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MACROECONOMIC EFFECTS OF REGULATORY CHANGES IN ECONOMIES WITH LARGE OUTPUT GAPS

The 'toxics rule' as an example

BY JOSH BIVENS

The debate over the effect of regulatory changes on employment has intensified in the past year, driven mostly by conservative members of Congress who have made an anti-regulatory campaign the centerpiece of their policy agenda to reduce the still-high levels of unemployment that are the legacy of the Great Recession of 2007–09.

Most mainstream economists would say that this linkage of regulatory changes and employment is odd, because regulation has trivial effects at most on the level of employment during normal economic times. But some economists have gone even further, arguing that regulatory changes should have zero impact on employment even during times of high cyclical unemployment. This latter argument is not quite right—regulatory changes can indeed affect cyclical unemployment, and in general the direction of these changes means they will lower the unemployment rate and create net new jobs in the economy. Granted, these effects will be modest in practice, generally because all of the proposed regulatory changes currently in play in American policy debates are modest, but it is important to note the direction of their effects given the public's justifiable concern about jobs.

This paper uses the "toxics rule" issued by the Environmental Protection Agency (EPA) in December 2011 to sketch out a macroeconomic framework for thinking about the impact of regulatory changes on jobs. The paper's major findings are:

- Even during normal economic times the effect of regulatory changes that increase the input cost of some businesses is most likely to shrink the measured "output gap" (the difference between what the economy is actually producing and what it could be producing if all resources were fully employed).
- During normal economic times, the effect of the downward pressure on output gaps will be fully offset by a Federal Reserve that is trying to maintain a constant inflation target.
- During times of significant economic slack, the downward pressure on the output gap caused by cost-raising regulatory changes is unlikely to be fully neutralized by a Federal Reserve that puts any weight at all on unemployment.
- When significant economic slack persists even when the interest rates controlled by the Federal Reserve are held at zero, the overall effect of cost-raising regulatory changes is almost surely expansionary.
- Previous studies (such as Bivens 2011) that have estimated the jobs impact of specific proposed regulatory changes have probably understated the gains to employment spurred by the rule, likely by roughly 50%. But even given these understatements, the effects of some specific regulatory changes—such as the toxics rule, the largest single air-quality rule currently being proposed by the EPA—are surely positive for job creation.
- Applying the same methodology as in previous papers assessing the jobs impact of the proposed toxics rule indicates that the final rule would create roughly 84,500 jobs by 2015.
- Applying the findings of this paper to the final rule indicates that the rule would probably create closer to 117,000 jobs.

Short-run changes in employment and unemployment and regulatory changes

A previous paper (Bivens 2011) provided background and analysis on the proposed toxics rule, which would limit toxic emissions from power plants. The paper noted that the long-run effects of a regulatory change of this scope would be trivial (an outcome also predicted by textbook economic theory), and it argued that, in the shorter run, in an economy with productive slack, the net effect of such a regulatory change would be the sum of a number of countervailing influences.

The first influence would be the effect of the regulatory change on employment in the directly regulated industries themselves. Bivens (2011), as well as the Regulatory Impact Analysis (RIA) prepared by the EPA (2011a), relied on the work of Morgenstern, Pizer, and Shih (2002) to assess these effects.

The second influence on the economic impact is the direct effect of employment created by the installation of pollution abatement and control (PAC) equipment to comply with the new regulations.

Third, as the higher costs at power plants filter through to higher prices for the goods whose production uses energy, households will cut back consumption in response to this higher overall price level.

Finally, the net of these first-round impacts will be subject to multiplier effects that can characterize economies with lots of productive slack.

Bivens (2011) took as a given that one need not assess the depressing effects of interest rate hikes engineered by the Federal Reserve in response to price increases. While the Fed would almost surely raise interest rates to blunt price increases during normal economic times, the current policy of the Fed is to keep interest rates low, even in the face of transitory price increases, until the large productive slack in the economy is substantially worked off. Hence, if the investments induced by the toxics rule come online in the next three years—a period when the unemployment rate is almost universally forecast to be well above full employment—it is unlikely that the Fed would institute any countervailing policy.

While that paper assumed that no Federal Reserve pushback against price increases need be factored into the short-run macroeconomic effects of regulatory changes like the air toxics rule, this follow-up paper provides more background on the likely macroeconomic effects of regulatory changes on an economy characterized by a large output gap even as short-term interest rates are held at zero.

In the previous paper, the full impact of price increases spurred by rising energy costs filtered one-for-one into rising prices economy-wide, and these rising prices reduced household demand for goods as goods became more expensive.

