Assessing the Impacts of Incentives to Attract New Businesses: A Case Study of the Scrap Recycling Industry

Preliminary Report

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Executive Summary

Virginia's business incentives program is similar in composition to programs offered in surrounding states and nationally:

- It contains a similar mix of dollars devoted to specific program components
- The combination of financial and other incentives offered in Virginia is close to the average combination
- The state's spending on incentives is "middle of the pack" compared to other states in terms of total incentives offered and incentives per capita. Virginia was 28th in total expenditures and 39th on a per-capita basis.

Use of a discretionary fund (e.g. the Governor's Opportunity Fund) for "closing the deal" is also common. Such a fund may be critical to the state's ability to attract certain types of businesses. The literature suggests that deal closers may break a tie between competing localities and thus may contribute to statewide growth.

The effectiveness of GOF may be improved by providing guidelines for its use. At a minimum, government should decide what it hopes to achieve through use of the fund.

- What are the objectives for use of fund? Several plausible objectives exist, such as employment maximization, income increases, targeting for disadvantaged areas.
- Currently, none of these objectives are explicitly being pursued and the resulting allocation of GOF resources appears haphazard and unfocused. In particular, the analysis of GOF allocations showed no correlation between use of the GOF and area economic conditions.

The Return on Investment (ROI) criterion used by the Virginia Economic Development Partnership to analyze the "soundness" of offers to firms should be modified. Currently, the analysis resembles no analysis a competitive business would undertake. First, it does not account for costs associated with providing services to in-locating firms. An improved ROI would look at all revenues (future taxes of all forms) derived from the business location decision minus all costs associated with providing services to the firms, their employees and associated

economic activities. Second, the input-output approach used in the ROI does not capture the effects on existing firms and input suppliers of changes in prices of inputs and outputs. Input-output analysis assumes, by construction, that all market participants gain from a firm's entry.

- An economic surplus approach captures price-related impacts of firm locations on existing input and output market participants.
- The ROI calculation should include costs associated with offering similar incentives to existing firms

Firm location in the Commonwealth clearly has an impact on government revenues and expenditures. Location has impacts on owners of factors: inputs, including land, labor and capital. In cases where firm location benefits everyone there are no distributional issues. However, most economic development events involve winners and losers. The Commonwealth should undertake an analysis of winners and losers and ensure that its economic development program produces more gains to the winners than losses to the losers.

In the case study examined here, the incentives provided to Chaparral Steel have had a large negative impact on existing firms (who lose more than $1 million in annual surplus) that is exceeded by the benefits to suppliers of scrap (who gain more than $1.3 million).

Guidelines for Incentive Programs

The following guidelines are suggested steps the legislature might take to enhance the effectiveness of Virginia's business incentives programs.

- Maximize local input at all stages of the recruitment decision. The programs currently require local input, and, in fact, the process is started through an application from the locality to the VEDP. However, the localities are often left out of the process of estimating ROI and the localities themselves incur many of the hidden costs (education, growth management, etc.) not covered by the ROI.
- Revise the ROI process to include the costs of services provided by the state to the firm and its employees. Also examine the costs and benefits to other participants in relevant markets.
- At a minimum, the current I-O model should be more closely scrutinized; employment multipliers of 3.0 are well above the norm experienced in other studies.
- Do not offer incentives to firms that offer wages below prevailing wages in an area,

unless distributional goals are being met. For instance, in a depressed area, there might be reason to work to attract a firm offering below-average wages, but not in general.

- Do not offer incentives to locate in one area of the state over another. That is, intra-state competition should not be encouraged. This guideline already appears to have been incorporated into existing practice.
- Impacts of investments on existing businesses and owners of factors used in production should be considered in the analysis prior to the decision about offering incentives. In practice, this guideline may be difficult to implement because of confidentiality and the speed with which decisions are made about providing incentives. However, in tight labor markets and when input or output markets are characterized by spatial segmentation (due to high transport costs relative to the value of the good in question), entry may have significant external (to the firm) impacts.
- Fairness dictates that long-term tax breaks for entering firms should be extended to existing firms, especially in the case where the existing firms might be harmed by entry.
- Clawback provisions should become more prominent in VEDP performance agreements. The sample performance agreements provided by VEDP indicate that incentives are only provided once specific performance is documented. However, this performance does not include "longevity" in the state. Although there is no known evidence that firms are abandoning the state following completion of performance agreements, clawbacks are an accepted practice in other states. Even without including costs of providing state services to the entrant and its employees, the typical ROI shows a "break-even" time well beyond the period spelled out in the performance agreement. By including the costs of services, the break-even period will clearly be extended. Clawbacks should be used to ensure that the firm at least achieves "break-even" performance levels.
- When legislation is proposed with a clear intent to benefit a single entering firm (e.g. 58.1-439.8), impacts on existing firms ought to be carefully considered. Firms that might be harmed by the entry should be compensated to the same relative extent as is the entrant. Existing firms that are close to meeting the conditions laid out in the legislation should be allowed the same benefits. Such fairness should be considered as a part of the "cost" of the legislation.

I. Introduction

Background

The ability to attract new businesses and to maintain existing businesses is crucial for both localities and the Commonwealth to maintain a healthy economy. Currently, a wide variety of incentive packages are being used to achieve this end. Concurrently, virtually every state in the country uses incentives to try to induce firms to locate within its boundaries. This proliferation of business incentive programs induces states and localities to compete with one another for a limited number of footloose firms. Increased competition between states has generated considerable debate on the merits of these incentive packages. For the most part, this debate has focused on whether the new firm would generate enough additional tax revenues to recover costs of the incentives within a reasonable time period. Such an exercise ignores many of the important impacts that firm location can have.

Entry of a firm into a locality can have important indirect impacts on existing firms through the local labor market, markets for raw materials, and output markets where the new entrant sells its products. In the local labor market, for example, unless there is a pool of unemployed individuals that possess the exact job skill required by the entrant, relocation will draw employees from existing businesses or induce in migration. In order to keep valuable employees, the existing businesses may be forced to increase wages. This upward pressure on wages clearly benefits the workers, but may harm the owners of the existing businesses. Economic development is a process involving winners and losers. Public policy should seek to maximize gains while ensuring that losers in the process can adjust to the new environment.

If existing businesses purchase raw materials that are also used by the new firm, then the prices to these businesses of the raw materials may increase with firm entry. This is particularly

important in the case where these raw materials are expensive to transport relative to their value. Such price increases benefit the owners of the raw materials, but hurt other businesses that require them.

Thus, the well-being of some individuals and firms may rise as a result of entry, but others may lose. It is understood that the net impact and its distribution depends on a number of attributes including the characteristics of the input and output market (how freely products move over space), the nature of supplies and demands for inputs and outputs, and the overall profitability of the industries in question. However, few empirical attempts at quantifying these impacts are known.

Problem Statement

The impacts of an economic development package can be properly assessed by considering not only the impacts (e.g. employment and incomes) of the new plant, but also examining the indirect impacts on existing firms and consumers (as both suppliers of labor inputs and demanders of final products). As economic development efforts affect input and output market structures, the net result of an incentive package might result in an unfair competitive advantage being bestowed on one market participant to the detriment of existing firms. Without understanding all the effects, direct and indirect, positive and negative, the desirability of providing incentives cannot be properly assessed.

Objectives

Economic development programs employ a variety of tools to influence business decisions. While these tools are relatively simple, their use produces a magnitude of economic impacts. Often, these impacts are not fully understood or considered. The general objective of this study is therefore to examine business incentive programs with the goal of elucidating, and,

where possible, measuring, the economic impacts of business incentive programs. To meet this goal, the following specific objectives will be accomplished:

1. To review the literature on business development incentives with a focus on the nature and level of economic impacts of development incentives. We will examine the existing evidence on the development impacts of incentive programs.

2. To provide a general review of economic development incentives offered by the Commonwealth and a comparison of the Commonwealth's development programs vis-à-vis the programs of other states.

3. To evaluate the procedures used in Virginia for granting incentives and then monitoring their impacts.

4. To analyze a case study of the Texas Industries Inc./Chaparral Steel incentives package. This case study provides insights into the incentives process in Virginia and uses economic methods to evaluate the impacts of the incentives program on already-established firms.

5. To provide guidelines for enhancing the effectiveness of incentives programs.

Procedures

The first objective will be met through a literature review. The goal of this review is not to exhaustively present the results of previous studies. Rather, the review focuses on the determinants of firm location decisions and the impacts of development incentives on these decisions. The second objective will be met by: (i) reviewing the package of economic development incentives employed in the Commonwealth; and (ii) contrasting economic development incentive programs offered by other states with those used in the Commonwealth. Emphasis will be placed on programs offered in bordering states.

The economic development programs offered by Virginia will be assessed by evaluating incentive programs against the stated goals and the legislative mandate of the programs. Particular emphasis will be placed on historical allocation of Governor's Opportunity Fund grants. In addition, the study will evaluate Virginia's allocation of incentives relative to criteria

espoused by leading researchers. The case study will present an analysis of a single incentives package that was accepted by TXI/Chaparral for the construction of a ferrous scrap recycling facility in Dinwiddie County. A framework for evaluating market-related impacts on existing firms is presented. Data from the case study are used to calibrate and run the economic model. The results of the study are then discussed.

II. Review of Literature

When evaluating business incentives, one objective is to determine if such incentives affect the investment decisions of businesses. Specifically, incentives are intended to attract business investment to or retain investments in particular locations and, as such, the factors involved in the business location decision are of concern. Thus, it is relevant to explore the major factors in the business location decision and how development incentives influence such decisions. The literature on firm location decisions is voluminous and, while the conclusions of the studies differ markedly, it is possible to identify some common themes.

Traditionally, studies of the determinants of business location have relied on surveys and interviews of business decision-makers to identify important factors in the location decision. Such studies tend to find that a variety of factors influence location decisions and generally fail to identify any individual factor as being extremely influential. In a review of such early studies, Blair and Premus (1987) indicated that factors such as "industrial climate," labor productivity, transportation and land availability are important. Firm surveys conducted by Heckman (1982) indicated that labor productivity, transportation, land availability and cost of land and construction and quality of life factors were most important in location decisions. In Schmenner's (1982) survey of Fortune 500 companies, access to markets, labor market conditions and land costs were found to be the most important factors. After reviewing several such studies, Fox (1991) concludes that the "decision of a firm to locate in a specific state is a complicated process in which many factors must be balanced and weighed before a final site is chosen."

Interestingly, many early studies found that factors such as tax rates and "favorable business climates" were not very important in the location decision. For example, Carlton

(1979) found that factors such as agglomeration economies and wages are important while taxes and the "business climate" did not seem to be important. However, more recent studies tend to find that the opposite is true.

