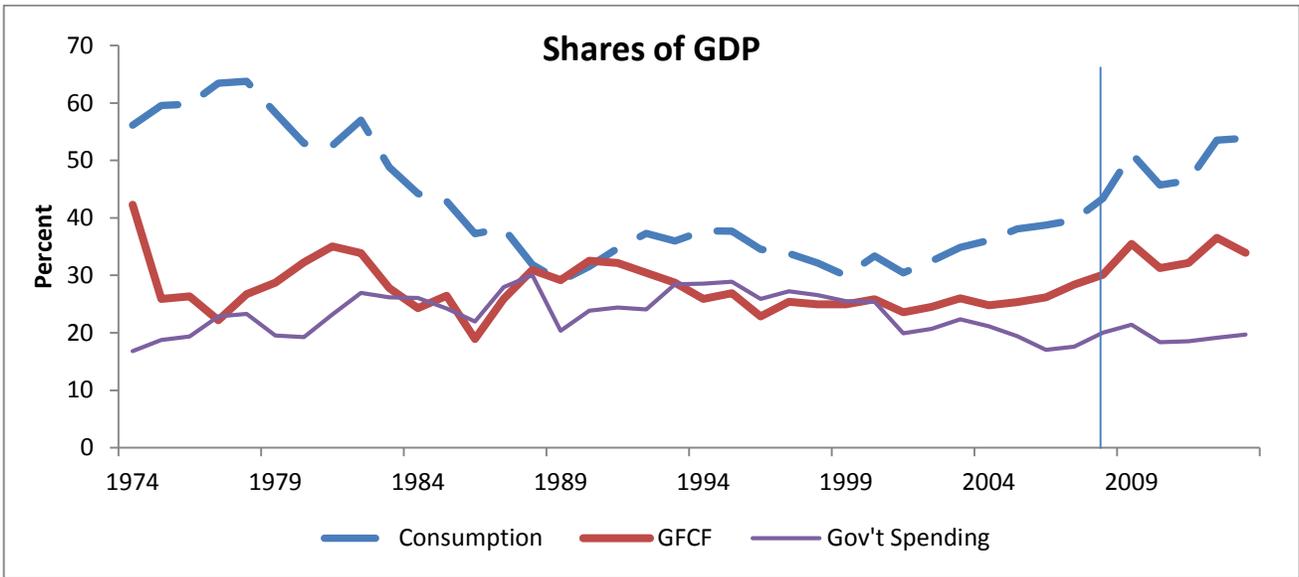
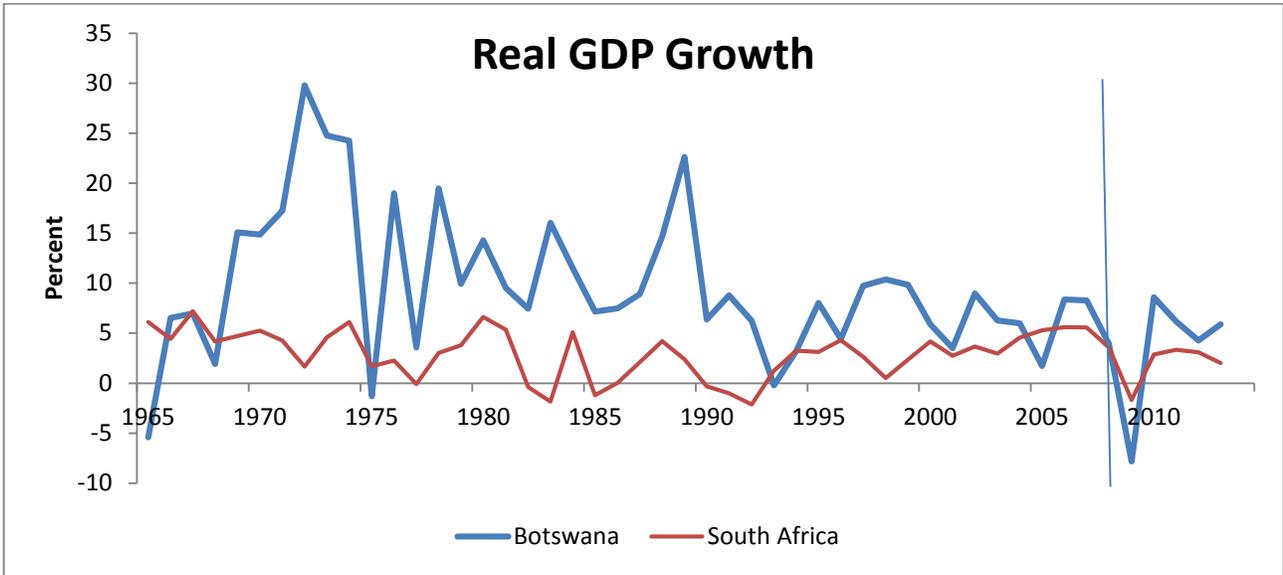
Botswana!

This exam focuses on Botswana, a country in the heart of sub-Saharan Africa. Botswana is roughly the size of France, geographically, but its population of two million is far smaller. Botswana has the good fortune to be dominated by just one tribe, the Tswana. Perhaps for this reason it has been blessed for decades with stable, effective, and enlightened democratic government. Though one of the poorest countries in the world at independence in 1961, Botswana has grown rapidly and now ranks among the middle-income emerging markets.

