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Capital investment and employment in the information sector

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ABSTRACT

Estimation of the employment effects of changes in capital investment is a standard tool in public policy debates. Typically, such predictions are based on employment multipliers derived from Input–Output analysis. In this paper, we measure the employment effects of changes in capital investment in the U.S. information sector by econometrically estimating an "employment multiplier" from historical data. The estimated multiplier is 10 information sector jobs for each million dollars in expenditure, and perhaps 24 new jobs per million dollars invested across the entire economy. Employment multipliers derived from the Input–Output methodology average about 16 jobs per million, but the multiplier includes jobs outside the information sector. Including employment spillovers, our estimates suggest the multipliers from Input–Output models are plausible. We also note that information sector jobs have substantially higher median earnings than the private sector average, so the economic significance of changes in information sector employment are greater than might first appear. Our findings may be useful in debates over changes in industry regulation that could affect investment.

1. Introduction

Many studies of information sector employment have concluded that employment both in and outside the communications industry is highly responsive to capital expenditures by communications firms. Consequently, it is argued that, depending on the response of firms to regulatory interventions, public policy has significant employment effects. The consistency of these findings is unsurprising – these studies rely almost exclusively on employment multipliers calculated by the U.S. Bureau of Economic Analysis' ("BEA") Regional Input–Output Modeling System ("RIMS II") (Erlich, 1997).[1] RIMS is a general equilibrium model of the U.S. economy sponsored by a federal government agency and, unlike private-sector models, the RIMS output is available at low cost to the research community. For these reasons, RIMS is a popular tool for the estimation of regional jobs impacts. Thus, although numerous studies suggest similar employment multipliers for the information sector, this unanimity may be quite misleading, since it represents a single initial source.

In recent studies, the use of employment multipliers in U.S. communications policy is varied. Crandall, Jackson and Singer (2003) use (an average of industry-relevant) multipliers to estimate the effect of broadband adoption and expanded investment in information technology on the U.S. economy. This study used an average RIMS-based multiplier of 18.1 jobs

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[1] http://www.bea.gov/regional/rims/index.cfm. Use of the RIMS multipliers to size employment gains and losses is attractive for many reasons: (a) RIMS is a general equilibrium model of the economy, so it can estimate employment effects for the entire economy of expenditures in just one sector; (b) the multipliers are calculated by a government agency and thereby are unaffected by any alleged researcher bias; and (c) these numbers can be looked up rather than calculated or estimated directly, thereby making it easier for researchers to produce estimates of employment effects.

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for each $1 million in capital expenditures (Crandall et al., 2003, p. 14). More recently, Crandall and Singer (2010) updated this earlier study, employing a RIMS-based multiplier of 16.7 jobs per million dollars in investment spending. In an effort to encourage government investment in broadband technology as part of the American Reinvestment & Recovery Act, the Communications Workers of America (CWA, 2009) claimed that 97,500 jobs would be created for each $5 billion in investment (using a RIMS-based multiplier of 19.5). Davidson and Swanson (2010) used a multiplier-based approach to argue that Network Neutrality regulation will reduce employment by curbing the incentive to invest in communications networks, applying the RIMS-based multiplier from Crandall and Singer (2010). Eisenach, Singer and West (2009) employ a multiplier of 19.7, while Singer and West (2009), leaning on estimates for non-fiber investments from the Eisenach et al. (2009) study, predict that an increase of 39,961 jobs would occur due to $2.72 billion in investment for an implied multiplier of about 14.7 jobs per million. Bazelon (2010) also considers the employment effects of reduced investment from Network Neutrality regulation, but uses the IMPLAN Input–Output model to estimate employment effects rather than the RIMS multiplier tables. The resulting multiplier (averaged over five years) is smaller than those cited in the prior studies at 13.6 jobs per million of investment. The studies described here represent a small sample from a voluminous literature that has utilized employment multipliers in an attempt to influence communications policy over many decades. Almost all studies to date apply multipliers obtained from Input–Output (I–O) models.[2]