No general conclusions can be drawn from the literature on location decisions. Clearly, the location decision is not entirely driven by profit maximization or cost minimization. Indeed, while costs are a clear concern, the location decision itself is quite subjective and the factors that are important seem to vary between companies. This leaves little hope of deriving a satisfying and tractable explanation of the location decision process.

In the present case, it is more relevant to ask whether and how development incentives affect the location decisions of firms. Given the similarities between development incentives and tax rate differentials, one can draw some conclusions from the location decision literature by examining the effects of tax rates on firm locations. Once again, the answers provided in the literature are not quite satisfying, but nonetheless provide some insight.

It is often more feasible to study business activity rather than the firm location decision. Bartik (1992) presents a meta-analysis of studies that examined the impact of tax rates on business activity and finds that of the 57 studies he reviewed, 70% found "at least one negative and statistically significant tax effect." Bartik argues that many studies have failed to properly consider various public service and fixed effects. Thus, the impact of the tax rate cannot be considered independently of services provided (through taxes); both the rate and level of services affect costs. Bartik notes that all of the seven studies that include controls for these factors found significant and negative tax effects. Additionally, Bartik estimated the elasticity of economic activity with respect to taxes (hereafter, "tax elasticity"). As would be expected from the previously mentioned results, he found that studies that control for public services and fixed

effects presented higher absolute tax elasticities than studies without the controls. Overall, the average estimated elasticity was –0.25, that is, a one-percent increase in the tax rate lowers economic activity by 0.25 percent. The average was -0.51 for the studies that included the controls.

A more recent review by Phillips and Goss (1995) employs a meta-regression model to analyze the studies reviewed by Bartik. Their basic assertion is that Bartik did not sufficiently control for differences among studies. The authors therefore introduce a set of binary control variables in order to account for study differences. After controlling for differences between studies, the authors estimated the tax elasticity to be –0.35. As would be expected, the authors found that studies controlling for fixed effects and public services found larger absolute tax elasticities.

These studies provide consistent evidence that tax rate differentials do indeed affect business decisions, at least when considered via a proxy variable such as economic activity. However, the relationship between business activity and location decisions is not entirely clear. The implicit argument is that businesses could produce additional units of output in existing facilities or by establishing facilities in different locations. Thus, a given increase in business activity in an area is tantamount to a firm deciding to locate there. This argument is somewhat questionable but the studies' conclusions are nonetheless interesting.

Other researchers have taken a more direct approach by attempting to assess the impact of taxes and tax incentives on business location decisions directly. In such direct studies, the difference between tax differentials and tax incentives is trivial since a given decision maker would theoretically view a tax incentive with a certain value as being equivalent to a negative tax rate differential of the same amount.

Generally, economic development programs endeavor to lower the state tax burden of target companies. Many researchers argue that state tax burdens are not important relative to other costs. Thus, they conclude that state economic development programs can have little impact on the location decisions of firms. There is some evidence to support this conclusion. For example, Calzonetti and Walker noted that about 80% of firms locating in an area were not even aware of the availability of business incentives.

In recent literature, tax incentives are more commonly viewed as "tie-breakers." As the business location decision process is generally viewed, businesses narrow their choice to several candidate locations between which they are nearly indifferent. Tax incentives are thought to affect the process most markedly at this point in the decision process. For example, Hanson (1993) notes that "Surveys of corporate executives show that policy inducements enter business calculations only when proximity to raw materials and markets, cost of energy availability of skilled workers, and other important investment criteria are equally well-satisfied by more than one location."

No known study exists showing how pecuniary effects (i.e. impacts on prices of inputs and outputs) from a firm location decision affect existing market participants. While economic theory is clear that entry of a large firm in a relatively small market will impact these markets, such effects are difficult to examine empirically. Numerous studies use standard input output models to examine multiplier effects caused through economic activity generated by input purchases and incomes created by the new firm (see Otto and Johnson, 1993 for an excellent summary and examples of empirical applications of input-output modeling to economic development impacts). An acknowledged weakness of input-output studies is that they assume prices are constant. They thus ignore a major source of impact on existing firms.

Summary

Business location decisions are clearly affected by costs associated with doing business in the area in question, among other things. This cost sensitivity depends on the type of business, its markets, and a number of other factors. Some businesses, e.g. those that are tied to specific locations, are not at all influenced by incentive packages, while "foot-loose" firms tend to play localities off against one another. At the state level, business activity is clearly sensitive to the tax rate, and incentives, by offering lower rates, may thus stimulate overall growth. But, as noted in the subsequent section, incentive-based tax reductions tend to be of limited duration, and no known study examines short-term tax reductions and their impacts on aggregate economic activity. Note that reductions in taxes can also benefit aggregate economic activities through expansions in existing firms. But these benefits only occur if the existing firms are offered the incentive packages.

Experts generally agree that incentive packages often serve as tie-breakers in the firm's location decision. This role as a tie-breaker provides justification for the existence of discretionary packages: once a state is identified as a finalist in the firm location decision, actors in the state can use their discretion in trying to land the firm.

III. Development Incentive Programs Around the Country

Economic development incentives are grants, loans, loan guarantees, tax credits, tax exemptions, and other tools used to partially or totally offset the costs of machinery, tools, buildings, land, and worker training. In addition to offsetting these costs, public funds may be used to build or expand infrastructure such as road and rail access, water and sewer facilities or to prepare sites or for combinations thereof. All states have some mechanism by which economic incentives are offered to firms as inducements to locate or expand. This fact provides justification for the use of incentives: if all other states use them then any one state will be disadvantaged in the economic development game by eschewing their use.

Because of the myriad of incentive programs, uneven accounting systems and, in some cases, confidentiality, it becomes difficult to compare the level of spending on incentive programs across states. One comparable data set is from the National Association of State Development Agencies (NASDA). Spending on economic development incentive programs varies greatly between states. Based on the NASDA survey for the fiscal year 1997/1998, Alabama's economic development program spent the least ($3.6 million) while Pennsylvania's program spent the most ($543.8 million). Virginia ranked 28th in the nation with total expenditures of $33.6 million (see table 1).

It is useful to normalize economic development expenditures so that comparisons between states are more meaningful. Population is a useful normalization variable insofar as it serves as a proxy for a number of factors. On a per-capita basis, Connecticut's program spent the most ($56.44) while Florida's spent the least ($0.76). Virginia ranked 39th with per-capita expenditures of $4.89.

Table 1. Economic Development Expenditures by State, Fiscal Year 1997/98

	Total Expenditure		Per-Capita Expenditure	
	($ Millions)	Rank	($)	Rank
Alabama	0.83	46	3.624	47
Arizona	12.21	28	58.355	22
Arkansas	20.30	20	51.790	25
California	2.71	43	89.834	14
Colorado	1.14	45	4.610	46
Connecticut	56.44	1	185.244	4
Delaware	24.53	15	18.488	39
Florida	0.76	47	11.461	44
Georgia	2.61	44	20.302	37
Idaho	15.36	23	19.229	38
Illinois	8.77	33	106.394	13
Indiana	13.56	25	80.586	15
Iowa	38.57	4	110.666	12
Kansas	26.61	11	70.616	18
Kentucky	3.38	42	13.397	41
Louisiana	13.45	26	58.819	21
Maine	23.71	16	29.706	31
Maryland	22.85	17	118.148	11
Massachusetts	5.35	38	33.033	30
Michigan	18.95	21	186.951	3
Minnesota	33.55	8	160.212	5
Mississippi	14.62	24	40.475	27
Missouri	25.86	14	141.410	7
Montana	30.57	10	26.990	34
Nebraska	32.56	9	54.247	24
Nevada	4.19	40	7.580	45
New Hampshire	11.79	30	14.163	40
New Jersey	3.44	41	28.048	33
New Mexico	7.04	36	12.251	42
New York	8.22	34	149.607	6
North Carolina	25.97	13	198.713	2
North Dakota	37.43	6	23.717	36
Ohio	10.97	31	123.467	10
Oklahoma	20.45	19	68.683	19
Oregon	8.02	35	26.609	35
Pennsylvania	45.34	3	543.765	1
Rhode Island	11.98	29	11.870	43
South Carolina	18.71	22	72.697	16
South Dakota	38.46	5	28.195	32
Tennessee	10.05	32	55.127	23
Texas	6.88	37	137.929	8
Utah	33.96	7	72.334	17
Vermont	55.77	2	33.116	29
Virginia	4.89	39	33.600	28
Washington	21.78	18	125.400	9
West Virginia	26.42	12	47.736	26
Wisconsin	12.87	27	67.592	20

Virginia is also similar to other states in terms of the variety and balance of its incentive programs (figure1). As is the case with other states, the Virginia programs tend to focus on reduction of tax burdens (credits, exemptions, refunds and deferrals) and on provision or guarantee of credit. Virginia offers a similar number of programs of each type compared with other states in the region.

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Figure 1. Types of Economic Developement Programs Offered Nationally, Regionally, and in the Commonwealth

IV. Economic Development Incentives Offered by Virginia

Virginia's Business Incentive Program is designed to contribute to the State's overall plan to stimulate economic development. This plan, known as *The Virginia Strategy: Prosperity into the New Century* has goals that include: (i) to create new economic and employment opportunities; (ii) provide work-force training to meet the challenges of the 21st Century; (iii) strengthen existing sectors and businesses; and (iv) concentrate economic development efforts on areas of greatest need to reduce economic disparity and increase the prosperity of all Virginians. The Commonwealth's business incentive program was revamped by the 1999 General Assembly to better enable the program to contribute to these goals (*Report on Business Incentives: 1997-1999).*

Description of Programs

Virginia business incentives programs can be classified into five categories:

1. Tax Incentives;
2. Enterprise Zone Incentives;
3. Workforce Services;
4. Infrastructure Incentives; and
5. Direct Grants.

Each program contributes to the overall state goals in different ways. Many seek to increase employment or promote capital investments. Others are targeted to specific areas and intended to boost the economic fortunes of less-advantaged areas. In most cases, there is little or no discretion involved in determining eligibility: firms that meet certain criteria are immediately eligible. In the following analysis of the programs, issues such as the goal of the program, the degree of discretion, etc. are described together with the components of the programs.

Tax Incentives

Tax incentives are determined by the legislature and apply to all firms and potential firms meeting the guidelines set forth by the enacting legislation. Such incentives are not discretionary. Virginia has three major tax incentive programs. The "Major Business Facility Job Tax Credit" (§ 58.1-439) grants a $1,000 per-job tax credit to companies that either expand or locate in Virginia. This tax credit has a 100 job threshold that must be met before a tax credit may be claimed (50 job threshold in designated Enterprise Zones).