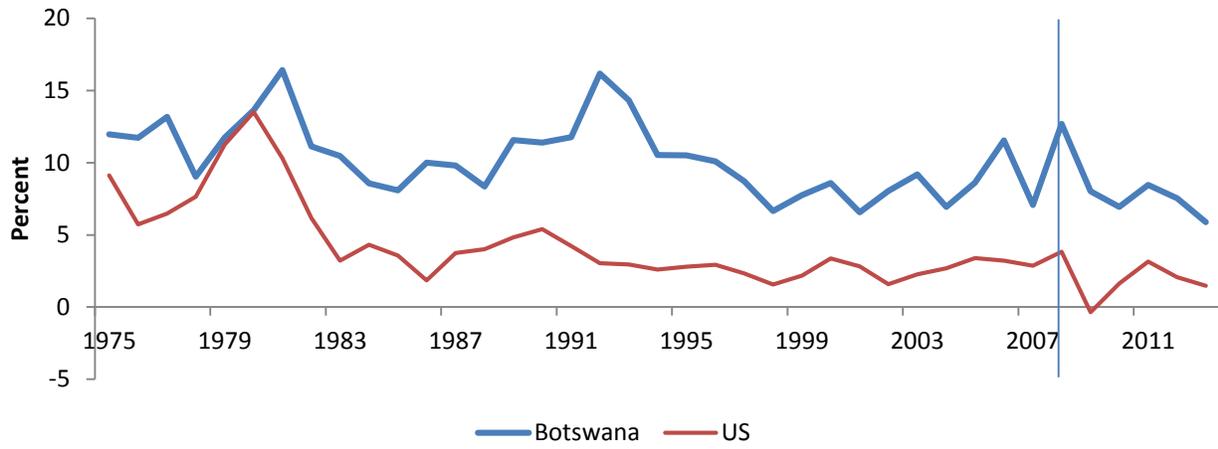
Botswana's economy relies heavily on diamond exports, which represent a large portion of government revenue as well as a large portion of GDP. The government owns 50% of the diamond mines; the other 50% is owned by the DeBeers mining corporation. Given the diamond revenues, the government runs a surplus in most years. For this reason, and because the country's bond market is not well-developed, the government has never issued substantial quantities of government debt.

DeBeers dominates world diamond production and chooses to maintain fairly stable prices by varying its worldwide sales. During the 2008-2010 financial crisis demand for diamonds fell dramatically.