The widespread use of multipliers immediately raises the issue of their validity. Providing evidence on this point is the purpose of this paper. To this end, we will calculate employment multipliers using an entirely different methodology. Specifically, we estimate a type of "employment multiplier" directly from historical data using time-series econometrics (Rosen & Mathur, 1973). This econometric approach offers several benefits. First, while the I–O models provide uniform, annual employment effects, the time series approach is dynamic, thus permitting the estimation of both the immediate and delayed effects of a shock. Second, the causal connection between jobs and expenditures (at the margin) can, in principle, be statistically tested. In contrast, the I–O methodology is predicated on the existence – and uniformity – of such effects. Third, and most importantly, most studies of employment effects in the communications and information industry are national in scope, but the BEA makes clear that the RIMS multipliers are, in fact, *regional*, and caution that "[d]ifferences in industry-specific regional multipliers are not meaningful or appropriate for use in a national context."[3] Additionally, the BEA offers a number of reasons why the RIMS multipliers "are likely to be upper bound estimates," including the assumptions of: (1) no supply constraints; (2) fixed patterns of purchase; and (3) the use of local inputs when available.[4] As a check on the validity of the common use of the multipliers to evaluate public policy, the multipliers obtained from econometric estimation can be compared to the I–O multipliers used in prior studies, providing policy-makers with either independent support for current estimates, or else reason to apply the current estimates with caution. For both historical and practical reasons, the I–O multiplier methodology has become standard, and we do not claim the statistical approach is superior. We do suggest, however, that the nearly universal reliance on the I–O framework means the apparent "consensus" on employment effects should be seen for what it is – a reflection of the use of a common methodology, rather than evidence in support of the magnitude of current estimates.

Our approach, however, is not without important limitations which must be recognized. For example, our analysis is limited to "Information" sector capital expenditures and jobs. Clearly, capital expenditures in the sector may create employment opportunities outside of the information sector, so we suspect our "multipliers" could be smaller than those found using RIMS or other I–O models, which take a broader view of the economy. Consequently, our directly-estimated (information sector) multipliers are probably conservative estimates relative to those found in these prior studies. We will make an effort to assess the impacts of such limitations, but the reader should keep these caveats in mind.

Our findings are mostly reassuring: we calculate investment-employment multipliers that are similar to, but smaller than, those often borrowed from RIMS and similar models. In the first year, a one million dollar shock to information sector capital spending will "create" six information sector jobs (one-year multiplier of 6). Five-years after the shock, the employment multiplier is about 14. This five-year effect is broadly consistent with I–O values (see Table 1). This finding is somewhat surprising since the RIMS (and some other) models are specifically designed to provide *regional* employment effects across multiple industries. Whether this pleasant discovery is purely fortuitous, or is result of some peculiarity of the information industry, is an interesting question beyond the scope of the present paper.

2. The multiplier method

The development of I–O analysis is attributed largely to the Nobel Prize-winning work of Leontief (Carter & Petri, 1989), though some economic historians trace the idea to Quesnay's Tableau Economique (Ekelund & Hebert, 2007). The I–O model is primarily used as a tool for simulating the impacts – measured by changes in output, income and/or employment – of an economic event on a particular regional economy, and this is accomplished by a detailed accounting of inter-sectoral relationships within the target economy (country, region or county) using an I–O matrix populated with observed data (Miller and Blair, 1985). As described by Fjeldsted (1990, p. 1), the term regional impact multiplier "refers to the ratio of the

[2] In many cases, the multipliers used are for telephone equipment manufacturing and construction, the latter having very large multiplier effects (Eisenach et al., 2009).

[3] http://www.bea.gov/regional/rims/index.cfm (Emphasis supplied).

[4] https://www.bea.gov/regional/rims/RIMSII/illustrativetables.aspx.