Yet both of these assumptions (full pass-through to prices and a one-way cause from a higher price level to reduced demand) are likely inappropriate for the U.S. economy today. For one thing, there are ample reasons to believe that a rise in the cost of energy spurred by regulatory changes will not raise prices economy-wide in an economy with such high levels of productive slack. Further, even if a rise in the price level did occur, it is not obvious that these higher prices would unambiguously reduce demand in an economy with ample productive slack. In fact, much recent research has come to the opposite conclusion.

The rest of this brief sketches out these arguments, and the broader framework that results from this analysis finds that there will be no negative impact of regulatory changes on short-run employment or unemployment.

The macroeconomic framework

The framework used in Bivens (2011), while complete, is tailored to the specific impact of the toxics rule. The rest of this section will generalize the macroeconomic implications of regulatory changes that require firms to make investments to comply. These macroeconomic implications are not particularly intuitive. Often the intuitive way to think of these changes is to imagine oneself as the regulated business. The regulatory change makes meeting current levels of production (slightly) more costly, so the impact is imagined to be simply less production and hence less employment. But this outcome is not the full story, because it does not cover the full general equilibrium effects of the change. The investments that are a cost to the regulated industries actually employ people and constitute incomes for other business owners and workers.

Probably the most straight-forward way to think of a regulatory change that requires costly compliance investments is as a negative shock to measured levels of productivity. Productivity is the amount of output produced with a given level of inputs (in what follows we will generally look at simple labor productivity, i.e., the amount of output generated during each hour of work). If a regulatory change leads firms to purchase more inputs (in the case of the air toxics rule, scrub-

bers and other emissions-controlling devices, as well as labor and materials) to produce the same amount of measured output, then modeling the regulatory change as a shock to measured productivity makes sense.

Note that *measured* productivity is the correct way to frame this. While the regulatory change will make measured output—energy generation, for example—more input-intensive, many of the benefits of the regulatory change will be unmeasured and will likely not be measured by the regulated firms. Premature mortality and losses to children's IQ that are avoided by instituting the toxics rule, for example, will not be measured as gains to economic output and hence will not stop the regulatory change from manifesting itself in macroeconomic statistics as a lower level of productivity. But these benefits are large enough to justify the regulatory change in a rigorous cost/benefit analysis.

Given that it is misleading from a cost/benefit analysis to portray regulatory changes strictly from the point of view of the regulated industry, it may seem likewise odd to model them as a negative shock to the level of productivity. But this method is actually a useful device for analyzing how they will affect employment growth.[1]

The keys to spurring job growth in the short run: reducing the output gap

In an economy with productive slack, short-run changes in the unemployment rate will occur through reductions in the "output gap"—the gap that exists between what the economy could be producing if all resources were fully employed and what the economy is actually producing currently. If actual lags potential production, then the economy is said to have productive slack, and the source of this slack is simply that aggregate demand for goods and services stemming from households, businesses, and governments is not sufficient to fully employ available productive resources (land, labor, and capital) in the economy.

Short-run changes in unemployment are driven almost entirely by changes in the output gap (see **Figure A** on the historical relationship between the output gap and unemployment). As of November 2011, the output gap remained large in historical terms while unemployment remained high. Grading any policy's effect on unemployment will therefore depend on how the policy affects this output gap.

Regulatory changes and potential output

Thinking of regulatory changes as a negative shock to measured productivity makes it clear how these changes can lower unemployment and boost jobs. A negative shock to measured productivity reduces potential output, and this drop-off mechanically reduces the output gap. Essentially, after implementation of the regulation the same amount of output demanded by households, businesses, and government can only be produced with *more* inputs, including labor. So the most direct effect of regulatory change will be to make economic output more labor-intensive, i.e., output will require more hiring and hence create jobs.