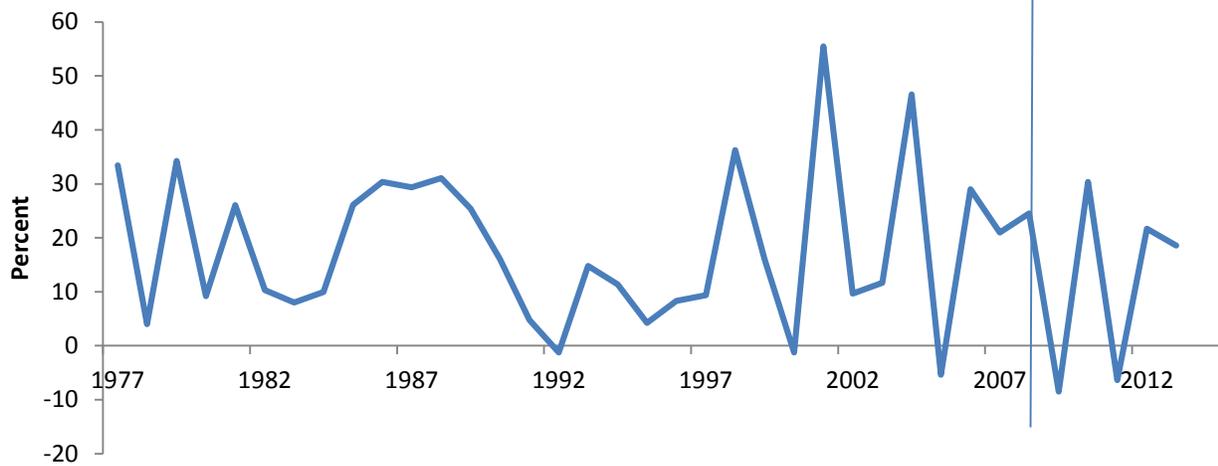




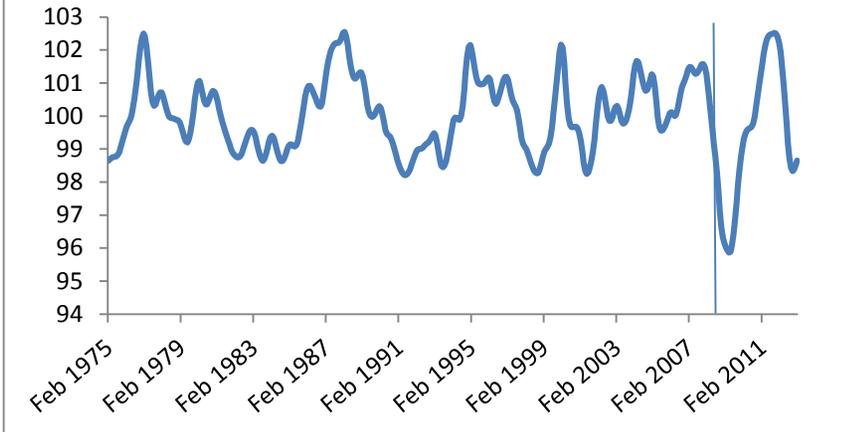
Inflation: Botswana & US



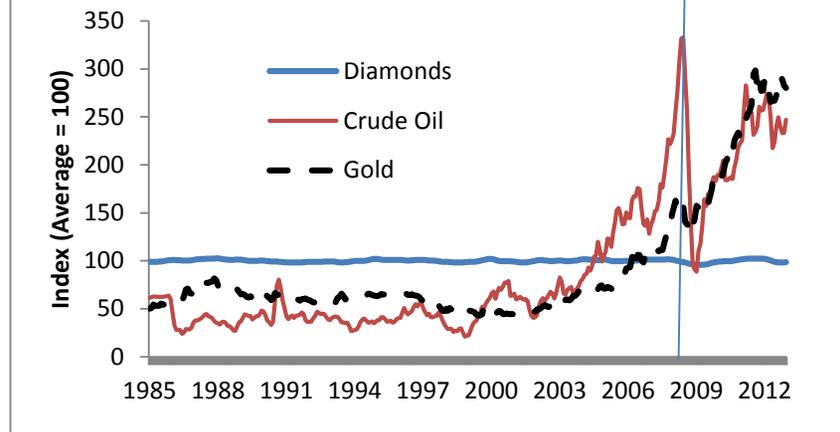
Money Growth



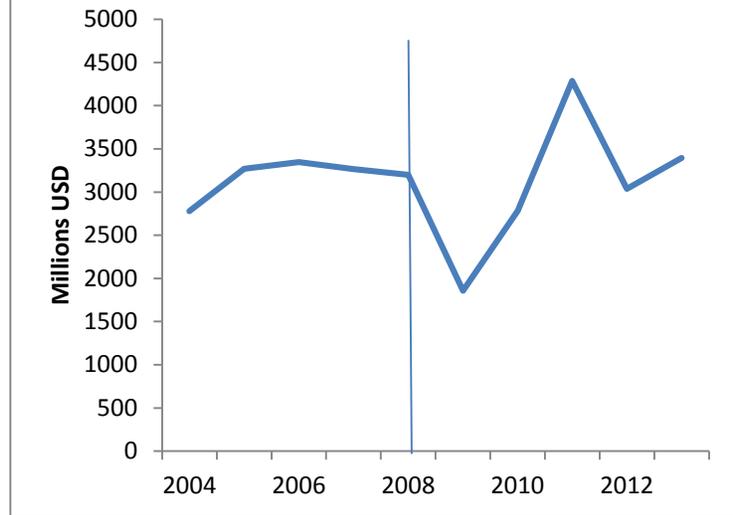
Diamond Prices (USD)



