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A Dynamic AD–AS Analysis of the UK Economy, 2002–2010

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Abstract
This educational note helps instructors to utilize the Cowen/Tabarrok dynamic AD–AS model. I use it to interpret some major shocks and policy responses that hit the UK economy from 2002 through 2010 and I describe how to incorporate the model into a classroom setting.

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Introduction

In their *Modern Principles of Macroeconomics* textbook, Tyler Cowen and Alex Tabarrok introduce a dynamic version of the aggregate demand–aggregate supply (AD–AS) model.[1] It is a simple framework to make sense of economic shocks and policy responses. Its main difference from the traditional AD–AS model is that instead of showing the price level and real GDP on the two axes, the dynamic version shows inflation (on the *Y* axis) and real GDP growth (on the *X* axis), making the analysis much more accessible to students for two reasons. First, in a world of sustained inflation, it can be confusing to model declines in aggregate demand as leading to a fall in the price level. Second, inflation and growth are the main economic indicators discussed in the news—after all, *inflation* targets tend to be 2 percent, and recessions are defined as two quarters of negative GDP *growth*. Therefore, the dynamic model allows students to instantly draw upon their existing knowledge of the main

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[1] Readers who are unfamiliar with the dynamic AD–AS model should start with the thorough exposition provided in Cowen and Tabarrok (2009). There is also an unaffiliated video introduction on YouTube titled "An Introduction to the Dynamic AD–AS Model."

economic indicators.[2] This article will discuss how it can be used to illustrate movements in the UK economy from 2002 through 2010.[3]

I. The UK Case Study (2002–2010)

The following text can be used directly with students, who are required to identify which curve(s) will shift and draw the new diagram. The solution (i.e., the graph) can be revealed alongside the actual data (see appendix).

Instruction 1: Your task is to depict the following shocks to the UK economy using the dynamic AD–AS model. The starting point is the first quarter of 2002. The "Great Moderation" is occurring, where productivity gains and the emergence of China and India as trading partners have created a relatively high potential growth rate. Real GDP growth is 2.2 percent, which you can treat as being equal to the Solow rate.[4] Inflation is in line with expectations, and indeed inflation expectations remain stable throughout the entire analysis.[5] The money supply is growing at 7 percent, and V is falling by 2.4 percent.

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[2] Wren-Lewis (2013) has argued that since the Phillips curve shows inflation, we should use that and simply ignore the AD–AS model. However, as Sumner (2009) has argued, using the Phillips curve would place too much emphasis on demand shocks and would neglect supply shocks. Mueller (2014) attempts to inject some Austrian consideration to macroeconomic configurations by presenting a "goods side" and "money side" model. Like the dynamic AD–AS model, it draws upon the Solow model and is also based on the equation of exchange. However, it explains things in terms of levels rather than growth rates. A dynamic version of the AD–AS model may be the best of all worlds.

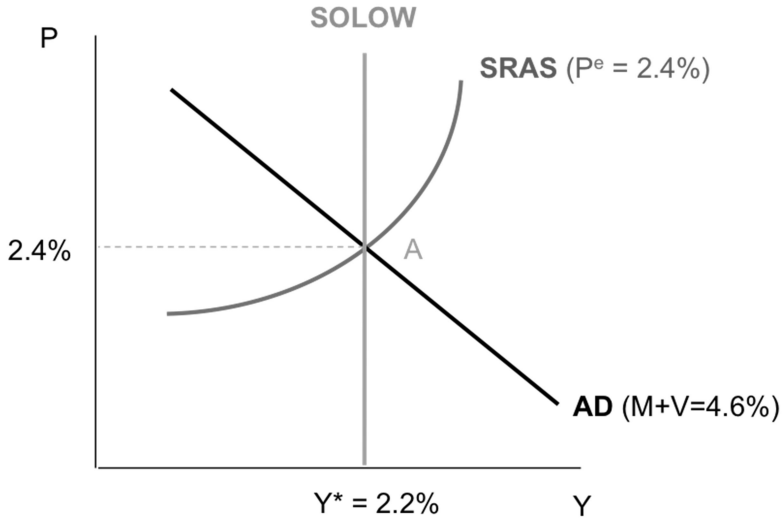
[3] The figures are taken from "Second Estimate of GDP: Quarter 4 (Oct to Dec) 2015," *Office for National Statistics*, February 25, 2016. The appendix shows NGDP data for the United Kingdom from Q1 2002 through Q4 2010. The GDP deflator is being used as the measure of inflation so that it is compatible with the real GDP growth measure, and thus sums to our measure of NGDP. Unfortunately, using the GDP deflator means that we lose the ability to talk in terms of changes to CPI. For the periods chosen, there is not a dramatic difference between the two measures of inflation, and the CPI figure is included in the appendix. Also, Christensen (2012) has pointed out that the European Central Bank often conflates the GDP deflator and CPI.

