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Oil crisis, energy-saving technological change and the stock market crash of 1973–74 ☆

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ABSTRACT

The market value of U.S. corporations was nearly halved during the oil crisis of 1973–74. In this paper, we investigate the hypothesis that the sharp rise in energy costs during this period resulted in the obsolescence of firms' existing capital and reduced their market value. To quantify this obsolescence channel of the energy crisis, we simulate a calibrated dynamic general equilibrium model, where firms adopt energy-saving technologies along with the rise in energy prices, and the value of their installed capital falls due to investment irreversibility. We find that this channel can account for a third of the decline in Tobin's q observed in the data. Separately, we consider the role of investment subsidies extended by the government during this period to expedite the adoption of energy-saving technologies. This extension of the model can account for more than half of the decline in q. We also find empirical support for the capital obsolescence channel in cross-sectional regressions, where we show that the sectoral variation in the decline of energy use following the crisis is significant in explaining the sectoral variation in the drop of market values.

1. Introduction

U.S. corporations were valued at par with their tangible asset holdings during 1962–72, but by 1974, almost half of their market value was wiped out (see Fig. 1).[2] In the decade following the crash, the ratio of the market value of corporations to the replacement cost of their tangible assets (i.e. Tobin's average-q) was only 0.55, and did not recover to its pre-crash levels until the early 90's. The fact that q fell well below 1 and for a prolonged period of time, makes this stock market episode, in the words of Hall (2001), the "single hardest [stock market] episode to understand". The abrupt decline in corporate market values coincides with the oil crisis initiated by the OPEC embargo. The embargo was announced in early October of 1973, and the largest drops in the stock market occurred during the 4th quarter of 1973 and throughout 1974. Energy prices (relative to the business GDP deflator) more than doubled by 1981 and were still about 50% higher than their pre-crisis levels after two decades.

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1 The views expressed are those of the individual authors and do not necessarily reflect official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve System, or the Board of Governors.

2 See Appendix A for data sources and calculations underlying the figures.

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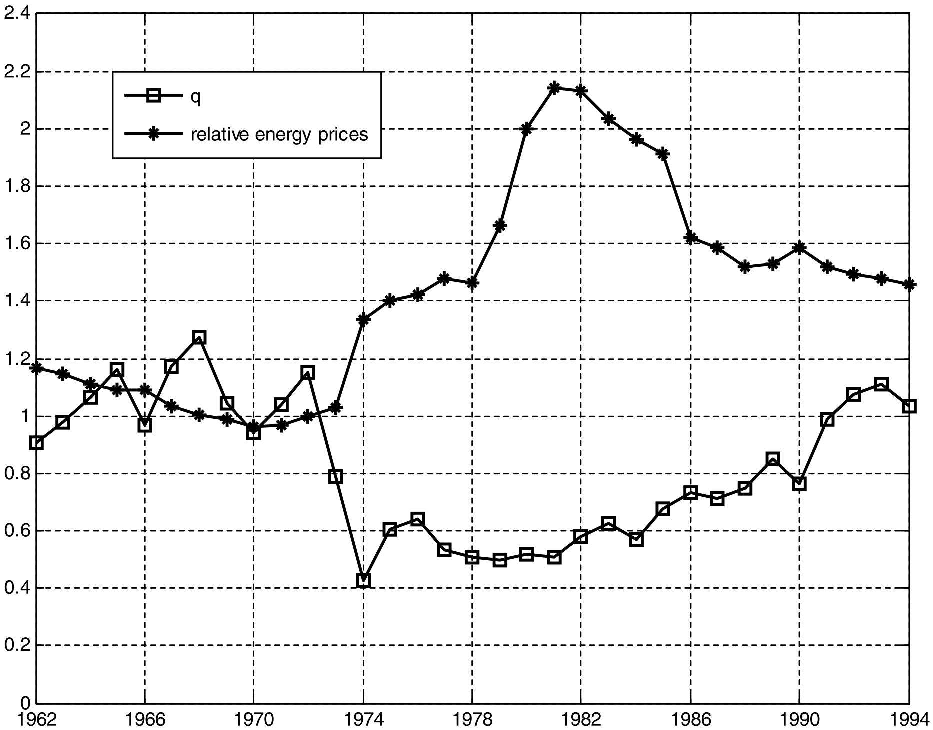

Fig. 1. Tobin's average-q and energy prices relative to GDP-deflator.

The main objective of this paper is to quantify the apparent link between these two events, and determine how much of the decline in market values and Tobin's q can be accounted by the observed changes in energy prices. A quick back-of-the-envelope calculation can illustrate the importance of energy costs in influencing stock prices: Although energy represents a small portion of overall costs of corporations, it is sizable relative to their dividend payments; both are about 5% of corporate value-added. Everything else constant, a 50% permanent increase in energy prices would increase energy costs by 2.5 percentage points and reduce current and future dividends by an equivalent amount. This would translate into a 50% decline in market value. Of course, everything else is not constant, and changes in energy prices also have implications for interest rates, wages, investment, and other factors that could affect dividend flow and market value. A general equilibrium model is thus needed to sort out all these different factors in play.

Perhaps more challenging is to account for the drop in Tobin's q rather than simply the drop in market value (i.e. the numerator of q). By itself, an increase in energy costs would not cause a drop in q, as long as the price of firms' installed capital does not deviate from the price of potential replacements (Sargent, 1980). Firms would simply reduce investment, and market values would decline along with the fall in their capital stock, but q would not be affected. In the data, not only did q fall, but corporate investment actually rose during this period. The ratio of corporate investment to corporate value-added was 16% in the decade prior to the oil crisis, but rose to an average of 18% in the decade after. Given these observations, Baily (1981) and Sakellaris (1997) argue that the main channel through which energy prices affected market values in this period was capital obsolescence. The oil crisis spurred the adoption of energy-saving technologies, which drove the value of installed energy-inefficient capital down relative to its replacement cost. As Fig. 2 illustrates, real energy use to GDP ratio started to decline following the crisis, and this decline in energy intensity continued even after 1981 when energy prices were falling.[3] These facts are consistent with the presence of energy-saving technological change in the post-crisis period.

The literature on induced innovation has pointed to a causal link between the energy crisis and the introduction of energy-saving technologies during the 70's. Schurr (1983) reports that the energy-intensity of the U.S. economy was stable during 1950–73, and declined at a faster pace between 1973–83 than any other period in the 20th century. He concludes that the introduction of energy-saving technologies resulting from the oil crisis is the main culprit for this faster decline. Popp (2002) uses patent data to analyze the impact of energy prices on energy-saving innovation. He finds that the number of successful patent applications of energy-saving technologies increased dramatically during the mid-70's. The main conclusion of the author, based on econometric analysis, is that energy prices have a strong, positive impact on the number of energy-saving technologies. Dooley (1999) and Margolis and Kammen (1999) report that energy-related research and devel-

[3] Real energy use is obtained by deflating nominal energy costs by the real relative price of energy in Fig. 1.