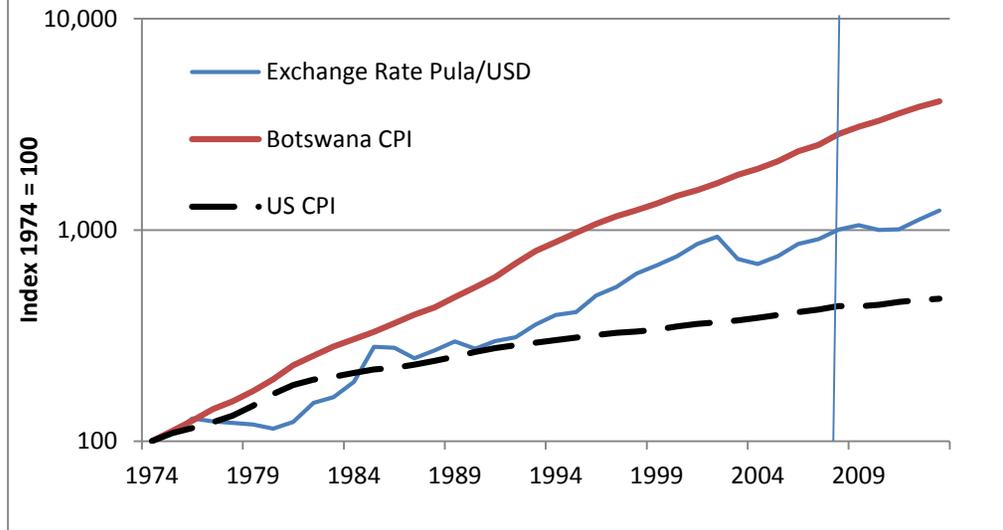
Raw Materials Prices

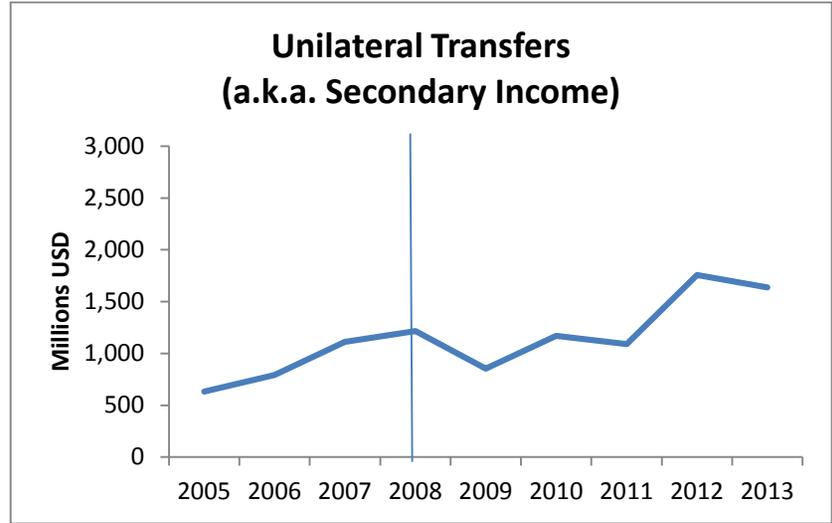
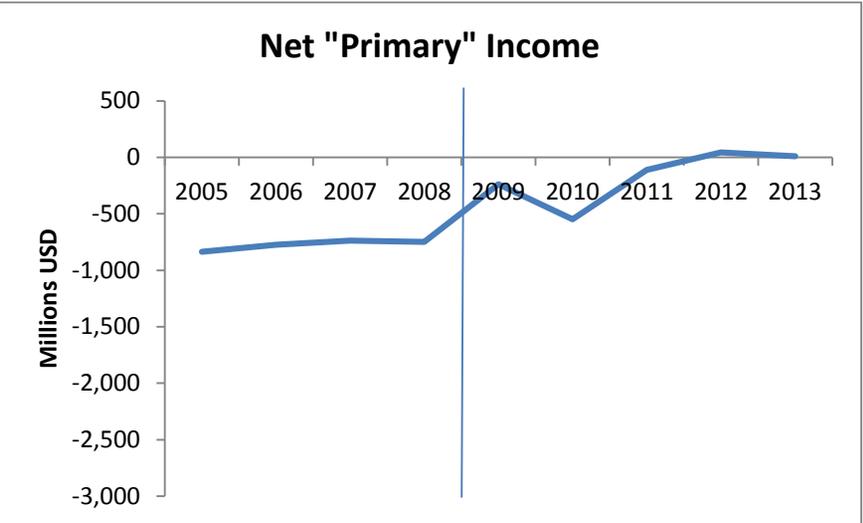
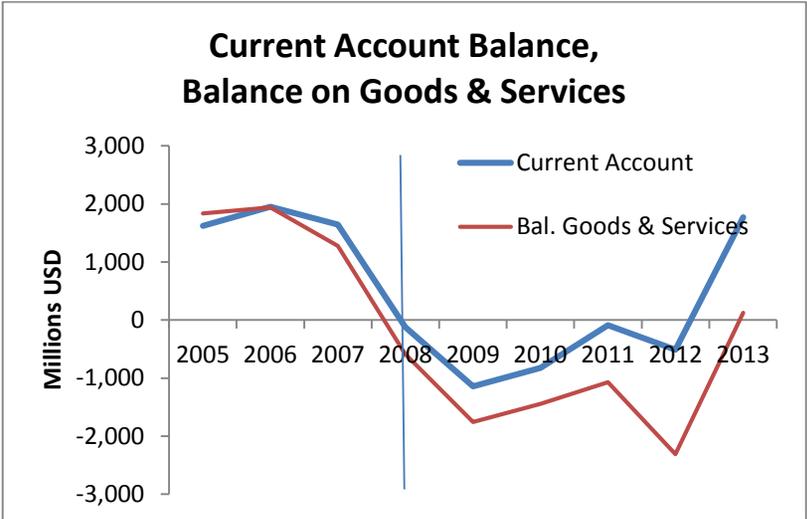
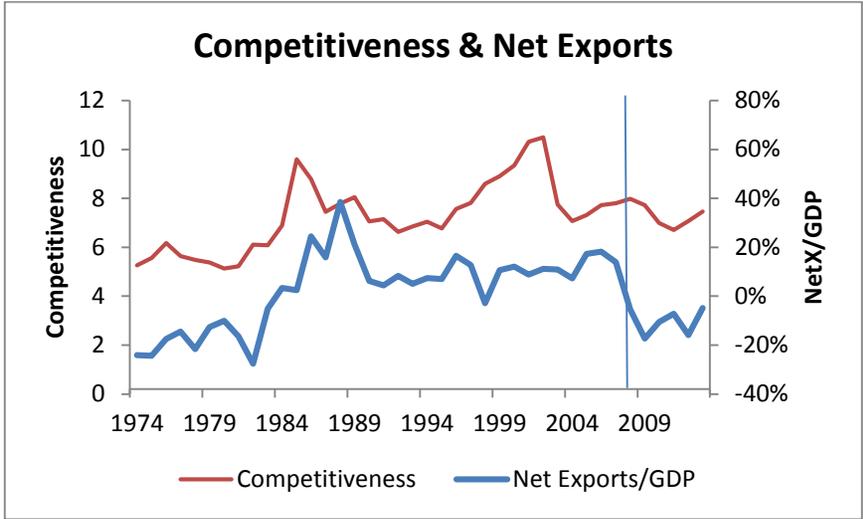