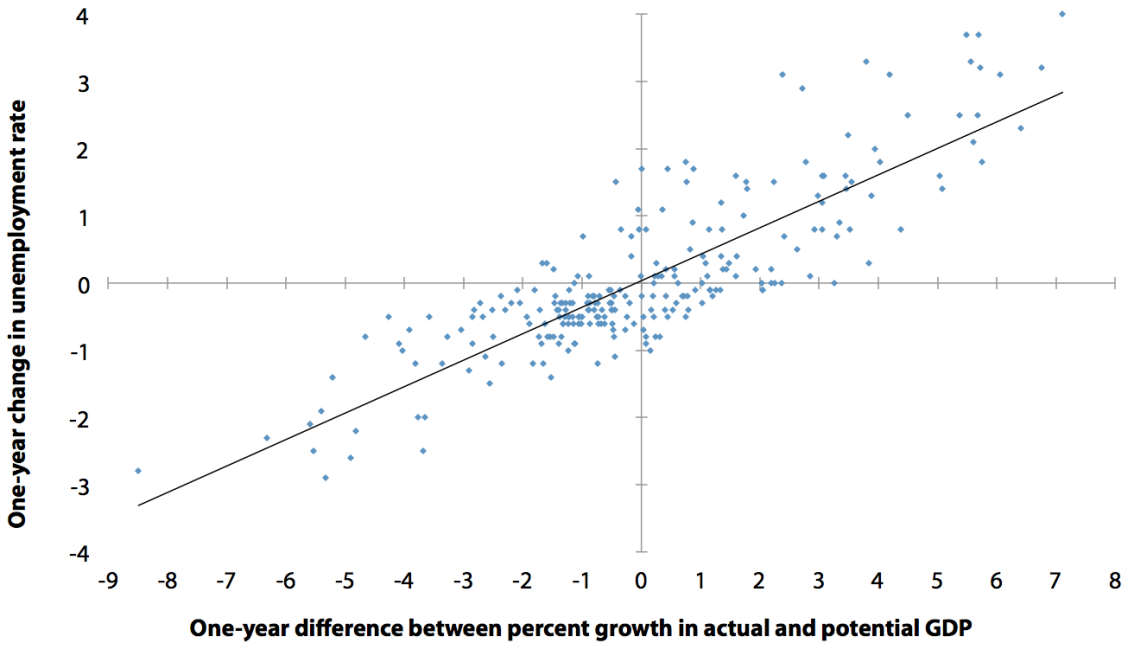
Regulatory changes and aggregate demand

If the negative shock to measured productivity were the only consequence of the regulatory change, then these changes would lead unambiguously to job growth and lower unemployment rates. However, there are possible channels through which these changes could also spur reductions in aggregate demand, not just aggregate supply.

If the negative shock to measured productivity were seen as permanent, then households would likely see a reduction in the level of their permanent incomes and would cut back their spending proportionately. Productivity provides the

FIGURE A

One-year difference between growth in actual and potential GDP and one-year change in unemployment rate, 1950–2011



Sources: Author's analysis of Bureau of Labor Statistics (BLS 2011); Bureau of Economic Analysis (2011), Table 1.1.5; and Congressional Budget Office (2011)

ceiling at which average living standards in an economy can grow over time, so a shock to productivity seen by households as permanent will lead them to cut back what they perceived they could afford with their lifetime income. If this reduction in household spending were exactly as large as the negative shock to measured productivity, aggregate demand would fall proportionately and leave the output gap unchanged.

Of course, even if the output gap were unchanged, the fact that the economy now has lower levels of measured productivity could still imply that more jobs were demanded even in the face of an unchanged output gap. Specifically, if the industries producing the output on which households were cutting back were not as labor-intensive as the new investments needed to comply with the regulatory change, then even an unchanged output gap could lead to more jobs demanded in the overall economy.

This race between the extra labor needed due to the negative shock to measured productivity and the labor displaced as households cut back spending is actually the best way to view the results from Bivens (2011), the earlier paper on the toxics rule.

If the negative shock to measured productivity were seen as completely transitory (say, that produced by a one-time installation of scrubbers), then households would likely *not* cut back their spending proportionately. The result in this case would be a reduction in the output gap, as aggregate supply would fall further than aggregate demand. This reduc-

tion in the output gap could then lead to a rise in the overall price level (prices are generally seen as a positive function of the output gap). If the Federal Reserve followed a standard "Taylor rule" that mandated interest rate increases in the face of upward price shocks, then this reduction in the output gap would likely be offset by higher interest rates that blunted growth in consumer spending and business investment.[2]

Besides prompting a response from the Federal Reserve, a rise in the overall price level could also affect aggregate demand directly through "wealth effects"—as prices rise, the real value of wealth is reduced and households may cut back on spending.

Regulatory changes and the output gap at the zero bound

The previous section presented a simple framework to view the macroeconomic effect of regulatory changes that necessitated costly investments on the part of firms. It sketched out the likely impacts of these regulatory changes on aggregate demand and supply as well as (by definition) on the size of the output gap, and it forecast the response of the Federal Reserve to these changes.