[4] Indeed, the long-term average real GDP growth rate, calculated from Q1 1957 to Q4 2001, is 2.345 percent. We can treat this rate as being approximately equal to the Solow rate.

[5] This seems like a dramatic over simplification, but two-year-ahead inflation expectations remained reasonably close to 2 percent from 2006 through 2010 (see "Do Inflation Expectations Currently Pose a Risk to Inflation?" Bank of England Quarterly Bulletin 2015 Q2). There are no real estimates of GDP deflator expectations, so we assume that they remain constant at 2.4 percent.

Draw the dynamic AD–AS model, identify the inflation rate, and label the starting position point *A*. (Figure 1 shows what the graph should look like.)

Figure 1. Q1 2002



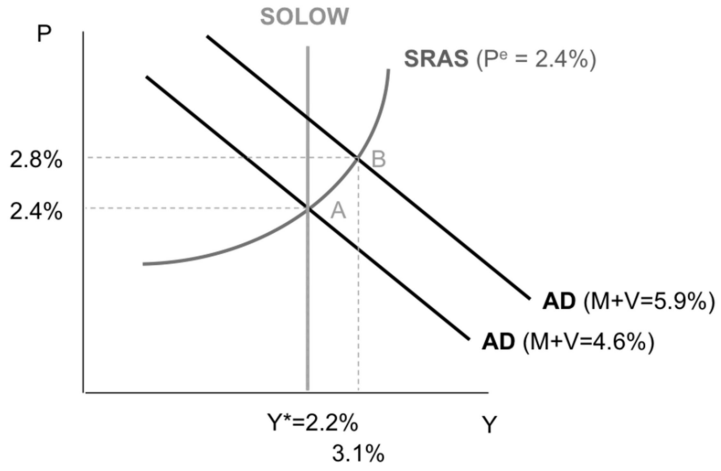
Instruction 2: In August 2005, the Bank of England's Monetary Policy Committee (MPC) cut interest rates from 4.75 percent to 4.5 percent, and this cut preceded an increase in the growth rate of the broad money supply. Despite some economists flagging the dangers of double-digit growth in broad money at the time,[6] because inflationary pressures weren't evident in CPI figures, the MPC turned a blind eye to it. This period also saw an increase in the growth rate of government spending. In 2002, government spending accounted for around 36 percent of GDP, but by 2007 it was 39 percent.[7] By

[6] Congdon et al. (2006) argued that "although the current welcome decline in oil and gas prices may depress headline inflation in the next few months, this should not disguise underlying concerns about domestic inflation." A similar story occurred in Europe. Eurozone M3 was growing at around 6.5 percent from 2000 until 2006. It then began to escalate quickly, rising to almost 10 percent in 2008 (see Christensen 2012).

[7] This increase in *G* could suggest that AD was too high, and as Cowen and Tabarrok (2009) point out, this is a temporary phenomenon and therefore at some future point we should expect negative shifts in AD. Note that excessive growth in government spending also implies negative shifts in the Solow curve, because

Q4 2007, the economy was growing at 3.1 percent and inflation had risen to 2.8 percent.[8] Draw an updated graph and label the new situation point *B*. (Figure 2 shows what the graph should look like.)

Figure 2. Q4 2007



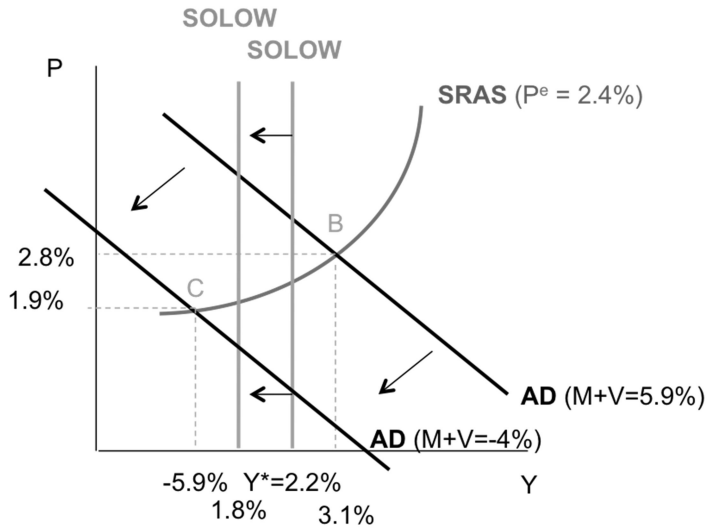
Instruction 3: The actual growth rate of real GDP is now beyond the Solow rate; in other words, growth is being driven by excessive AD rather than high potential GDP. This suggests that the growth rate is unsustainable, but there is also evidence that the Solow rate may be falling. According to Congdon (2007), UK output was 1 percent to 1.5 percent above trend growth at the beginning of 2008 due to factors such as declining North Sea oil production, the squeeze on financial services (the largest source of UK value creation), and planning restrictions. However, this negative productivity shock is small (assume *Y** falls to 1.8 percent) in comparison to the massive demand shocks that are occurring. These include a stock market crash (which constitutes a reduction in wealth and a reduction in consumption spending); government attempts to spend lots of money and reassure people (which generates regime uncertainty that leads to a massive fall in private investment); and damage to financial intermediation caused by the collapse of some of the largest banks. AD drops to –4 percent, with real GDP reaching