Virginia has two "Recycling Equipment Tax Credits" authorized in §58.1-439.7 and 58.1-439.8. The former has no investment threshold and requires investment before the end of CY 2003; the latter, known as the "Alternative Recycling Equipment Tax Credit" requires an investment of at least $350 million before the end of CY 2002. Further, the recycling equipment tax credit referred to in §58.1-439.7 allows a maximum tax credit in any given year of 40% of the taxpayer's Virginia income tax liability and any unused credit can be carried over to offset the taxpayers income tax for a period of ten years. The alternate tax credit allows an offset of up to 60% of the claimant's Virginia income tax liability and allows a 20 yr carryover. This credit was created expressly for the Chaparral Steel recycling and steel plant that is described in more detail in subsequent sections of this report.

The final tax credit, the "Worker Retraining Tax Credit" (§ 58.1-439.6) provides credits for expenses related to certain approved worker training courses. This relatively small program is capped at $2,500,000 for any given fiscal year and is used by relatively few employers. In CY 1999, only four employers took advantage of the worker training credit, claiming a total of about $151,000.

Enterprise Zone Incentives

Enterprise Zone (EZ) incentives offer grants and tax credits to firms within designated enterprise zones. Virginia currently has fifty-two enterprise zones, each of which was designated by the governor in office at the time of designation. The Petersburg/Dinwiddie EZ was created to enable the Chaparral Steel plant access to EZ incentives. Virginia enterprise zones represent a partnership between localities and the state through which a package of industrial retention and recruitment incentives are offered. Four types of EZ incentives are currently offered:

1. A "General Income Tax Credit" that offsets a portion of a qualifying company's state income tax liability for ten years. In the first year, 80% of a company's state tax liability is offset; 60% is offset for the remainder of the period.

2. A "Real Property Improvement Tax Credit" of up to 30% of certain non-residential property improvements.

3. As an alternative to the Real Property Improvement Tax Credit, some companies can claim an "Investment Tax Credit" of up to 5%. The Investment Tax Credit is only available to businesses that invest at least $100 million and create at least 200 jobs.

4. "Job Grants" are allocated to companies for each full time position created due to location or expansion within an enterprise zone. This grant is $1,000 for each full time position given to an enterprise zone resident and $500 for positions given to in-migrants.

Workforce Services

Workforce services incentives provides reimbursement for training costs for each new job created after a firm attains certain job creation or investment thresholds. The level of incentives is negotiated individually by the firm and the Department of Business Assistance. Nearly 450 companies requested workforce services funds during FY 2000.

Infrastructure Incentives

Virginia has three major infrastructure incentives programs. The industrial access railroad program (§ 33.1-221.1) provides matching grants to localities for improvement of railroad access. Similarly, the Industrial Access Roads Fund (§ 33.1-221) provides matching funds to localities for the improvement of road access to certain industrial sites. Expenditures from the road access fund have increased steadily from $1.6 million in FY 1998 to $3.8 million in FY 2000. Expenditures from the rail access fund were $1.1 million and $1.26 million in FY 1998 and FY 2000, respectively.

Direct Grants

The Commonwealth has two direct grant programs. First, the Virginia Investment Partnership (VIP) is targeted towards existing Virginia firms in the manufacturing and basic sectors. The amount of a grant is based on the amount of additional revenue the state will accrue. Firms must meet certain investment thresholds and job creation thresholds to become eligible for VIP grants.

The second direct grant program is the "Governor's Opportunity Fund" (GOF). The GOF is a discretionary fund intended for use by the Governor as needed to compete with other states for investment and employment. (The GOF is discussed in detail in the following section). From FY 1998 through FY 2000, there were 91 GOF grants with a total value of $45.6.

Governor's Opportunity Fund (GOF)

The Governor's Development Opportunity Fund (GOF) is authorized by § 2.1-51.6:5 of the Code of Virginia. The GOF is intended to provide discretionary funds "to attract economic development prospects and secure the expansion of existing industry in the Commonwealth," and is similar to "deal closing funds" used elsewhere around the United States. GOF funds are generally awarded to localities, mainly for infrastructure and utility improvement or for site

preparation, although other possibilities are provided for in § 2.1-51.6:5-C. Although the program is discretionary, in general the level of private investment must reach a minimum threshold of $10 million and at least 100 jobs must be created for a project is eligible for GOF funds. Some exceptions are made for central cities, urban cores and for cities with populations below 100,000.

The Virginia Economic Development Partnership (VEDP) is charged with assisting the Governor "in developing objective guidelines and criteria which shall be used in awarding grants or making loans from the Fund." GOF application procedures are administered by the VEDP.

From the perspective of VEDP, the process of granting GOF funds begins when a company or locality contacts VEDP. In some cases, the company has chosen a specific locality. More often, companies know the type of location in which they would like to locate and contact VEDP with their site requirements. In such cases, VEDP uses a database of possible sites to help the company choose appropriate locations within the Commonwealth.

Before recommending sites, VEDP considers several factors. Most importantly, VEDP considers whether the locality's labor force can meet the needs of the company. A statewide environmental database is used to determine which locations are appropriate for the company and to help the company meet permitting and regulatory requirements. Next, the company works with one or more local governments to determine the terms for each locality. The company and locality also decide on the level of local incentives. Finally, the locality sends a letter to VEDP including all incentives to be considered for GOF matching funds. The locality forwards a separate signed letter from the company stating that the chosen locality is the only Virginia location under consideration.

After receiving the application letter, VEDP begins assessing the project. At this stage,

VEDP is concerned with the statewide impact of granting funds. Apparently, VEDP assumes that the community has considered local impacts before making its offer. The primary assessment mechanism is a return on investment (ROI) analysis. The ROI analysis is designed to determine when the increased tax revenue (returns) resulting from the firm's location will exceed the cost to the Commonwealth of the incentives (investment). The only costs included in the ROI are direct program costs (i.e. tax and direct funds or expenditures on infrastructure provided to the business in question). No state costs associated with providing public services to the firm or in-migrating workers are included in the ROI, so the cost side of the ledger is incomplete.

Returns in the ROI include sales and use taxes (and sometimes corporate income tax) that are stimulated as a result of the firm location. These taxes are estimated using direct, indirect and induced state tax impacts derived using an IMPLAN input-output (I-O) model. The direct impacts include those jobs, output (sales), and incomes created by the firm. Indirect impacts are associated with input purchases by the firm. Local purchases of goods and services are a necessary part of most productive processes, and the firm's output will create demands for inputs. The induced impacts are created as a result of spending of income generated through the direct and indirect effects. These impacts can be measured in terms of incomes created, sales, or total output and generate tax receipts. The impacts are computed using an I-O model. No impacts on existing firms caused by price changes or cost advantages are included in the ROI.

VEDP considers several possible funding scenarios using the procedure described above. The most important output from the ROI analysis is the breakeven year of the project. Apparently, VEDP has a target range for the breakeven year; the VEDP representative chose to keep this target confidential. In addition to the ROI analysis, VEDP considers the ratio of incentives to jobs and incentives to private investment. When breakeven year and/or ratios do

not meet VEDP's requirement, levels of incentives may be adjusted until the necessary figures are obtained.

As the final approval in the GOF procedure, the Governor considers the application. VEDP forwards a decision brief, the ROI analysis and other relevant information to the Governor for his consideration. The governor considers other factors including local unemployment, and the level of local participation and, as required by Virginia Code, the Council on Local Governments Fiscal Stress Index (CLGFSI). Generally, the Governor approves applications, although governors have at times changed the levels of incentives from those originally proposed by VEDP.

After approval by the Governor, a performance agreement between the locality and company is drafted. The agreement includes specific information on the responsibilities of the company such as: employment and investment goals to be reached within a specified time period and average annual salaries of company employees. The agreement also details the clawback provisions to be employed if the company does not meet the specified employment and investment goals. The clawbacks are, however, invoked only over the relatively short horizon of 30 months. Following these 30 months there is no penalty for a firm leaving. Although the performance agreement is between the locality and the company, it must be approved by VEDP before funds are distributed.

VEDP uses a formal monitoring process to determine if companies meet the requirements of the performance agreement. Generally, this is accomplished by surveying the locality thirty months from the date incentives were granted. However, monitoring is primarily the responsibility of the locality, and the locality, as the recipient of GOF funds, is responsible for the company's performance.

Analysis of Past GOF Allocations

Over the previous three fiscal years, total Governor's Opportunity Fund grants have totaled $45.6 million (current dollars). FY 99 funding was just under $20 million; expenditures during FY 98 and FY 00 were significantly lower: $13.4 million and $12.8 million, respectively. On a per-capita basis, statewide GOF expenditures over the three year period averaged $6.60. However, the funds were not dispersed evenly across the state. Per-capita GOF expenditures were generally lower in northern PDCs and were higher in southern and western PDCs (see figure 2).

Because one of the goals of an economic development program could be to target labor-intensive project to high unemployment areas, an interesting question is whether GOF funding has indeed gone to projects in areas of relatively high unemployment. On a per-capita or overall GOF funding basis, there is no clear relationship between GOF funding and the PDC unemployment rate (see figures 3 and 4, below). Across districts, the unemployment rate is slightly negatively correlated with per-capita GOF funding, although this correlation is not statistically significant.[1] In addition, as shown in figure 5, there is no clear correlation between the number of jobs created from projects that received GOF funding and the PDC unemployment

[1] The relationship between GOF grants and unemployment may be obscured by the data only being available at PDC level. Since the unemployment rate will likely vary across counties within a PDC, using an average unemployment rate across the PDC will tend to make the correlation between the unemployment rate and GOF grant smaller.

rate.[2] Most of the GOF projects were located in PDCs with unemployment rates well below four percent, the level most economists typically associate with full employment. Such cases

[2] Estimates of the number of jobs created were obtained from Appendix B of the "Report on Business Incentives: 1997-1999."