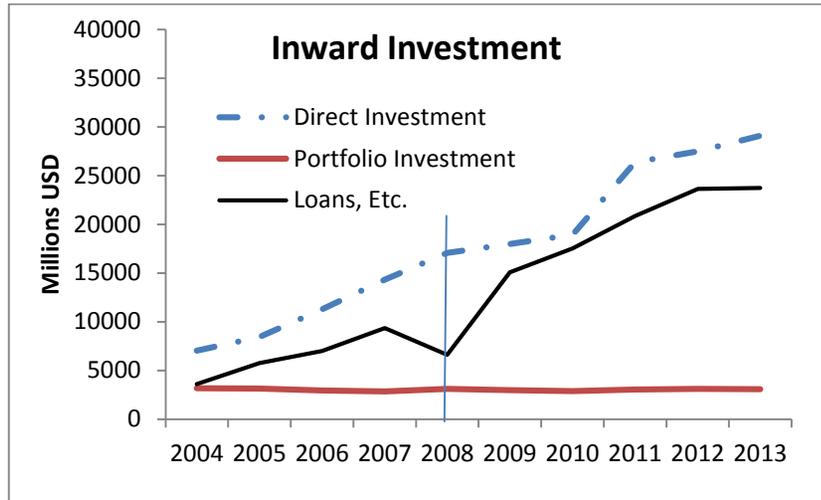
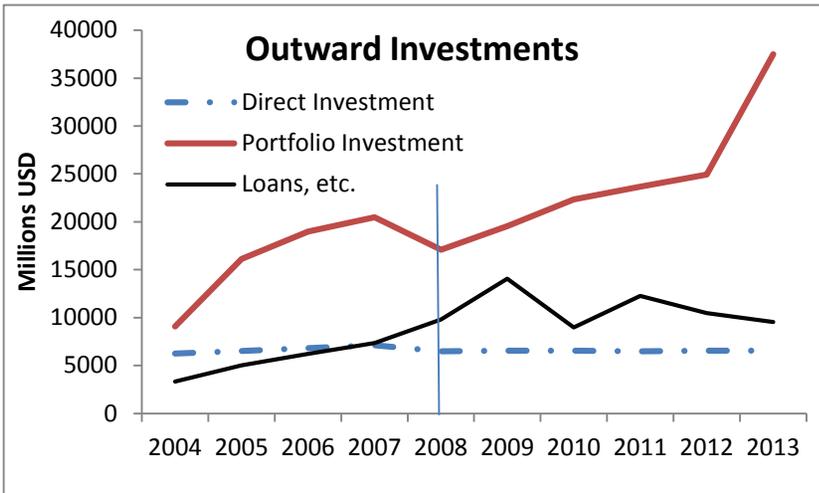
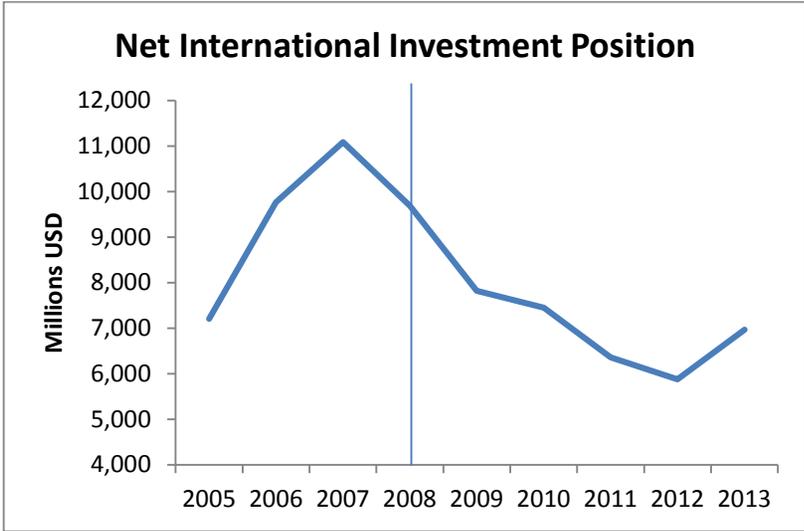
Botswana's Diamond Exports



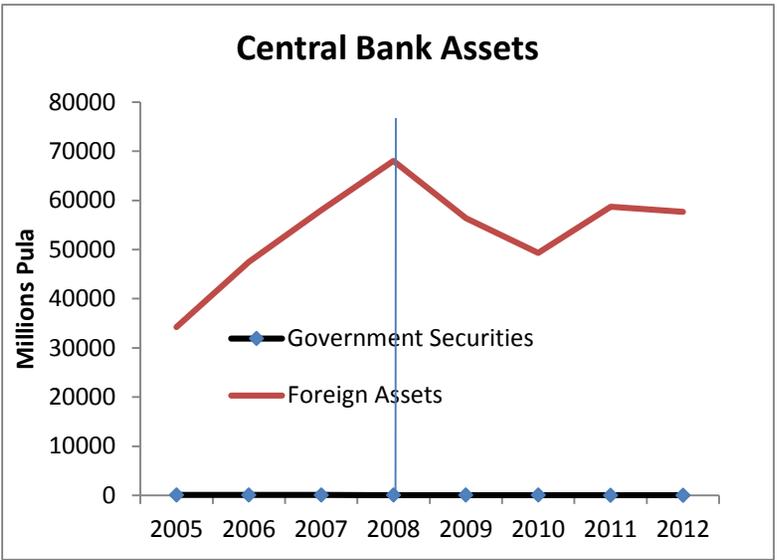
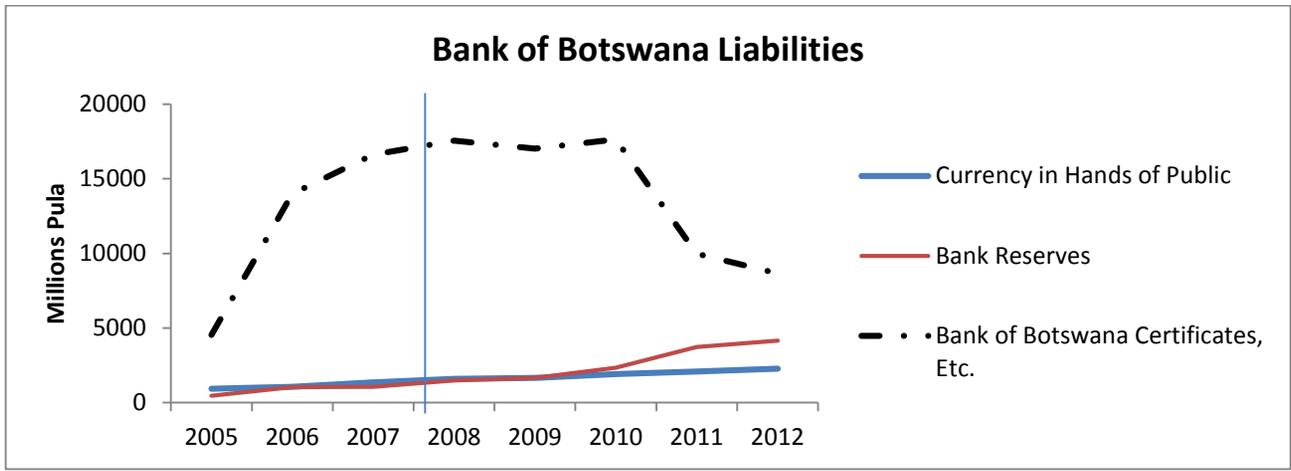
US & Botswana: Prices & Exchange Rate