government spending can crowd out private expenditure and private sector investment, which will reduce total factor productivity.

[8] The rise in inflation immediately prior to a crash is evidence of the Ricardo effect (see Miller 2009).

–5.9 percent in Q1 2009. Show the impact of these simultaneous shocks, and label the new situation point *C*.[9] (Figure 3 shows what the graph should look like.)

Figure 3. Q1 2009

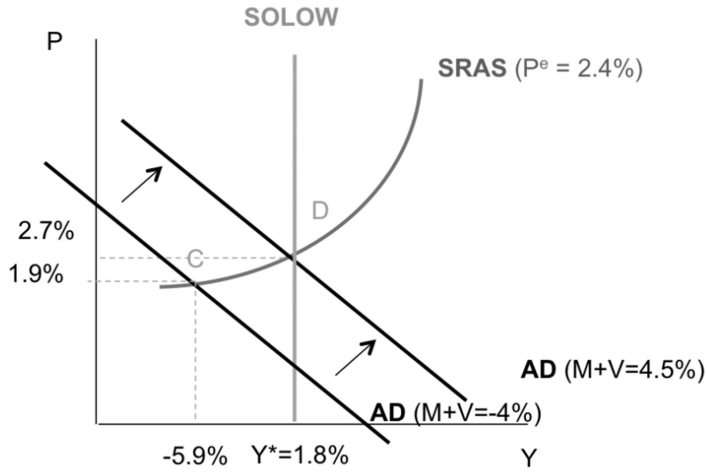


Instruction 4: In March 2009, the MPC launched quantitative easing (QE) in an effort to boost AD, and despite being dampened by a simultaneous increase in capital requirements (see Bridges and Thomas 2011) and also offset by fiscal austerity, by Q4 2010, AD rose by 8.5 percentage points.[10] If this increase in AD coincides with the underlying Solow curve, show the UK economy as of Q4 2010 and label it point *D*. (Figure 4 shows what the graph should look like.)

[9] It is only through a combination of a negative AD *and* a negative Solow shock that we would expect such a large decline in real GDP growth but such a moderate fall in inflation. During 2008, the MPC were reluctant to cut interest rates because CPI was high. The diagram above demonstrates the problem with inflation targeting. Because of a negative Solow shock, the concurrent AD shock wasn't deflationary. But it was highly damaging to the real economy.

[10] Despite the rhetoric, the evidence suggests that little austerity actually took place (see Evans 2012). Also, the UK policy uncertainty index fell during this period, suggesting a rise in confidence.

Figure 4. Q4 2010



Point *D* isn't an equilibrium, because inflation is above expectations. But since further elaborations would make things even more complicated, it seems a reasonable place to stop. Events in the Eurozone could be added to, which would constitute a negative AD shock. In addition, the previous austerity was front-loaded with tax increases that are likely to damage the economy's underlying potential. Therefore, we could factor that in as a negative real shock. We might also emphasize a point made by Salter (2012): that regime uncertainty is best expressed as a short-term decline in AD, but over time, this also reduces the long-run growth potential.[11] There are plenty of ways to extend the analysis and bring it up to date. However, the four-step process from *A* to *B* to *C* to *D* already covers a number of different shocks and is testing enough to be an appropriate application for an undergraduate class.

II. Conclusion

Instructors can debrief by providing a critique of various policy decisions. Indeed, we identify three claims about the point at which monetary policy errors were made. The first is 2002, by orchestrating an NGDP growth rate that was suboptimally high. The second is August 2005, with the decision to cut interest rates. The third is September 2008, with the decision to allow NGDP growth

[11] It's debatable whether it's best to show this as a future shock to Solow or as an immediate one.

expectations to collapse. The reason the MPC allowed NGDP to contract in 2008–09 was because they were committed to a 2 percent inflation target. This discussion allows us to link the discussion with one about monetary policy rules, and the dynamic AD–AS model is especially helpful in distinguishing between money growth rules (targeting *M*), inflation targets (*P*), or NGDP growth targets (*P*+*Y*).