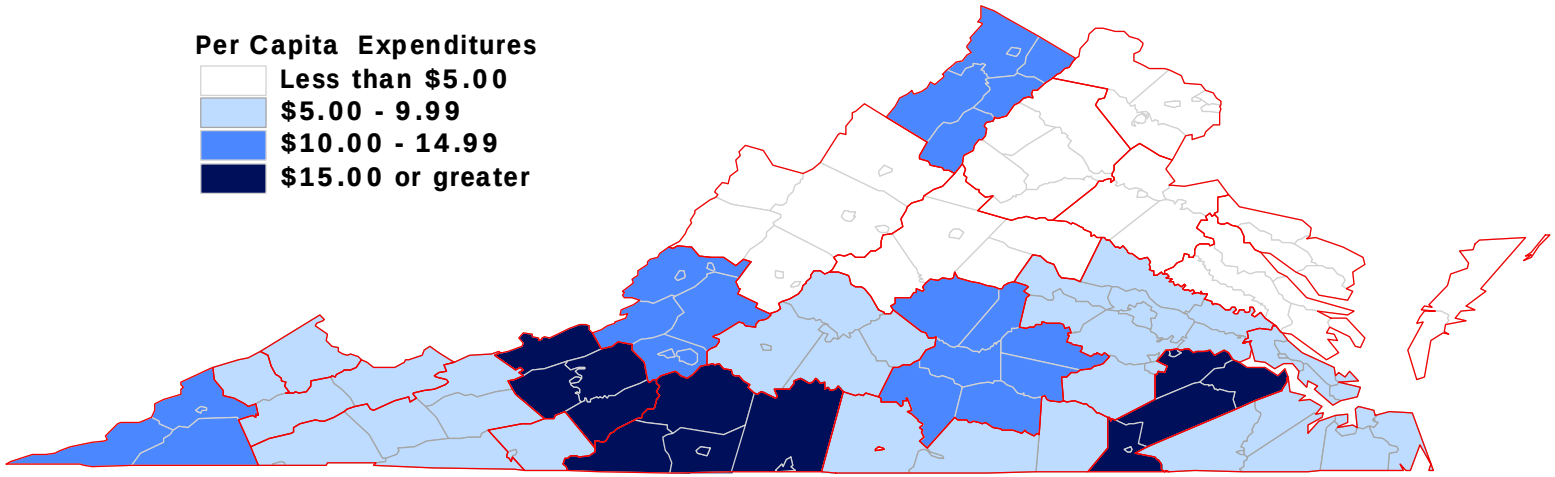

Figure 2. Per-Capita GOF Grants by PDC, FY 1998-FY 2000

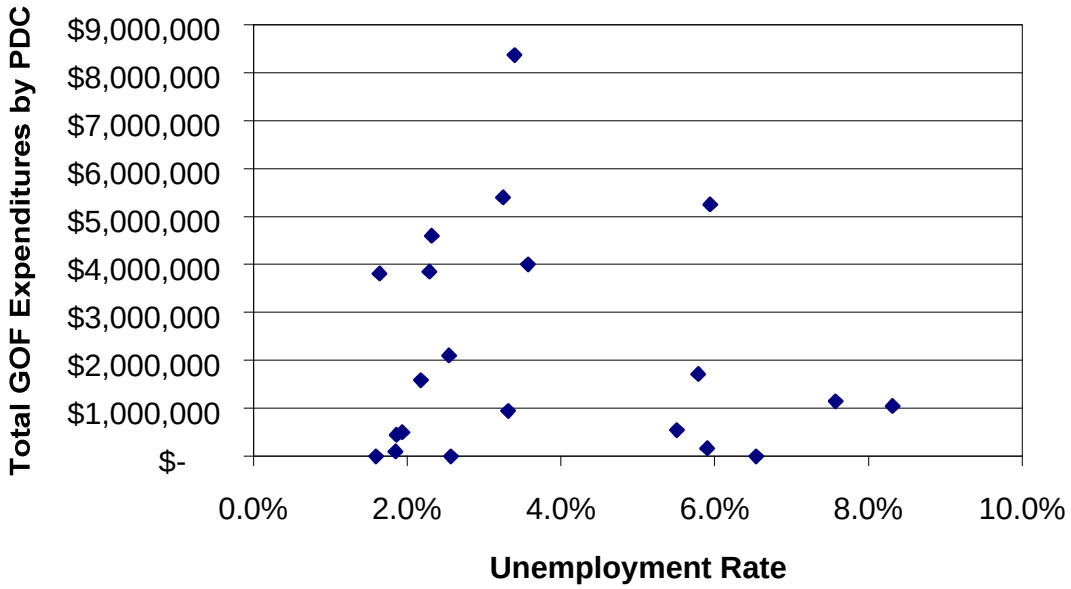

Figure 3. Total GOF Expenditures and Unemployment by PDC

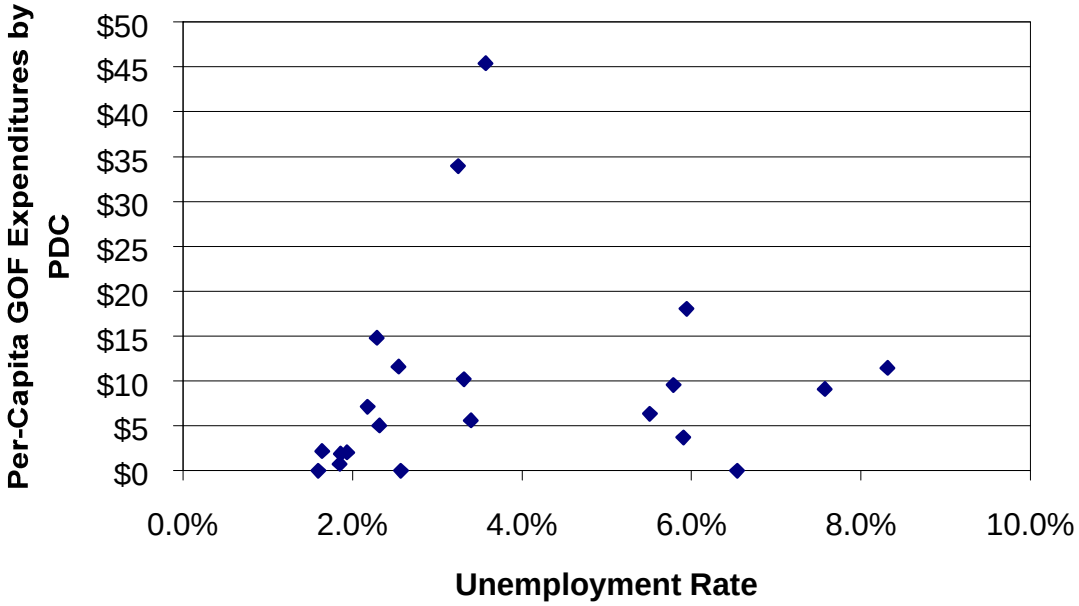

Figure 4. Per-Capita GOF Expenditures and Unemployment by PDC

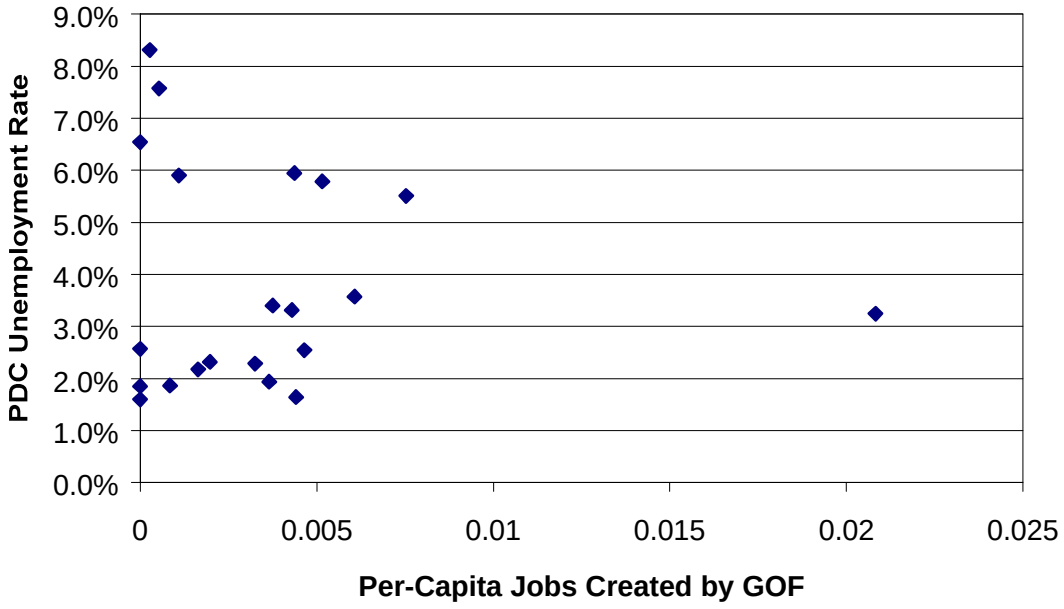

Figure 5. PDC Unemployment Rate Per-Capita Jobs Created by GOF

increase the likelihood that existing firms will be affected through the labor market. They are also associated with more potential for in-migration with its associated increased costs of providing services such as education, police and fire protection that must be borne by local governments.

Another possible goal of economic development programs would be to target lower income areas for funding and/or target companies that create jobs with relatively high wages. On a per-capita basis, figure 6 shows that there is no correlation between GOF funding and adjusted gross income on a PDC basis. As shown in figure 7, there is also no relationship between GOF funding per job created and the wage rate of those new jobs. In fact, a relatively large number of GOF-funded projects were projected to pay $10.00 per hour or less. Interestingly, there is a

positive and statistically significant correlation between the level of economic incentives (not GOF) provided per job created and the wage rate for projects that did not receive GOF funding

