INVENTORIES IN GDP: A CLASSROOM LEARNING STRATEGY

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Abstract

The Gross Domestic Product (GDP) is a component of macroeconomics courses that is widely used by economists and the society alike. However, many students find it difficult to understand what GDP encompasses. The understanding of the concept can be facilitated by a tool that explains the specific spending categories in the GDP identity. This study presents a teaching strategy and tool to facilitate students' learning of the role of inventories in the GDP and how inventories can be used concurrently with other spending categories, that is, Consumption (C), Investment (I), Government Expenditure (G), and Net Exports (NX). It presents four scenarios in which inventories are used as a corrective mechanism to solve the temporal problem that the good produced in one year and sold in another create. By using this tool, the students can quickly and fully understand the role of inventories in GDP calculations.

Key Words: GDP, Inventories, Spending, Teaching Strategy

JEL Classification: A2, A20, A21, A22

Introduction

The Gross Domestic Product (GDP) is a key concept in a macroeconomics course. It is widely used by economists and the society at large. It is typically presented using the expenditure approach: $Y = C + I + G + NX$. Although GDP is a widely used concept, students find it challenging to understand what it encompasses. For instance, Wolla (2018) discusses typical misconceptions about Net Exports (NX) and, more specifically, the interpretation of subtracting imports from the GDP identity. While subtracting imports is a corrective tool to remove the influence of imports from other spending categories, i.e., Consumption (C), Investment (I), and Government Expenditure (G), it is often misinterpreted by students as imports reducing the total value of GDP. To overcome this problem, Wolla (2018) presents an effective teaching strategy that aims at rectifying this misinterpretation and presenting students with the correct interpretation of the (non-)influence of imports on GDP, as implied in its definition. Although I could not find studies that clarify the role of inventories for students, other examples of such clarifications of economic concepts include those by Dupont & Durham (2021) and Picault (2016, 2021).

Imports are not the only aspect of the GDP identity that can be misinterpreted by students. The role of inventories in investment expenditure is another source of confusion. In GDP calculations, inventories are a tool used to resolve the temporal problem that the goods produced in a year and sold in another create. For instance, all the other expenditure categories in the GDP identity must be considered for a specific period, typically a year. However, inventories require considering at least two periods, which can confuse the students. The inventories

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subcategory is necessary because the GDP measures the current production, not sales (Pritzker et al., 2018). Goods produced in a year but not sold in the same year cannot be directly observed in the market transactions during a production year that is considered for GDP calculations. Instead, these transactions will be recorded in the following year when these goods are sold. Like the imports subcategory described by Wolla (2018), the inventories subcategory can be interpreted as a corrective mechanism allowing goods to appear in the GDP of their production year instead of their consumption year, which is another cause of confusion.

This study presents a teaching strategy to clarify this confusion. It proposes an activity using a table that the students can complete when presented with a problem involving inventories. It offers students a tool that will help them understand how inventories work, and thus, gain conceptual clarity. The activity also shows that inventories can be used for consumption as well as investment, whether purchased by domestic or foreign consumers, companies, and the government. The paper is organized as follows. The Table section explains the tool (a table) that is used for the purpose, its contents, and an illustration of how it should be completed. The Activity section explains how to prepare the activity for a lesson either online or in the classroom, and the various scenarios for which the tool should be used. The Conclusion section details the time taken for the activity and the results of the activity.

The Table

Presentation
Table 1 was designed to analyze how and when inventories affect various spending categories in the GDP.[2]

Table 1: GDP Table

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 - GDP						
Year 2						

When a good is produced in one year and sold in another, its value is reflected in the GDP of the year of its production (Year 1), and not in the year when it was sold (Year 2). However, the sales transaction in Year 2 implies that some spending categories are affected. Therefore, the table represents both the years. The columns represent the spending categories where students can record any change occurring in both years. For instance, in Year 1, when

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[2] This table is useful to analyze various scenarios that affect the spending categories in the GDP. I developed this tool specifically to show the effect of inventories, but noticed that students used it for other scenarios not requiring the use of inventories.

goods are placed in inventory, both the GDP and Investment will show an increase. In Year 2, the Investment is negatively affected because the goods leave the inventories. Depending on who purchased those goods and what they purchased them for, at least one spending category from Consumption, Government Expenditure, and Exports will show a corresponding increase. Therefore, students can observe that these two records compensate for each other and thus, the GDP remains unchanged in Year 2.

An Illustration
You purchase this year at your local supermarket a good that was domestically produced last year. Its value is $1000. Table 2 shows how this scenario can be analyzed and easily depicted by following the representation in Table 1.

Table 2: Example

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 – GDP	$1000		$1000			
Year 2	$0	$1000	- $1000			

In the first year, the good is produced but not sold. Therefore, the Investment increased by $1000 as the good is placed in inventory. No other spending category is affected by this, implying that the GDP increases by $1000.

In Year 2, the good is sold. Therefore, it is removed from the inventories, subtracting its value from the Investment category. The transaction is now recorded in the Consumption category as the good is sold to a consumer. Therefore, when the two effects are added up, the GDP shows no change in Year 2.