However, today's economic environment and the likely response of the Federal Reserve to changes in aggregate demand and supply are very different than in nearly any other period in postwar U.S. history. Not since the Great Depression has the economy found itself with such a large shortfall of aggregate demand relative to potential supply, particularly several years after the Federal Reserve pulled short-term interest rates all the way to zero (see **Figure B**). Given this context, it is worth asking where these considerations leave us in assessing the real-world impact of regulatory changes on job growth in the next couple of years, a time when general principles and intuition about the effects of regulatory changes are probably bad guides.

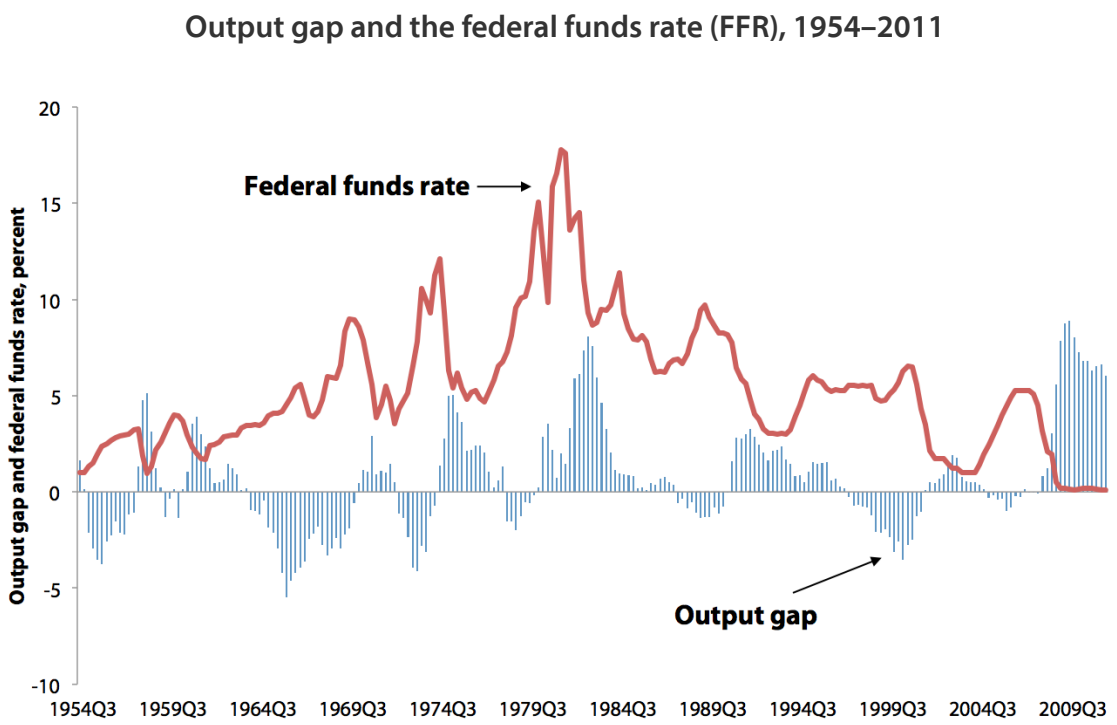
The assumption that households will react to the negative shock to measured productivity by cutting back their spending one-for-one is extremely conservative. For one thing, it is likely that the measured-productivity shock of regulatory changes is not permanent: many of the compliance costs are front-loaded (building scrubbers, cooling towers, baghouses, etc.). While there is a component of compliance that will involve ongoing costs, it is almost surely incorrect to model the entire shock to measured productivity as permanent.

Further, even if the shock were permanent, a substantial body of economic research shows that the permanent income hypothesis—the argument that households adjust current consumption only in response to permanent income changes—is incorrect. Rather, households use rule-of-thumb consumption rules and tend to adjust consumption slowly, even in the face of permanent shocks.[3] As such, it seems unlikely that aggregate demand will fall one-for-one with aggregate supply in the case of regulatory changes.

In all likelihood, then, the output gap is most likely to shrink as a result of the regulatory changes, meaning that, all else equal, one should expect growth in jobs and lower unemployment.