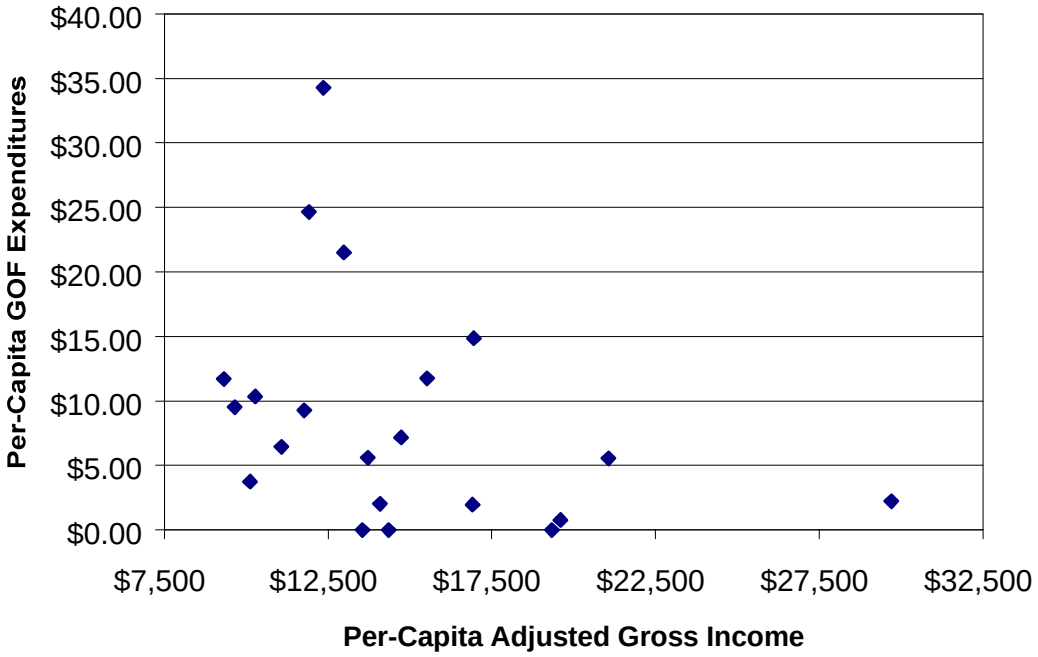

Figure 6. Per-Capita GOF Expenditure and Per-Capita Adjusted Gross Income

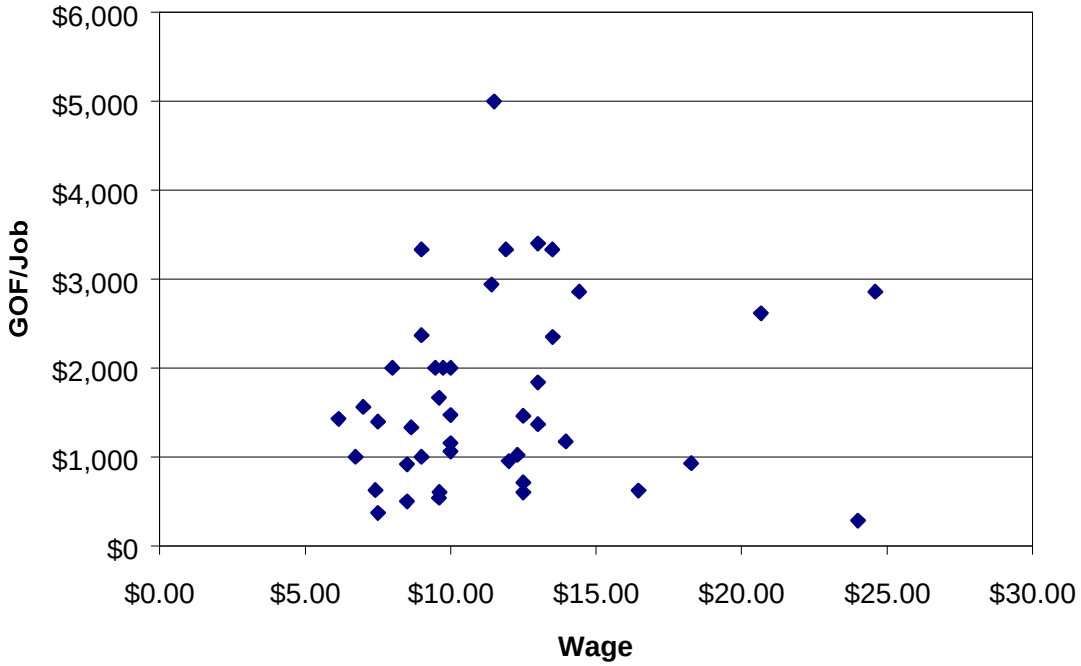

Figure 7. Relationship Between GOF Expenditures per Job Created and the Wage Rate

during the fiscal years 1998 and 1999. Increasing the non-GOF funding per job by 1 percent is associated with an increase in the wage rate of 0.098 percent. Thus, the influence of non-GOF funding is statistically significant, but in practical terms it is weak.

The Commission on Local Governments Fiscal Stress Index (FSI) provides a measure of the fiscal stress experienced by local governments. The GOF-enacting legislation specifies that "the Virginia Economic Development Partnership shall use the Fiscal Stress cited in the Index published by the Commission on Local Government for the locality in which the project is located or will be located as one method of determining the amount of assistance a locality shall receive from the Fund." As such, the correlation between a region's FSI and the amount of GOF funds is useful in determining whether or not the GOF program is meeting its stated goals.

The Commission on Local government reports the FSI for localities and counties. However, aggregate GOF data are provided by PDC. Thus, the FSI was aggregated to the PDC

level by determining the population weighted FSI for each PDC. Specifically, the FSI for each PDC was calculated as:

$$AFSI_j = \sum_{i=1}^{n} \frac{FSI_i}{POP_i}$$

Where:

- $AFSI_j$ is the population weighted FSI for PDC region j,
- POP_i is the population of the i^{th} locality in PDC region j, and
- FSI_i is the FSI for the i^{th} locality in PDC region j.

The population-weighted AFSI is plotted against total GOF funding in figure 8. There is a very small, but statistically insignificant, positive correlation between the variables. This implies that AFSI is not an important variable in determining the level of GOF funding received, at least at the PDC level.

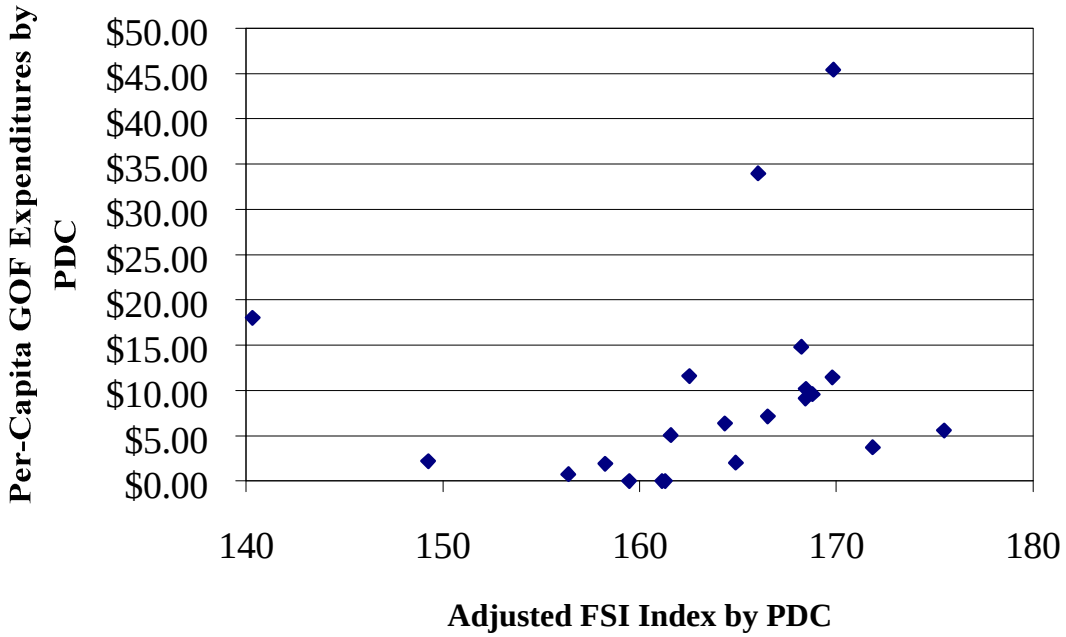

Figure 8. Per-Capita GOF Expenditure and Adjusted FSI by PDC

Summary

Virginia business incentive programs are similar in composition and in levels of funding to those in other states. The types of programs and relative resource allocations to their components are similar. Use of a discretionary fund to close the deal is also common nationally, and may be appropriate given what the literature says about firm location decisions. On the other hand, the discretionary Virginia program (the GOF) does not appear to be well focused. Allocations of resources under the program show no relationship to community need and little correspondence to the goals of the programs as laid out in the enabling legislation. The funds appear to be randomly spread around the state and not related to levels of income, wage rate, unemployment, or fiscal stress. While such an allocation might make political sense, it does not contribute to program goals. The program clearly creates jobs, but lack of targeting limits its effectiveness in raising incomes, lowering unemployment in distressed areas, or alleviating fiscal stress. Because the process of obtaining GOF funding must begin with a locality filing an application, more effective targeting of GOF funds may require greater interaction between VEDP or other state agencies and the localities in order to help the localities with the greatest needs to attract new firms to locate in their area.

The criteria used by the VEDP in analyzing or justifying levels of GOF funds are inappropriate. VEDP does not include costs of services provided to the firm in its calculation, nor does it include potential negative effects on existing firms. In the subsequent section, we examine a case study of a business incentive program and provide a framework for analyzing impacts on existing firms.

IV. Case Study: Chaparral Steel in Dinwiddie County

Background

In its December 3, 1997 letter of application to VEDP, Dinwiddie County indicated that it would provide eight types of incentives to Chaparral, with a total estimated value of $21.4 million (see table 2). Of this amount, $18.6 million was derived from a 15-year recycling equipment tax reduction and a 35-year pollution control equipment tax reduction. The county also paid for water and sewer improvements to the site ($2.1 million), utility connection fees ($162,000), permitting fees ($75,000) and other preliminary site costs ($120,000). The remaining $350,000 was used as matching funds for anticipated road and rail access funds from the state.

The state granted $45.25 million in incentives (see table 2). Standard (non-discretionary) direct grants for workforce training, road access and rail access were valued at $1 million. The state also granted the standard major business facility job tax credit of $1,000 per employee (not including the first 100 employees) for a total job tax credit of $350,000. Further, Governor Allen allocated $3 million from the Governor's Development Opportunity Fund (GOF) as described below.

As specified in the June 17, 1999 performance agreement between Chaparral and Dinwiddie County, the company agreed to accomplish the following within 30 months of receiving GOF funds (the "completion date"):

1) Invest at least $400 million in capital at the Dinwiddie county site (the "investment goal")

2) Employ at least 400 people in full-time permanent positions with an average annual salary of $35,000, excluding management salaries (the "employment goal").

Table 2. Incentives Provided to Chaparral Steel

Incentive	Value (or Estimated Value)
State Incentives	
Governor's Opportunity Fund	$3,000,000
Workforce Training	400,000
Industrial Access Road Program	450,000
Rail Access Program	150,000
Enterprise Zone Investment Tax Credit	10,000,000
Recycling Equipment Tax Credit	30,900,000
Major Business Facility Job Tax Credit	350,000
Total State Incentives	$45,250,000
County Incentives	
Tax reductions for recycling equipment	$15,299,625
Tax reductions for pollution control equipment	3,325,000
Water and sewer improvements to site	2,100,000
County grant for utility connection fees	162,000
County grant for building and related permit fees	75,000
Local match for industrial road access	300,000
Local match for industrial rail access	50,000
Miscellaneous preliminary site costs	120,000
Total County Incentives	$21,431,625
Total Incentive Package	$66,681,625

These provisions were specifically required in order to receive $3 million in GOF funds. Allocation of GOF funds requires that the county provide matching incentives of equal or greater value. Rather than providing direct matching payments, Dinwiddie County chose to specify that a portion of the incentives granted to Chaparral be considered its matching payment. Specifically, three years of each of the local tax reductions (M&T), the fee waivers, and the water and sewer improvement costs were included as matching funds. GOF funds were provided directly to Chaparral with the provision that the funds be used for site development and improvement costs (GOF funds generally accrue to the locality).