While analyzing Year 1 and 2 simultaneously, the table shows that GDP has increased only in Year 1 (production year), the Consumption has increased in Year 2 (consumption year), and the inventories were only used as a corrective mechanism for consumption and production values, with no net effect on the Investment category. An additional benefit of breaking the GDP into columns is that students can observe and learn that there are circumstances where the components of GDP can change, even if GDP doesn't.

The Activity

Preparation
After explaining the definition of inventories, Table 1 shall be presented to students with the above example. The students shall then be invited to complete the table using different scenarios. If the course is in-person, the simplest way is to prepare a template that the students can use to analyze a scenario involving inventories and distribute its printed copies to students

for direct practice on the tables provided in them.[3] To conduct this activity online, I usually email the slides before the lecture; the students can print them at home or use their electronic devices to complete the tables directly on the screen.

Scenarios
    The four scenarios explained below allow students to use inventories in the four spending categories, i.e., Consumption (C), Investment (I), Government Expenditure (G), and Net Exports (NX). Using the same method four times helps students develop familiarity with the method, and clarify the concept of inventories completely. I suggest discussing each scenario independently. For each scenario, I usually give students 3 minutes to work alone or in a group of two to analyze the scenario and complete the table. After this, we discuss the scenario to ensure everybody understands how the GDP and spending categories are affected in both years. The four scenarios were developed with Canada as the domestic country. However, they can be easily adapted to analyze any other country.

- Scenario 1: Consumption (C)
    Jade spends $25000 on a car produced in Ontario. She got last year's model.
    To calculate GDP in this scenario, students must present the car as an inventory as it was produced last year and bought this year. Figure 1 shows how the template should be filled to represent Scenario 1 accurately.

Figure 1: Inventories and Consumption

Event: Jade spends $25000 on a car produced in Ontario. She got last year's model.

- **Year 1**:
    – Inventories (in Investment I) increase by $25000.
    – GDP increases by $25000.
- **Year 2**:
    – Inventories (I) decrease by $25000.
    – Consumption (C) increases by $25000.
    – GDP is unchanged.

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 - GDP	$25000		$25000			
Year 2	$0	$25000	- $25000			

- Scenario 2: Investment (I)
    Air Canada spends $30 million on Bombardier aircraft produced last year in Canada.
    Here, the aircraft were produced last year, which requires presenting them as inventories. As aircraft purchase is included in Investment, the changes in Year 2 occur within the investment category, as the filled template shows.

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[3] The template of the slide is provided in Appendix.

Figure 2: Inventories and Investment

Event: Air Canada spends $30 million on Bombardier aircraft produced last year in Canada.
- **Year 1**:
  − Inventories (I) increase by $30 million.
  − GDP increases by $30 million.
- **Year 2**:
  − Inventories (I) decrease by $30 million.
  − Capital equipment (I) increases by $30 million.
  − Investment and GDP are unchanged.

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 - GDP	$30 million		$30 million			
Year 2	$0		$30M - $30M=0			

- Scenario 3: Government Expenditure (G)
  The Government of Canada spends $300,000 to purchase desks produced in a Canadian factory with Canadian wood. The desks were produced last year.
  The scenario allows students to apply the inventories to a purchase by the government that should be assigned to the Government Expenditure spending category of the GDP. Once again, the production occurred in the year before that of the purchase.

Figure 3: Inventories and Government Expenditure

Event: The Government of Canada spends $300,000 to purchase desks produced in a Canadian factory with Canadian wood. The desks were produced last year.
- **Year 1**:
  − Inventories (I) increase by $300,000.
  − GDP increases by $300,000.
- **Year 2**:
  − Inventories (I) decrease by $300,000.
  − Government expenditure (G) increases by $300,000.
  − GDP is unchanged.

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 - GDP	$300,000		$300,000			
Year 2	$0		- $300,000	$300,000		

- Scenario 4: Net Exports (NX)
  *Ford **US** purchases $1 billion worth of aluminum from Rio Tinto Alcan factories in Quebec. The aluminum was produced at the end of 2021 and sold at the beginning of 2022.*
  As the aluminum was produced last year, students should present it as an inventory. As the buyer is a foreign company, the sale is considered an export in the second year. This scenario also illustrates that intermediate goods are also placed in inventories when produced in a year different from when the final good is produced.

Figure 4: Inventories and Net Exports

Event: Ford **US** purchases $1 billion worth of aluminum from Rio Tinto Alcan factories in Quebec. The aluminum was produced at the end of 2021 and sold at the beginning of 2022.

- **2021**:
  - Inventories (I) increase by $1 billion.
  - GDP increases by $1 billion.
- **2022**:
  - Inventories (I) decrease by $1 billion.
  - Net Exports (NX) increase by $1 billion.
  - GDP is unchanged.

	GDP =	C	+ I	+ G	+ NX	
					+E	- Im
Year 1 - GDP	$1 billion		$1 billion			
Year 2	$0		- $1 billion		$1 billion	

Conclusion

This study presents a simple tool to help students understand how inventories are used in GDP calculations. Practicing this tool takes 20 minutes of class time. In this method, the instructor first presents the template to students to make them familiar with the template and the workings of inventories through four different scenarios. The scenarios involve using inventories with all four spending categories, i.e., Consumption (C), Investment (I), Government Expenditure (G), and Net Exports (NX). By showing inventories across these categories for the years under consideration, the students will be able to understand how the four categories and in turn the GDP change because of the presence of inventories.

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