But this leads to another question: Will the reduction in the output gap lead to upward price pressure that will choke off aggregate demand growth? The answer is most likely no. Any upward price pressure stemming from the regulatory change will be blunted in the current economic environment. Research on inflation in the face of persistent large output

FIGURE B



Sources: Author's analysis of interest rate data from Federal Reserve Board (2011), potential GDP data from Congressional Budget Office (2011), and gross domestic product data from BEA (2011), Table 1.1.5

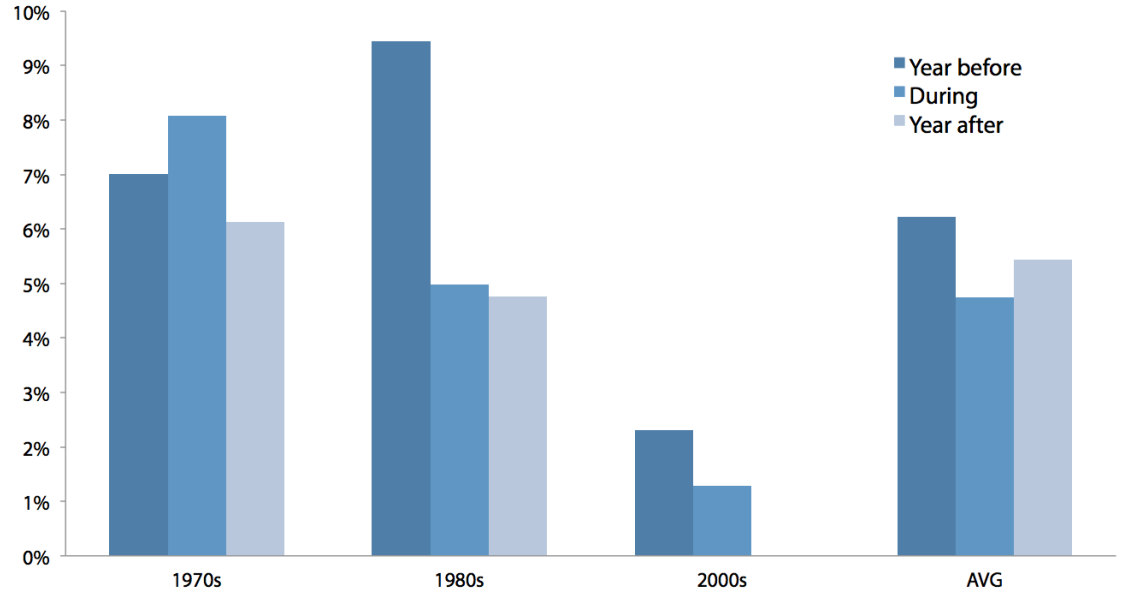
gaps (PLOGs) shows that these gaps exert great downward pressure on price growth (see, for example, Meier 2010). **Figure C** illustrates the point that very large PLOGs are associated with great downward price pressure.

Further, **Figure D** demonstrates that firms currently have very large profit margins—the highest pre- and post-tax margins in 45 and 42 years, respectively. These give firms a large buffer against cost increases pushing up prices (on the role of profit margins as buffers against future price increases, see Rich and Rissmiller 2000). In addition, unit labor costs in nominal terms remain lower at the end of 2011 than they were at the beginning of the Great Recession. All in all, slack in labor and product markets means that there is severe disinflationary pressure on firms that would make it less likely that anything as small as the compliance costs associated with proposed EPA regulations could register as overall price increases.

Figure E shows that, between 1958 and 2011, a $0.10 rise in unit non-labor costs is associated with a $.02 decline in unit profits, suggesting that about 20% of a rise in costs is absorbed by profit margins. There seems little reason to believe that profit margins cannot perform such a cost-absorbing function in coming years, given that they are starting at such high levels.

FIGURE C

Inflation rates the year before, during, and after persistent large output gaps (PLOGs)



Note: 1970s episode runs from 1974:3 to 1976:4, 1980s episode from 1981:4 to 1983:4, and 2000s episode began in 2008:4 and is currently ongoing.

Source: Author's analysis of core CPI-U from Bureau of Labor Statistics (inflation and prices programs). PLOG episodes identified by Maier (2010).