In addition to the above incentives, the company will receive an estimated $10 million in enterprise zone investment tax credits. Although such credits are now available to all qualifying firms locating within the county, one might consider this a special incentive directed at Chaparral. As stated in a December 15, 1997 press release, Dinwiddie County and Petersburg were designated as a Joint Enterprise Zone "[as] part of the incentives to secure the Chaparral Steel investment."

Finally, Chaparral will receive about $30.9 million from a Recycling Equipment Tax Credit. This credit allows any company investing at least $350 million in the Commonwealth between January 1, 1998 and January 1, 2003 to deduct recycling equipment depreciation over a 20-year period as long as the total deduction in a given year is not more than 60% of the company's total Virginia tax bill. This can contrasted with previous legislation that allowed for a 10-year deduction and a 40% limit. This legislation was enacted specifically with Chaparral Steel in mind and the threshold investment was so high that it was virtually unattainable by existing Virginia firms.

As stated in the prior section, VEDP is responsible for assessing applications for GOF

funds. VEDP's primary tool in this assessment is a return on investment (ROI) analysis. The ROI analysis attempts to determine if, and by how much, state tax revenues will increase net of the cost of incentives. The analysis implicitly assumes that the company would not locate in Virginia without the incentives package. It is important to note that the ROI analysis is only concerned with state level outcomes and only considers incentives granted by the state. As reported in a March 6, 2000 letter to Mr. Carsley of the Virginia State Corporation Commission, the VEDP ROI analysis concluded that Virginia will capture an additional $116.8 million in state tax revenue during Chaparral's first 20 years in the Commonwealth. Of this amount, $91.2 million are direct tax revenues and $25.6 million are indirect impacts. Indirect impacts are calculated using multipliers derived using an IMPLAN model maintained and administered by a professor at William and Mary University. The fiscal impact analysis also concluded that, when at full capacity, Chaparral was expected to generate about 1252 jobs in the Virginia economy, including 400 direct employees. This employment multiplier of 3.13 is exceedingly high compared to those used in other studies and not likely to be achieved.

The state tax impacts quoted above were not discounted. The ROI analysis estimated that over the next 20 years, the total state benefit less program costs would be about $71.56 million. When discounted over the period at an annual rate of 6.82%, the net present value of the state benefit was estimated to be about $25.03 million.

In addition to the benefits estimated using the ROI analysis, VEDP determined that, as of the end of March, 2000, six companies located in Virginia to provide services to Chaparral or because they use Chaparral products. These six companies will invest between $38.6 million and $48.6 million and will employ about 280 people. However, it is not clear how such impacts should be considered, especially since the input-output model already considers indirect impacts.

A VEDP document also implies that Roanoke Electric Steel Corporation experienced record earnings at least partially because of the siting of Chaparral (see attachments). The rationale for this conclusion was not provided.

Below, we provide a framework for analyzing impacts of the Chaparral location on other steel recyclers in the Commonwealth and owners of the primary input: ferrous scrap.

Framework for Evaluating the Impacts of Business Incentives

Typically, analysts use Input-Output analysis to examine the effects of a firm location. These I-O models examine linkages between the firm in question and its suppliers, and expenditure patterns of people who earn incomes from the firm. These linkages create multipliers associated with direct, indirect, and induced effects. Multipliers are then used to produce estimates of increased employment, incomes, expenditures and tax revenues associated with the firm location or expansion. In the VEDP analysis of firm location decisions, the IMPLAN Input-Output model is used to produce these estimates.

A major problem with such analyses, as practitioners readily admit, is that they treat prices in all markets as fixed and thus provide no indication of how price changes following the entry of a firm. In cases where the firm is relatively small purchaser of inputs or supplier of outputs, this omission will not be too troublesome. However, if the business is large enough to affect prices (either due to spatial sensitivity in the markets or the sheer size of the enterprise), then an I-O based analysis will be misleading as it ignores impacts on other market participants. By holding prices fixed, the I-O approach imposes the restriction that no one loses in the process. This restriction is obviously not valid in all cases.

A second problem with the I-O approach is that it focuses on employment and incomes, but provides no information about the changes in welfare for the various agents affected by the

entry of the new firm. Consumer and producer surplus measures approximate the change in welfare for agents that buy the same inputs as the entrant or sell in the same output market as the entrant. In the following paragraphs, we outline a simple economic framework for evaluating surplus changes associated with entry of a firm into a region. The framework is more formally presented in appendix A, which also contains details on how the framework was implemented to model the case of the scrap industry. This framework is especially appropriate when entry affects market prices faced by other market participants, as is the case of the scrap recycling industry in Virginia.

Firm entry and impacts on market participants: When a new firm enters a region, the aggregate regional demand for inputs and supply of outputs will both increase (these increases are implicitly part of the indirect and induced effects modeled in an I-O framework). The magnitude of these increases will depend on the size of the entrant relative to the respective markets and the technology used by the entering firm.

The impact of the increases in input demand and output supply on market participants will depend on the "structure" of the respective markets. The term structure generally refers to several different characteristics of any market. One such characteristic is the number of suppliers and demanders in the regional market and the degree to which one actor can affect regional prices. This is commonly referred to as the competitiveness of a market in the sense that in a more competitive market means that any one actor has less influence on price. Another characteristic of market structure is the responsiveness of regional supplies and demands of inputs to changes in prices. This responsiveness is commonly referred to as the *elasticity* of supply or demand. Input demand and output supply elasticities depend on the technologies firms use and on the ability to substitute inputs as their prices change. The supply elasticities of inputs,

such as scrap or labor, will depend on the ability to procure a raw material or for workers to change jobs.[3] The more responsive that demand and/or supply is to price changes, the smaller the impact of entry on prices.

Because firm entry shifts the output supply and input demand curves outward, generally raising prices of inputs and lowering prices of outputs, the impact of firm entry on pre-existing market participants is clear: input suppliers and consumers of output generally gain and input demanders and suppliers of outputs generally lose. By measuring surplus changes in input and output markets, we get an estimate of net changes in the aggregate welfare for each type of market participant.

Economic surplus is comprised of surplus to producers and consumers. Producer surplus is the area below the price received for a product and above the supply for the product. This area is revenue (in dollars) in excess of costs and represents economic returns to fixed factors such as capital and land. Consumer surplus is the area below the demand curve for a product above the price paid. Because the demand curve represents the consumer's willingness to pay for the product, this area is the difference in dollars between what the consumer was willing to pay and what he actually paid. Thus, it is a measure of the economic benefit to the consumer.

Components of the model: The model in appendix A uses this economic framework to measure the impacts of firm entry on market participants in Virginia's scrap industry. The model includes spatially distributed supplies of inputs, costs of transportation, and firm-level demands for inputs (from the major market participants). The model is calibrated to replicate conditions in the Virginia market prior to entry of Chaparral Steel. Entry is simulated through an increase

[3] Because the supply of scrap is to a certain extent linked to the rate of obsolescence of consumer goods like automobiles, the supply of scrap may not be too responsive to price changes in the long-run.

in the demand for scrap inputs. Depending on the spatial pattern of supply and transportation costs, the price paid for raw scrap by the recyclers (i.e., Roanoke Electric Steel, Simsmetal, and Chaparral) and the price received by the suppliers of raw scrap will change, leading to changes in surplus for both. The model measures this change.

Model results: The model shows that input prices will increase substantially as a result of Chaparral's entry into the Virginia scrap market. Geographic purchase of scrap is also affected by the entry. Because of its proximity, Chaparral has a bigger impact on inputs purchased by Simsmetal, where surplus losses are approximately $715,000 on an annual basis. Roanoke Electric Steel experiences surplus losses of $329,000 annually. On the other hand, scrap suppliers to the three recyclers experience annual surplus gains of more than $1.3 million. Thus, net benefits to producers and consumers of scrap are positive, but the incentive-induced entry of the firm produces a substantial reallocation of benefits among the different groups. Clear winners and losers emerge in this case study (see appendix A for further details).

The issue of whether there are positive net benefits to society in this case is beyond the scope of the study. Estimates of net social benefits need to include an analysis of surplus changes in other input markets (particularly the labor market where positive benefits to workers will result as demand for labor is shifted outward in the Petersburg vicinity) and all costs of providing services. These latter costs are particularly difficult to measure, and will depend on in-migration into the area among other things.

VI. Summary and Conclusions

Virginia's business incentives program is similar to programs offered in surrounding states and nationally. It contains a similar mix of dollars devoted to specific program components. In addition, the combination of financial and other incentives offered in Virginia is close to the average combination. Overall, the state's spending on incentives is "middle of the pack" compared to other states in terms of total incentives offered and incentives per capita. Virginia was 28th in total expenditures and 39th on a per-capita basis.

Use of a discretionary fund (e.g. the Governor's Opportunity Fund) for "closing the deal" is also common. Such a fund may be critical to the state's ability to attract certain types of businesses. Literature suggests that deal closers may break a tie between competing localities and thus may contribute to statewide growth.

The effectiveness of GOF may be improved by providing guidelines for its use. At a minimum, government should decide what it hopes to achieve through use of the fund. Objectives should be made more explicit in the report to the legislature. Several plausible objectives exist, such as employment maximization, income increases, targeting for disadvantaged areas. Currently, none of these objectives are explicitly being pursued and the resulting allocation of GOF resources appears haphazard and unfocused. In particular, the analysis of GOF allocations showed no correlation between use of the GOF and area economic conditions.

The Return on Investment (ROI) criterion used by the Virginia Economic Development Partnership to analyze the "soundness" of offers to firms needs to be modified. Currently, the analysis resembles no analysis a competitive business would undertake, because it does not account for costs associated with providing services to in-locating firms. An improved ROI

would look at all revenues (future taxes of all forms) derived from the business location decision minus all costs associated with providing services to the firms, their employees and associated economic activities.

The input-output approach used in the ROI does not capture the effects on existing firms and input suppliers of changes in prices of inputs and outputs. Input-output analysis has, by construction, all market participants gaining from firm entry. An economic surplus captures these price-related effects, as demonstrated in the case study shown here. The ROI calculation should include costs associated with offering similar incentives to existing firms.

Firm location in the Commonwealth clearly has an impact on government revenues and expenditures. Location has impacts on owners of factors: inputs, including land, labor and capital. In cases where firm location benefits everyone there are no distributional issues. Most economic development events involve winners and losers. The Commonwealth should undertake an analysis of winners and losers and ensure that its economic development program produces more gains to the winners than losses to the losers.

In the case study examined here, the incentives provided to Chaparral Steel have a large negative impact on existing firms (who lose more than $1 million in annual surplus) that is exceeded by the benefits to suppliers of scrap (who gain more than $1.3 million).