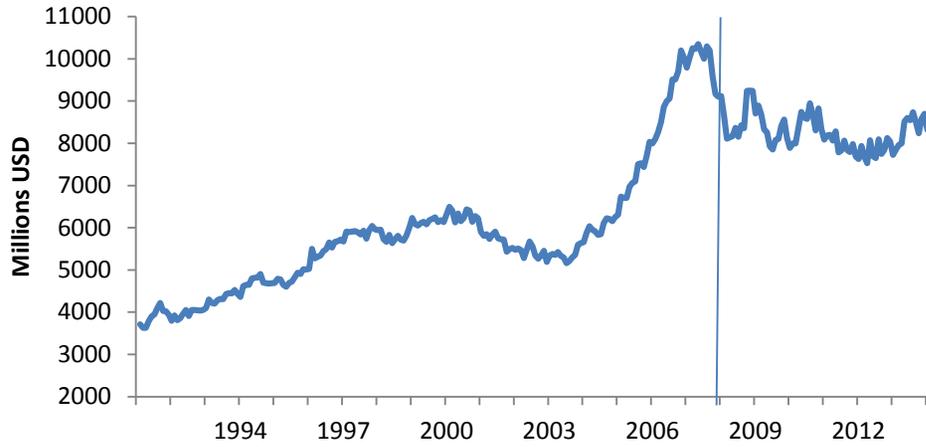




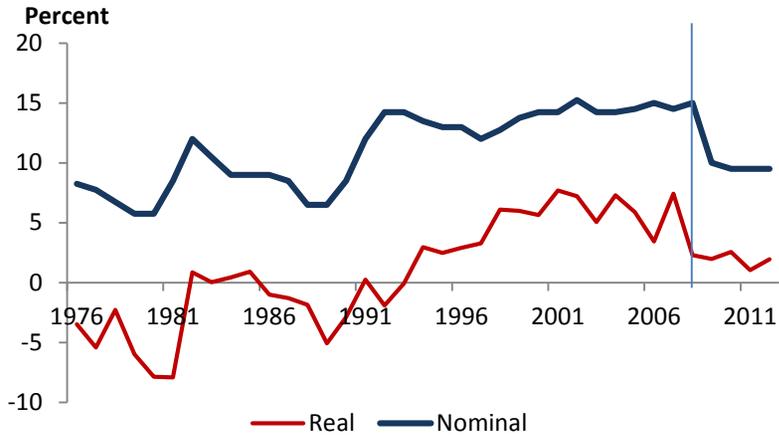
Assets		Central Bank Balance Sheet (Pula millions)	Liabilities	
24	Government Securities	2,275	Currency in Hands of Public	
57,652	Foreign Assets	4,169	Reserves of Banks	
	Etc.	8,664	Other, including Bank of Botswana Certificates	
			Etc.	