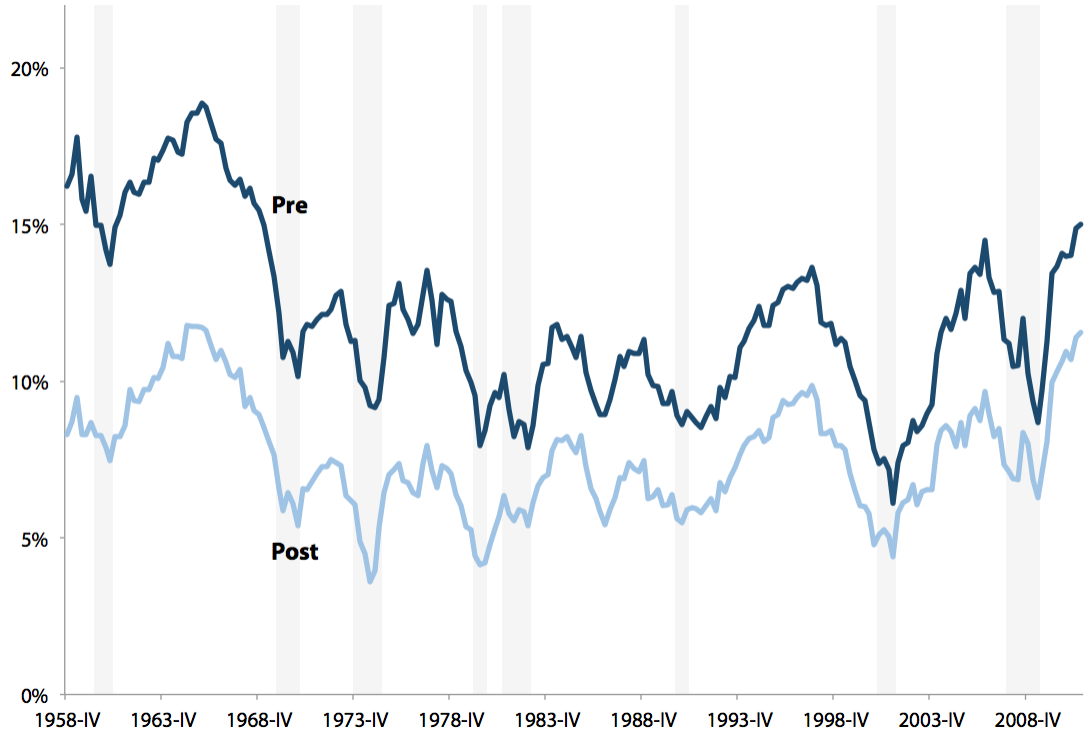
What if the price level rises due to the regulatory changes?

What if, even in the face of this disinflationary pressure, the overall price level did rise due to these regulatory changes? As noted above, during normal economic times a rise in the price level due to regulatory changes such as these will generally trigger a countervailing response from the Federal Reserve. An increase in interest rates to push down upward pressure on prices will lead to a reduction in aggregate demand. However, because of the PLOG, the Federal Reserve is unlikely to raise rates in response, so this channel through which price increases stemming from the regulatory change lead to lower aggregate demand seems unlikely as well.

Finally, so long as it did not spur a contractionary response from the Federal Reserve, a rise in the overall price level in the current economic environment is likely to boost, not lower, job creation in the near term. A longstanding macroeconomic argument maintains that during normal economic times a higher price level will reduce the real purchasing power of fixed nominal wealth and hence reduce aggregate demand. However, another longstanding argument maintains that a higher price level also decreases the real burden of debt, not just wealth, and if the propensity to consume out of current debt is higher than the propensity to consume out of current wealth, then a higher price level, by effectively redistributing purchasing power from lenders to debtors, can actually raise aggregate demand. Eggerston and

FIGURE D

Pre- and post-tax profit margins of nonfinancial corporate business sector, 1958–2011



Source: Author's analysis of BEA (2011), Table 1.1.5

Krugman (2011) argue that this "debt-deflation" effect is much more likely to occur in economies that have a large overhang of private debt, like the U.S. economy today.

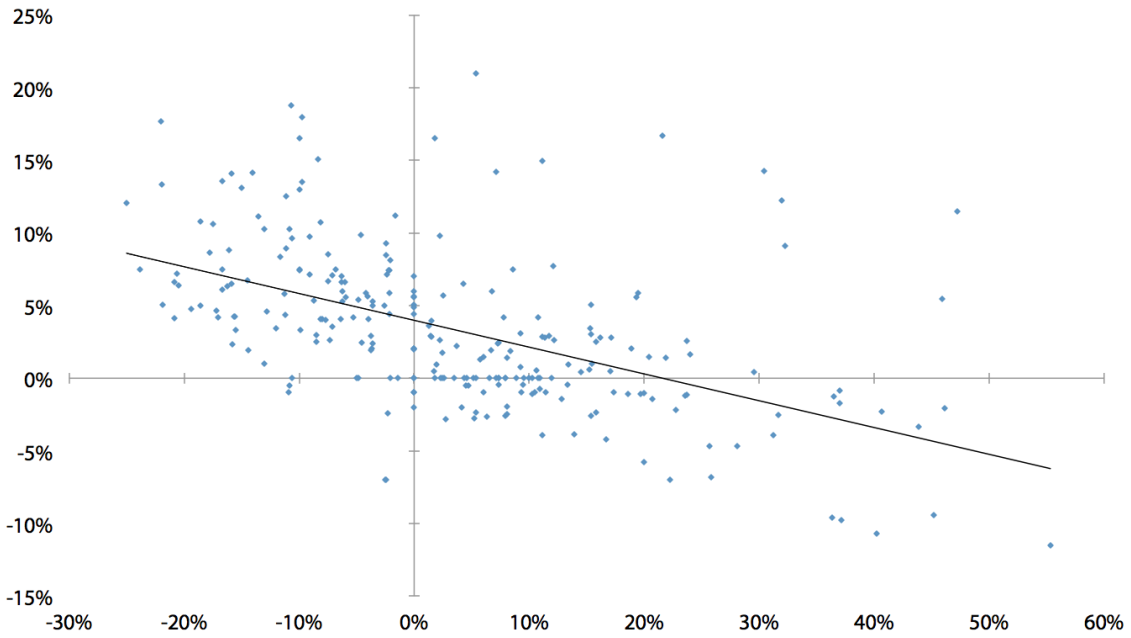
Given this latter point, Eggerston and Krugman argue that anything that reduces aggregate supply (like the negative shock to measured productivity that would follow from costly regulatory changes like the toxics rule) will actually increase aggregate demand if it leads to a rise in the overall price level.