The dynamic AD–AS model is a highly useful framework for understanding the economy. Cowen and Tabarrok's use of the Solow curve follows nicely from the concepts introduced in growth theory. The AD curve bridges the quantity theory with the Keynesian cross, and the SRAS curve emphasizes the signal extraction problem. Indeed, a downside of the traditional AD–AS model is distinguishing between long-run and short-run supply shocks. The dynamic model overcomes this downside because the only shock that will shift the SRAS is a change in inflation expectations. All real shocks (regardless of how "permanent" they are) will shift the Solow curve. Students often find this concept easier to grasp.

The case study provided is an attempt to combine some of the most important shocks to the UK economy, and the models' predictions fit the stylized facts.

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Appendix: NGDP

	CPI	GDP Deflator	RGDP	NGDP
	D7G7	*IHYU*	*IHYR*	*IHYO*
2002 Q1	1.5	2.4	2.2	4.6
2002 Q2	0.9	1.8	2.2	4.0
2002 Q3	1.0	2.9	2.5	5.5
2002 Q4	1.5	3.0	3.1	6.2
2003 Q1	1.5	2.8	3.4	6.3
2003 Q2	1.3	2.7	3.5	6.3
2003 Q3	1.4	2.5	3.3	5.9
2003 Q4	1.3	2.9	3.2	6.2
2004 Q1	1.3	2.3	3.1	5.5
2004 Q2	1.4	3.1	2.7	5.9
2004 Q3	1.3	3.2	2.2	5.4
2004 Q4	1.4	3.1	1.9	5.1
2005 Q1	1.7	3.1	1.9	5.1
2005 Q2	2.0	3.3	2.5	5.9
2005 Q3	2.4	2.5	3.3	5.9
2005 Q4	2.1	2.7	4.3	7.1
2006 Q1	1.9	3.2	4.0	7.3
2006 Q2	2.3	2.4	3.1	5.6
2006 Q3	2.4	3.3	2.2	5.7
2006 Q4	2.7	3.1	1.4	4.5
2007 Q1	2.9	3.0	2.0	5.1
2007 Q2	2.6	2.8	2.3	5.1
2007 Q3	1.8	2.9	2.9	5.9
2007 Q4	2.1	2.8	3.1	6.0
2008 Q1	2.4	3.0	2.4	5.5
2008 Q2	3.4	2.9	1.2	4.2
2008 Q3	4.8	2.8	–1.2	1.5
2008 Q4	3.9	2.8	–4.2	–1.5
2009 Q1	3.0	2.1	–5.9	–4.0
2009 Q2	2.1	1.8	–5.6	–3.9
2009 Q3	1.5	2.0	–3.8	–1.9
2009 Q4	2.1	2.2	–1.3	0.9
2010 Q1	3.3	3.4	0.7	4.1
2010 Q2	3.5	3.8	1.7	5.6
2010 Q3	3.1	2.5	2.0	4.6
2010 Q4	3.4	2.7	1.8	4.5
2011 Q1	4.1	3.0	2.1	5.2
2011 Q2	4.4	1.5	1.7	3.2
2011 Q3	4.7	2.1	2.0	4.1
2011 Q4	4.6	1.9	2.1	4.0

	CPI	**GDP Deflator**	**RGDP**	**NGDP**
	D7G7	*IHYU*	*IHYR*	*IHYO*
2012 Q1	3.5	0.8	1.5	2.3
2012 Q2	2.8	1.6	1.0	2.6
2012 Q3	2.4	2.1	1.2	3.4
2012 Q4	2.7	2.0	1.0	3.0
2013 Q1	2.8	1.6	1.4	3.1
2013 Q2	2.7	2.2	2.2	4.5
2013 Q3	2.7	2.3	2.1	4.5
2013 Q4	2.1	1.8	2.8	4.7
2014 Q1	1.7	2.1	2.8	4.9
2014 Q2	1.7	2.3	3.0	5.4
2014 Q3	1.5	1.8	2.8	4.6
2014 Q4	0.9	1.2	2.8	4.1
2015 Q1	0.1	0.8	2.6	3.4
2015 Q2	0.0	0.5	2.4	2.8
2015 Q3	0.0	0.0	2.1	2.1
2015 Q4	0.1	0.0	1.9	1.9

Source: "Second Estimate of GDP: Quarter 4 (Oct. to Dec.) 2015," Office for National Statistics, February 25, 2016. Figures subject to revision.