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Appendix A: Detailed Model Description and Model Results

This appendix provides a detailed description of the methods and data utilized to determine the potential impacts of the operation of Chaparral Steel's new scrap shredding facility on scrap suppliers in Virginia and existing recyclers of scrap, namely Roanoke Electric Steel (RES) and Simsmetal. This analysis focuses on the scrap market because transportation costs for scrap are relatively high compared to the value of the scrap. For example, for automotive scrap, the f.o.b. (supplier) price can be as much as 30 to 40 percent lower than the c.i.f. (mill) price when the distance between the supplier and the recycler is greater than 150 miles. Conversely, the shredded or processed scrap is often transported much larger distances, often shipped internationally, to steel mills. Because transportation costs are relatively much smaller for the processed scrap, the geographic size of the processed scrap market is much larger. As a result, the addition of Chaparral's new shredding facility will have a much smaller impact on the price of processed scrap than on the price of the raw or unprocessed scrap. Finally, the market for steel products is not included in the analysis because, based on personal conversation with the CEO of RES, Chaparral does not produce the same product mix as RES. Thus, the addition of Chaparral's new steel mill will not affect the prices of steel products produced by RES.

The remainder of this appendix is organized in the following manner. In the next section, the economic model used in the analysis is described, including the underlying assumptions of the model. The third section contains a description of the data used in the analysis and how it is incorporated into the economic model. The fourth section describes how the economic model is empirically implemented and the last section describes the results from the economic model.

Description of Economic Model

Because of the importance of transportation costs in the scrap market, a standard spatial equilibrium model with homogeneous goods is utilized. This type of model assumes that all markets are perfectly competitive and that prices between regions cannot differ by more than the unit cost of transportation between the regions (or else arbitrage will occur). A perfectly competitive market is characterized, among other things, by presence of many buyers and sellers who cannot individually affect the market price by their own actions. While there are many different suppliers of scrap in Virginia, there are only a few recyclers. So it may be possible for a recycler to behave as a spatial monopsonist within its market area. However, a non-competitive model requires good information on the underlying supply and demand elasticities for scrap. Unfortunately, these elasticity estimates were not available. In addition, information on how a firm responds to a price change by a rival is also required to empirically implement a non-competitive model. Again, this type of information is not available. Given these limitations, a perfectly competitive framework is chosen as a reasonable approximation of the scrap market.[4]

The assumption of homogeneous goods implies that each supplier sells the same type of scrap and that there is a single mill price paid by the recyclers. In the case of car bodies, the main type of scrap purchased by RES and to be purchased by Chaparral, this assumption is appropriate. For Simsmetal, which also purchases other types of scrap, the validity of this assumption depends on whether the prices of other types of scrap are closely related to the price of car bodies. If so, the average mill price paid by RES and Simsmetal should be highly

[4] A competitive and non-competitive model will both predict an increase in c.i.f. and f.o.b. prices when a new firm enters the market. The main difference is the predicted magnitude of the price increases.

correlated. In the price data provided by RES and Simsmetal, their monthly average mill prices have a correlation coefficient of 0.89, which indicates a high degree of correlation in their prices. Thus, the assumption of homogeneous products appears to be justified.

Following Takayama and Judge, the spatial equilibrium model is specified as a constrained maximization problem. In this formulation, net social payoff (NSP), which is defined as the area under the excess demand curve, is maximized for all regions. The area under the excess demand curve can also be defined as the value of consumer surplus less the value of producer surplus in each region.

Definitions and Notation: To help clarify the following presentation, the definitions and notation to be used are now given. First, let the index *i* denote each of the recyclers that purchase scrap in Virginia. This index will take on values of 1, 2, and 3 because there will be only three main recyclers in the state: RSE, Simsmetal, and Chaparral. Next, let *j* be the index of scrap suppliers. Define the mill (or c.i.f.) price for scrap paid by each of the recyclers as mp_i and the price of scrap received by the *j*th supplier (or f.o.b. price) as w_j. The supply and demand functions for scrap are defined as:

$$D_i = \alpha_i - \beta_i mp_i, \text{ and} \tag{1}$$

$$S_j = \delta_j + \lambda_j w_j, \tag{2}$$

where D_i is the quantity of scrap purchased by the *i*th recycler, S_j is the quantity of scrap sold by the *j*th supplier, and α_i, β_i, δ_j, and λ_j are parameters of the model that are determined later. Linear demand and supply functions are utilized for their simplicity. Previous research has shown that the assumption of linear functions does not lead to large errors in model predictions. Finally, let t_{ij} be the unit cost of shipping scrap from supplier *j* to recycler *i*.

Maximization Problem Formulation: As stated above, NSP is defined as the difference between consumer and producer surplus. Using the above definitions of the scrap demand and supply functions, this can be formally defined as:

$$\begin{aligned} NSP &= \sum_i \int_0^{mp_i} D_i dmp_i - \sum_i \int_0^{bp_i} D_i dmp_i - \sum_j \int_0^{w_j} S_j dw_j + \sum_j \int_0^{\hat{w}_j} S_j dw_j \\ &= \sum_i \alpha_i mp_i - 0.5 \sum_i \beta_i mp_i^2 - \sum_j \delta_j w_j - 0.5 \sum_j \lambda_j w_j^2, \end{aligned} \tag{3}$$

where bp_i and $\hat{w}_j$ are the initial equilibrium (or pre-trade) prices. Note that the constant of integration has been omitted from equation (3) because it will not affect the results of maximization problem. To solve for a spatial equilibrium, equation (3) is maximized, choosing the mill and supplier prices, subject to the following constraints:

$$mp_i - w_j \le t_{ij}, \text{ and} \tag{4}$$

$$mp_i \ge 0 \text{ and } w_j \ge 0. \tag{5}$$

Note that equations (4) and (5) must hold for all *i* (i.e., recyclers) and *j* (i.e., scrap suppliers). The economic interpretation of equation (4) is that the difference between the mill or c.i.f. price and the supplier or f.o.b. price cannot exceed the unit cost of transportation. Otherwise, arbitrage would be profitable. In an equilibrium, if supplier *j* sells to recycler *i*, then $mp_i - w_j = t_{ij}$. Conversely, if $mp_i - w_j < t_{ij}$, then supplier *j* will not sell to recycler *i* because the price differential is not enough to cover the transportation cost.

Data

The economic model given in equations (3), (4), and (5) requires information on sales of scrap from each supplier to each recycler, total purchases of scrap by each recycler, and unit transportation costs from each supplier to each recycler. Both Simsmetal and RES provided

information on their purchases of scrap by geographic "zone." RES provide information on scrap purchases from nineteen different geographic zones for the time period November 1997 through September 2000. Simsmetal provided information on purchases from five different geographic zones[5] for the time period March 1998 through December 2000. For the common time period of March 1998 through September 2000, RES's average purchase of scrap per month, on a shrunk basis, was 9,643.4 tons, while Simsmetal averaged 9,724.1 tons on a shrunk basis.

Number of Supply Points: In order to implement the economic model, a common set of geographic zones must be defined. The choice of a common set of geographic zones also entails considering how many supply points to include in the economic model. Because transportation costs play such a major role in the scrap market, the geographic regions should be small enough so that the variation in the distances to the recyclers within each region is not too large. In addition, defining the geographic regions based on existing legal boundaries will aid in interpreting the results from the model. To meet the above criteria, the geographic regions within Virginia are defined on a county basis, except for the cities of Chesapeake, Hampton, Suffolk, and Virginia Beach (see table A.1 for complete definitions of all regions). This results in 99 supply points identified within Virginia. Because RES and Simsmetal also purchase scrap from suppliers located outside of Virginia, six additional regions are defined: eastern North Carolina, western North Carolina, southern West Virginia and Kentucky, Great Lakes (Ohio; western Pennsylvania, New York, and Maryland; and northern West Virginia), Washington, D.C. and Baltimore, Maryland, and the Northeast (eastern Pennsylvania, Maryland, and New

[5] The geographic zones were based on radius from Simsmetal's location. The five zones were defined as 0-50 mile radius, 51-100 mile radius, 101-150 mile radius, 151-200 mile radius, and greater than 200 mile radius.

York; and New Jersey). Because the focus of this study is on Virginia scrap suppliers and recyclers, fewer number of supply points outside of Virginia are required to account for the supply of scrap from outside of Virginia. There is a total of 105 supply points in the economic model.

Initial Market Boundaries: Because the number of supply points in the economic model exceeds the number of geographic regions defined by RES and Simsmetal, the scrap purchase data reported by each firm must be allocated to the appropriate supply points. This is accomplished using a two-step process. First, an initial market boundary between RES and Simsmetal is defined based on transportation costs (see the next section for a more complete discussion of computing the transportation costs). Because scrap is assumed to be a homogeneous good and a constant per unit transportation cost per mile of distance is used, a supply point (or county) that is located closer to either RES or Simsmetal will only ship to the closest recycler. The counties of Rockingham, Augusta, Nelson, Appomattox, Charlotte, and Mecklenburg form the initial market boundary, being approximately equal distance between RES and Simsmetal. As such, suppliers in these counties could supply either or both recyclers. Any county to the west of the initial market boundary will supply RES and any county to the east of the initial market boundary will supply Simsmetal. (see figure A.1)

The identification of an initial market boundary is important in allocating the scrap purchase data to individual supply points because geographic zones defined by RES and Simsmetal have significant overlap. For example, consider the case of RES region 6, which contains all or parts of Halifax, Charlotte, Prince Edward, Amelia, Nottoway, Lunenburg, and Mecklenburg counties and RES region 11, which contains all or parts of Appomattox, Prince Edward, Cumberland, Amelia, Powhatan, Goochland, Fluvanna, Albemarle, Nelson, Augusta,

Rockingham, Greene, Madison, Orange, Page, and Louisa counties. One would not expect the purchases of scrap by RES in those regions to be evenly distributed across each region because many counties within these regions are located closer to Simsmetal than to RES. In RES region 6, all scrap purchases are assumed to originate from suppliers in Charlotte, Halifax, and Mecklenburg counties. Similarly, for RES region 11, all scrap purchases are assumed to originate from suppliers in parts of Rockingham, Augusta, Nelson, and Appomattox counties. For RES regions 12 and 13, in which all counties are located closer to Simsmetal than RES, the scrap purchases from region 12 are included in purchases from region 18, the New England area and scrap purchases from region 13 are included in the eastern North Carolina region. A similar approach is used to allocate scrap purchases within the Simsmetal geographic zones. For example, the 101-150 mile radius zone includes a portion of western Virginia that is in close proximity to RES. It is not likely that Simsmetal would have purchased scrap from those locations. Only those counties that are located closer to Simsmetal are allocated a portion of the scrap purchases for the geographic zone in which they are located.