What's the best estimate?

Given these cross-cutting influences, it is worth revisiting the estimates of Bivens (2011). In terms of the macroeconomic framework presented here, that paper presented the toxics rule as a negative shock to measured productivity that pulled down aggregate supply and aggregate demand near proportionately. Essentially, the estimates of jobs gained through the investments in PAC equipment can be thought of as the increase in labor intensity spurred by the reduction in measured productivity (i.e., the jobs gained through the decline in aggregate supply). And the estimates of jobs lost due to reduced household demand spurred by higher energy costs can be thought of as the reduction in aggregate demand caused by the productivity shock. Because the full values of the price increases were used in that study, they best correspond to the situation where the negative shock to measured productivity is perceived as permanent.

FIGURE E

Profit offset to rising costs: One-year change in unit profits and unit non-labor costs, 1958–2011



Source: Author's analysis of data from Table 1.15 of the NIPA accounts of the BEA

However, a rough calculation using the compliance costs identified in the RIA accompanying the toxics rule (EPA 2011a) indicates that about 60% of the costs are probably better classified as temporary rather than permanent. The EPA RIA breaks down projected compliance costs into capital costs (i.e., new investments made) versus operating costs induced by the proposed regulation. While the new capital installed to clean emissions will require maintenance and ongoing investment to keep depreciation at bay, it seems clear from the RIA data that a substantial part of the shock to measured productivity will be relatively short term, as plants make capital investments upfront.

Further, the rough estimate from Figure D about the possible profit margin absorption of some cost increases indicates that roughly 20% of the permanent decline in the negative shock to the level of productivity will not be transmitted to the economy through a higher price level.

Combining these two offsets—a 60% reclassification of the negative shock to measured productivity as temporary and a 20% offset to the price increases it spurs due to adjusting profit margins—would result in an aggregate demand decrease that was only 32% (100*(1-.6)*(1-.2) as large as that assumed in Bivens (2011).

The macroeconomic benefits of positive price shocks at the zero bound

Lastly, we can use two studies (Chung et al. 2011 and Carlstrom and Fuerst 2004) to derive rough estimates of the macroeconomic *benefits* of upward pressure on prices when the economy is stuck at the zero interest-rate bound.

The Chung et al. (2011) study uses the Federal Reserve Bank U.S. macroeconometric model (FRB/US) to estimate the impact of the unconventional monetary policy actions undertaken by the Federal Reserve since the onset of the financial crisis in 2007. It allows for an increase in the price level to affect real interest rates—specifically, a rise in inflation actually reduces real interest rates at the zero bound. Probably the best estimate from that paper as to the inflation/interest rate effect can be found in the difference between the "standard dynamics" estimate of the Fed's unconventional monetary policy effects in Figure 11 in the paper and the estimate that has agents that are not "forward-looking"—the authors characterize the difference between these two estimates as constituting the effect of the interaction between interest rates and inflation, with the causality running from upward price pressures to lower interest rates.