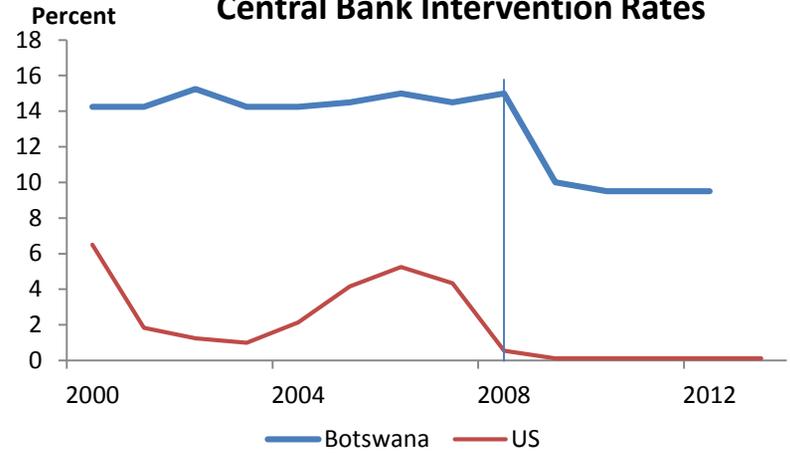
Foreign Exchange Reserves



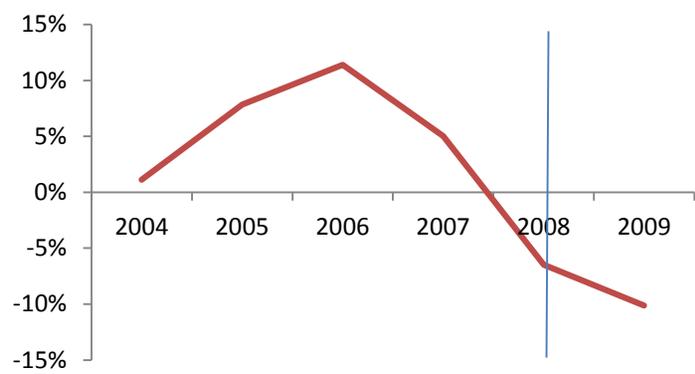
Central Bank Discount Rate



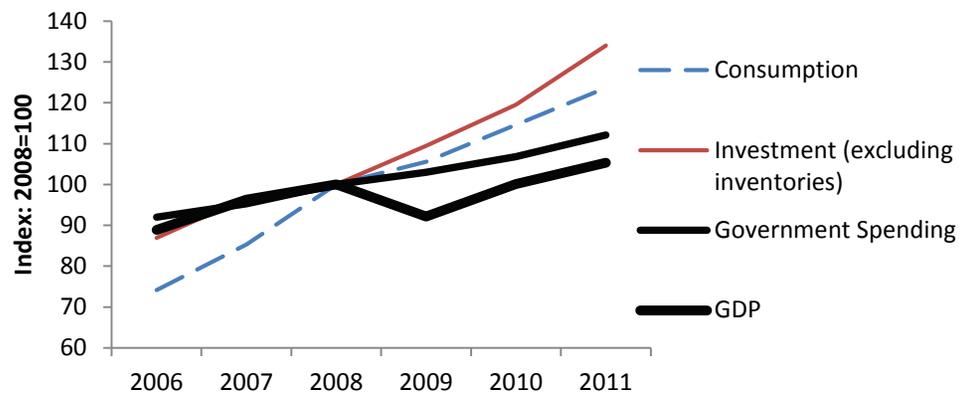
Central Bank Intervention Rates



Government Deficit/GDP



Real GDP Components Around Financial Crisis



Part I: Choose 2 of the following 3 questions

1. (31 points) Exchange-rate management.

- A. **Define** (briefly) the “Policy Trilemma,” listing the relevant policy goals and tools
- B. Nominal anchors
- Define** a “nominal anchor.” **Explain** why a country might want one
 - Each of the following has been used as a nominal anchor at some point, by some countries. **Explain** why they are no longer used in practice
 - Gold
 - A money growth rule
- C. Botswana could choose to peg its currency to the USD or the South African Rand
- Define** an “optimal currency area” (OCA)
 - Is Botswana an optimum currency area with the U.S. or South Africa? **Explain** briefly.
- D. Botswana maintains a flexible exchange rate and uses a medium-term inflation target of 3% – 6% as its nominal anchor. Saudi Arabia, which also relies heavily on exports of raw materials, uses its exchange rate (pegged to USD) as a nominal anchor
- Explain** how Saudi Arabia’s dependence on commodity exports motivates it to rely on its exchange rate (pegged to USD) as a nominal anchor
 - Explain** why Botswana, though dependent on commodity exports like Saudi Arabia, does *not* rely on its exchange rate as a nominal anchor. In your answer, **discuss** how Botswana’s choice of a nominal anchor is influenced by the way DeBeers manages the diamond business
- B. During the period **2004-2007** Botswana actively intervened to manage its exchange rate.
- Explain** how the charts show that Botswana’s central bank was intervening
 - Did the Bank of Botswana want its currency, the pula, to be stronger or weaker? **Explain**
 - Consider the Bank of Botswana’s balance sheet. The asset side differs dramatically from what we typically find for central banks in developed countries. **State** the difference. **Explain** why Botswana’s is different [a clue is provided in the opening text]
 - Explain** how we can be sure that Botswana sterilized the intervention. (Which chart would have looked different otherwise?)
 - Botswana did not sterilize the intervention in the classic way. **Why** was Botswana unable to engage in classic sterilization? **Explain** what Botswana did instead.

2. (31 points) Balance of Payments; Stocks vs. Flows, National Income.

A. Current account

- i. **Define** the Current Account
- ii. **List** the four main components of a country's Current Account
- iii. **Explain** why Botswana's Current Account and its Balance on Goods and Services have increasingly differed since 2008. Justify your answer with reference to other charts in this exam

B. Financial Account

- i. **Define** the Financial Account
- ii. **List** the four main components of the Financial Account

C. Net International Investment Position

- i. **Define** a country's Net International Investment Position
- ii. From 2005 through 2013, Botswana's Current Account went from positive to negative to positive. Concurrently Botswana's Net International Investment Position went from rising to falling to rising. **Explain** how these two developments are connected. Be sure to **distinguish** stocks and flows. Be sure to **distinguish** levels from changes

D. Income

- i. Use simple algebra to **explain** why a country's Net Primary Income often has the same sign as its Net International Investment Position
- ii. Consider the charts showing Botswana's inward and outward investment. Using these charts, **provide a reasonable explanation** for why, until 2012, Botswana's Net Primary Income was negative even though its Net International Investment Position was positive

E. National Income Accounts

- i. **Define and distinguish** GDP (Gross Domestic Product), GNI (Gross National Income), and GNDI (Gross National Disposable Income)
- ii. In 2013, was Botswana's GNDI larger or smaller than its GDP? **Explain**

3. (31 points) **Business Cycles and Inflation.** [Answers are graded on accuracy and thoroughness. A good-enough answer will get a good-enough grade.]