When Chung et al. (2011) estimate the effect of Federal Reserve actions after 2008 in supporting economic activity, they find that a 100-basis-point change in the federal funds rate corresponds with a 1% change in the price level and a 1% change in overall GDP. When they estimate this effect without the interest rate/inflation link, the effect is reduced by 25%. This implies that a 1% exogenous upward change in the price level should lead to a roughly 0.25% increase in GDP purely through the effect of lowering real interest rates. In the case of the toxics rule, the expected change in the overall price level stemming from the rule is probably best estimated by multiplying the change in energy prices (1.8%) by the share of utilities in the overall economy (2%), adjusted downward by 32% because of the influences of high profit margin buffers and the temporary nature of the compliance costs identified in the previous section. This calculation leads to an expected increase in the price level of 0.02%. Using the Chung et al. (2011) output implies that, if this increase in the price level directly reduces real interest rates, economic output should rise by roughly $3 billion (0.02% multiplied by a nominal GDP in 2011 of about $15 trillion).

Carlstrom and Fuerst (2004) estimate that, through its impact on redistributing wealth from borrowers to lenders, each 1% rise in deflation reduces output by just under 0.2%. Assuming this impact is symmetric and applicable to today's situation (which may be a conservative assumption), the 0.02% rise in the overall price level driven by the regulatory change will boost output by roughly $500 million.

All in all, the roughly $3.5 billion spur to aggregate demand produced through these channels reflecting the macroeconomic benefits of price increases at the zero bound would support roughly 30,000 jobs. This boost would provide a complete offset to the declines to aggregate demand caused by the reduced household spending following from the negative shock to measured productivity.

Summing up the effects

Bivens (2011) estimated that as a result of the toxics rule roughly 91,000 jobs would be created by investments in pollution abatement and control technologies, and roughly 38,000 jobs would be lost due to the higher overall price level when energy cost increases were passed on (one for one) to final goods prices. The paper also reviewed the EPA estimates that 9,000 jobs would be created within the utility sector itself due to the rule and found this a convincing (if conservative) estimate. Before multiplier effects, these two estimates together yielded 62,000 jobs created by the rule.

Since then, the EPA has released the final toxics rule and supporting technical documentation. In its final analyses, the rule will have lower compliance costs (about 13% lower) than in the original estimates and will also lead to lower price increases (roughly 20% lower). Therefore, a strict replication of the previous paper's analysis would result in 80,500 jobs created through investments in PAC equipment and 32,000 jobs displaced by rising energy prices. The new RIA

estimates that the number of jobs created within the utility sector would rise by 8,000 rather than the 9,000 specified in the proposed rule, for a net of 56,500 jobs total. Applying the 0.5 re-spending multiplier to these results (as in Bivens 2011) yields the result that the final rule would create 84,500 jobs, as opposed to the 92,500 jobs created through the proposed rule.

If this paper is correct, however, then the job declines stemming from the price effects are too high. If most (60%) of the compliance costs generated by the rule are temporary, and if profit margins are likely to absorb 20% of the rise in input prices, then the negative price effects should be cut by roughly two-thirds (40%*80% = 32% of the price rise being permanent and actually faced by consuming households). If one cuts the jobs lost to higher prices estimated in the earlier paper by this two-thirds, then the central estimate for pre-multiplier jobs rises to 78,000.

Further, if the macroeconomic benefits of upward price pressure fight the decline in permanent income to a draw, as this paper suggests may be the case, then no loss of jobs will occur due to rising prices in the next 3–4 years. This outcome would raise the central pre-multiplier job estimate to just under 90,000 jobs gained.

Even with multiplier effects, these estimates translate into job gains of roughly 117,000 to 135,000 in 2015, depending on whether one or both offsets to the job-depressing effects of price increases are used. To be clear, this remains a very modest job boost—the economy needs roughly this number of jobs to be created each month simply to keep the unemployment rate stable. In short, even with this re-assessment of Bivens (2011), the toxics rule is not a jobs program. It is a sensible regulatory change that will see benefits that far outweigh costs. But what this reassessment does make clear is that it is near-inconceivable that adoption of the rule will cost any jobs at all in the near term. The effect will be unambiguously positive.

Endnotes

1. Note that this device—modeling exogenous increases in energy prices as a shock to aggregate supply—is also used by Eggerston (2010) in his exposition of how the economy behaves differently at the zero interest-rate bound than during other times. He specifically talks about an oil-price shock as an exogenous change in input prices that shifts the aggregate supply curve.

2. This discussion about the different effects that shocks to the level of productivity would have depending on whether they were seen as transitory or permanent draws largely on the work of Buiter (2000).

3. A study by Card, Chetty, and Weber (2007) is the best reference on this. They find that the representative household is, as they describe it, about "70% of the way" toward rules-of-thumb consumption decisions and away from decisions based on the household's own estimates about the trajectory of permanent income.

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