- A. **Describe** briefly how Botswana's GDP shares for consumption, investment, and government spending differ from those for the US (Higher? Lower? What's normal for the US?)
- B. **Explain** how the 2008 financial crisis created an aggregate demand shock for Botswana. **State** whether this shock was a positive or negative. **State** which of the four major GDP components was affected directly
 - c. **Describe** how consumption, investment, and government spending *typically* move during a business cycle. Which is *typically* most volatile? Which is *typically* "countercyclical," and why?
 - d. **Analyze whether and why** the movement of *Botswana's* GDP expenditure components during and after the 2008 financial crisis did or did not conform to this typical pattern
 - e. **Give the name** for charts like "Real GDP Components Around Financial Crisis"
- C. In the next few sub-questions you will use the business-cycle framework developed in class to analyze how the financial crisis in the developed world affected Botswana
 - f. Our business-cycle framework includes two curves: (1) an aggregate demand curve and (2) an expectations-augmented Phillips curve. For each one, **write down** the equation, **draw** it, and briefly **explain** the economics that underlies it
 - g. Using the graphical business-cycle framework you outlined above, **analyze** how the 2008 financial crisis in the developed world affected Botswana's GDP. Use words but avoid paragraphs.
 - a. **Show** which curve was involved
 - b. **Show** whether there a movement along a curve or the curve shifted.
 - h. In the absence of any inflation shocks, what would have happened to Botswana's inflation, and why? In our graphical framework,
 - a. **Show** which curve was involved
 - b. **Show** whether there a movement along a curve or the curve shifted.
 - i. Central banks usually respond to aggregate demand shocks, attempting to smooth the economy and/or inflation
 - a. **Explain** how a central bank would typically adjust *nominal interest rates*, *real interest rates*, and *money* in response to an aggregate demand shock in this direction?
 - b. Was the Bank of Botswana's response consistent with this normal pattern? **Explain.**

4. (31 points) Interest Parity. [Answers are graded on accuracy and thoroughness. A good enough answer will get a good enough grade.]

- A. Write out the open interest parity expression very carefully and explain it intuitively. Be sure to identify how exchange rates are quoted, etc.
- i. **List** which variables are endogenous and which are exogenous for a country with a flexible exchange rate.
 - ii. **List** which variables are endogenous and which are exogenous for a country with a fixed exchange rate.
 - iii. **Explain** why a country with a fixed exchange rate loses control over its monetary policy.
- B. In March, 2015, “The Fed dropped the key word ‘patient’ from its [policy] statement ..., signaling that it could increase interest rates in June for the first time in nine years. The stock market surged on the news. The Dow [U.S. stock index] was falling over 100 points before the Fed statement and immediately jumped. It ended the day up 227 points.” (<http://money.cnn.com/2015/03/18/investing/federal-reserve-rate-announcement/>)

The pula – and most other currencies – depreciated vis-à-vis the USD in response to this news. **Analyze** this event, following the steps below

- i. Upon the news, the change in investors’ expectations of future US monetary policy brought a change in one of the current exogenous variables in the open interest parity expression. **State** which current exogenous variable changed and whether it rose or fell. **Explain** why it changed.
- ii. After the shift in the current exogenous variable identified in (i), but before the current exchange rate moved, interest parity no longer held. **State** which currency looked more attractive to investors at that point – the dollar or the pula. **Explain**. AVOID PARAGRAPHS
- iii. **Explain** what did investors did, and how did it affect the value of the pula. AVOID PARAGRAPHS
- iv. **State** what determined the level at which the dollar-pula exchange rate stopped moving. AVOID PARAGRAPHS

Part II: Answer one (1) of the following two (2) questions about the readings

1. (7 points) Policy duration commitments have emerged over the past decade as a relatively new approach to something.
 - A. What institutions use policy duration commitments? (give a name)
 - B. Why do they use them? (briefly!)
 - C. How do policy duration commitments differ one from another? (briefly – just a few descriptors will do)
 - D. What’s currently the style in policy duration commitments? (just a few descriptors will do)
 - E. The economic world is currently “learning by doing” with respect to policy duration commitments. ***Briefly identify*** at least one previous major episode of world economic history through which economists learned from experience. What didn’t we know before that we figured out after?

2. (7 points) After the 2008 financial crisis, Uwe Reinhart of Princeton University, discussed how the episode revealed a major professional blindspot among economists: “Fewer than a dozen prominent economists saw this economic train wreck coming — and the Federal Reserve chairman, Ben Bernanke, an economist famous for his academic research on the Great Depression, was notably not among them. Alas, for the real world, the few who did warn us about the train wreck got no more respect from the rest of their colleagues or from decision-makers in business and government than prophets usually do.”
 - A. ***List*** the force that Reinhardt and Robert Shiller (Nobel prize winner) think led to this professional blindspot (one word will do)
 - B. ***Explain*** how that force is related to his humorous motto for the profession: “*Est, ergo optimum est, dummodo ne gubernatio civitatis implicatur*” (be sure to give a rough translation of this motto)
 - C. ***Discuss*** briefly the implications of his perspective for your future career