Once each county has been identified as a supplier to either RES or Simsmetal, then scrap purchases for each of the geographic zones identified by RES or Simsmetal are allocated to each county based on population. For example, in RES region 6, all scrap purchases are assumed to originate from Charlotte, Halifax, or Mecklenburg counties. RES scrap purchases in region 6 are then allocated to each county based on the county's population as a share of the total population in three counties (or region).

Because the six supply points outside of Virginia have been constructed to be larger in size, they are comprised of several geographic zones as defined by RES and Simsmetal. Eastern North Carolina is defined to included RES geographic zones 7, 13, and 14, and comparable

portions of Simsmetal zones 51-100, 101-150, and 151-200. Again, scrap purchases within a region by Simsmetal are allocated to the counties located closer to Simsmetal and then by population share. Western North Carolina is defined to include RES geographic zones 8 and 15. Because all counties in this region are closer to RES than Simsmetal, it is assumed that Simsmetal purchases no scrap from this region. Southern West Virginia and Kentucky is defined as the portions of RES geographic zones 4, 9, and 16 that lie outside of Virginia. RES scrap purchases are allocated between Virginia and non-Virginia suppliers based on population share of the counties included in the RES geographic zone. Again, since this entire region lies closer to RES, it is assumed that Simsmetal does not purchase scrap from this region. The Great Lakes region is defined to include RES regions 17 and 19 and part of region 10 and the portions of Simsmetal's zones that include parts of Ohio; western Pennsylvania, New York, and Maryland; and northern West Virginia. The Washington, D.C. – Baltimore region includes the District of Columbia, and the Maryland counties of Anne Arundel, Baltimore, Carroll, Frederick, Montgomery, Prince Georges, and Baltimore City. Because of its proximity to Simsmetal, it is assumed that RES does not purchase any scrap from this region. Finally, the New England region is defined to include regions 12 and 18 for RES and counties in eastern Pennsylvania, Maryland, and New York; and New Jersey for Simsmetal.

Transportation Costs: The distances between each supply point and each recycler is computed by first determining the longitude and latitude of each location. For the counties within Virginia, a point in the middle of the county is chosen. For each recycler, a point within Richmond and Roanoke is chosen. Then the air miles between the two points is computed.[6]

[6] Using air miles will underestimate the actual distance traveled by roads and therefore the transportation costs, but provides a reasonable approximation.

Based on information obtained from Simsmetal, a constant per mile transportation charge of $0.13 is then multiplied by the distance to get the total transportation cost. For the supply points outside of Virginia, the following locations were assumed to be the supply points: eastern North Carolina, Durham; western North Carolina, Wilkesboro; southern West Virginia, Charleston, WV; Great Lakes, Pittsburgh; Washington, D.C. – Baltimore is an average distance for the counties included in that region.

Missing Data: Jacobson Metal Company filed for bankruptcy and ceased operations before any data could be collected. Thus, no data are available on their scrap purchases during the time period March 1998 through September 2000.

Model Calibration

To implement the empirical model, values for the model parameters in equations (1) and (2) must be chosen. The parameters in the demand function, α_i and β_i, are chosen to replicate the level of scrap demand by RES, Simsmetal, and the demand from Chaparral's new shredding facility plus a chosen elasticity of demand for scrap. The demand parameter β_i is chosen to replicate the demand elasticity for scrap of –0.5 for all recyclers.[7] The elasticity of demand is defined as:

$$\varepsilon = \frac{\partial D_i}{\partial mp_i}\frac{mp_i}{D_i} = \frac{\beta_i mp_i}{D_i}, \qquad (6)$$

where ε is the elasticity of demand for scrap. Thus, equation (6) can be solved for β_i yielding:

$$\beta_i = \frac{\varepsilon D_i}{mp_i}. \qquad (7)$$

The value of D_i in equation (7) is the annual average amount of scrap purchased[8] and mp_i is the average value of mill price paid for scrap during the period March 1998 through September 2000. The average mill price paid by RES was $60.98 per ton (on a shrunk basis) and $61.23 for Simsmetal. Because these two average prices are almost identical, an average mill price of $61 is used in equation (7) to determine the value of β_i. Because Chaparral's new shredding facility has four times the capacity of RES and Simsmetal combined, the value of D_i for Chaparral is assumed to be equal to four times the average annual purchases of RES and Simsmetal. The initial mill price for Chaparral is assumed to be equivalent to RES and Simsmetal for calibration purposes. Once the value of β_i has been determined, the value of α_i can be found by solving equation (1) for α_i.

A similar procedure is used to determine the values of δ_j and λ_j in the supply equation. The supply parameter λ_j is chosen to replicate the value of the supply elasticity of scrap, which is assumed to equal 0.5 for all suppliers:[9]

$$\eta = \frac{\partial S_j}{\partial w_j}\frac{w_j}{S_j} = \frac{\lambda_j w_j}{S_j}, \tag{8}$$

where η is the scrap supply elasticity. Solving equation (8) for λ_j yields:

$$\lambda_j = \frac{\eta S_j}{w_j}. \tag{9}$$

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[7] A demand elasticity of –0.5 is a common choice when an estimate of the elasticity in question is not available. This choice allows for some but not an overwhelming response to a change in price.

[8] A year is chosen as the empirical model's time period because it will take at least a year for the scrap market to adjust to the operation of the Chaparral's new facility. For RES and Simsmetal, this is equal to twelve times the average monthly purchases of scrap.

[9] Again, a supply elasticity of 0.5 is a very common choice when an empirical estimate is not available.

The value of w_j, the f.o.b. price for the *j*th supplier, is determined by subtracting the transportation costs from the *j*th supplier to the appropriate recycler based on the initial market boundaries. So for suppliers who initially sell to RES, the f.o.b. price is equal to the RES mill price less the cost of transportation to RES. The value of S_j is the amount of scrap sold by the *j*th supplier. For all regions that initially sell to RES (e.g., all regions in western Virginia), this is equal to the region's average annual sales to RES. However, for all other regions in Virginia, S_j must be adjusted upward to account for not having data from Jacobson Metal. Assuming that the Jacobson Metal Company purchased approximately the same amount of scrap as RES or Simsmetal on an annual basis, the supply of scrap from all Virginia regions that initially sell to Simsmetal is doubled. The total level of scrap supplied from regions outside of Virginia must also be adjusted to reflect that RES and Simsmetal are not the only recyclers that purchase scrap in those regions. Thus, the initial estimates of scrap purchases from RES and Simsmetal from these regions are scaled up by 4 to 10 times to reflect differences in population across regions. Once the value of λ_j has been determined, the value of δ_j can be determined solving equation (2) for δ_j.

Model Results

To determine the potential impacts of Chaparral's new shredding facility, an experiment is performed using the economic model presented in equations (3), (4), and (5). The model is first solved in order to replicate the mill prices and regional scrap purchases (on an annual basis) of RES and Simsmetal during the period March 1998 through September 2000. Then the additional demand for scrap from Chaparral's new facility is introduced and the model is resolved.

When Chaparral enters the market at full capacity, both RES and Simsmetal lose scrap suppliers to Chaparral (see figureA.2). RES loses suppliers on its eastern market boundary in Virginia, namely Amherst, Halifax, and parts of Augusta, Rockingham, and Campbell counties to Chaparral. RES also loses its suppliers in eastern North Carolina to Chaparral. To offset some of these losses, RES must raise its mill price for scrap by 4.7 percent to attract more scrap from suppliers in western Virginia and from suppliers in western North Carolina and southern West Virginia and Kentucky. Even with the increase in mill price, RES still purchases 2.3 percent less scrap, on an annual basis, than during the March 1998 through September 2000 base period.

Because of its closer proximity to Chaparral, Simsmetal loses a greater number of suppliers in Virginia than RES. Once Chaparral begins to operate its shredder at capacity, Simsmetal will lose almost all of eastern Virginia, except for basically the I-95 corridor north of Richmond. As was the case with RES, Simsmetal must offset the loss of suppliers by increasing its mill price. However, because it is located much closer to Chaparral, it must increase its mill price by a much larger percentage, 10.2 percent. Even with the larger increase in mill price, Simsmetal still experiences a 2.5 percent decrease in scrap purchases.

Since the operation of Chaparral's new shredder will increase f.o.b. prices, scrap suppliers in Virginia will enjoy an economic gain, which can be measured as an increase in producer surplus (*PS*). Formally, producer surplus is defined as the area above the supply curve, bounded by the market price. For an increase in the f.o.b. price from w_j^0 to w_j^1, the increase in producer surplus will be the area of rectangle *A* plus the area of triangle *B* as shown in figure A.3. For the *j*th scrap supplier, the areas of rectangle *A* and triangle *B* can be formally defined as:

$$PS_j = \left(w_j^1 - w_j^0\right)S_j^0 + 0.5\left(w_j^1 - w_j^0\right)\left(S_j^1 - S_j^0\right), \quad (10)$$

where w_j^0 and S_j^0 are the initial f.o.b. price and quantity of scrap supplied and w_j^1 and S_j^1 are the f.o.b. price and quantity supplied after Chaparral begins operating its shredder. This measure shows that scrap suppliers in Virginia gain $1.372 million in producer surplus on an annual basis from the operation of Chaparral's shredder. However, as shown in figure A.5, most of this gain in surplus flows to scrap suppliers in eastern Virginia.

Because both RES and Simsmetal must increase their mill price after Chaparral begins operation, they both lose economic surplus, which can be measured as a decrease in consumer surplus (*CS*). Consumer surplus is defined the area under the demand curve, bounded by the market price. For a c.i.f. price increase from mp_i^0 to mp_i^1, the decrease in consumer surplus is the area of rectangle *C* plus the area of triangle *D* in figure A.4. For the *i*th recycler, the area of rectangle *C* and triangle *D* is defined as:

$$CS_i = \left(mp_i^1 - mp_i^0\right)D_i^1 + 0.5\left(mp_i^1 - mp_i^0\right)\left(D_i^0 - D_i^1\right) \quad (11)$$

where mp_i^0 and D_i^0 are the initial mill price and quantity of scrap purchased and mp_i^1 and D_i^1 are the mill price and quantity of scrap purchased after Chaparral begins operating its shredder. RES loses $329,000 in surplus on an annual basis while Simsmetal loses $715,000 in surplus on an annual basis.

The net change in economic surplus for suppliers and users of scrap in Virginia, computed as the increase in producer surplus less the decrease in consumer surplus is $328,000 per year. It must be stressed that this estimate is *only* for the scrap market and does not include any increase or decrease in surplus that may accrue to workers that may receive higher wages from a job in Chaparral's steel mill, from new companies that have located in Virginia to support

Chaparral's steel mill, or any costs to local and state governments due to the location of Chaparral's new plant.

The estimated change in producer and consumer surplus likely represents an upper bound of the potential change because scrap prices in Virginia will not be able to increase a great deal relative to the price of processed scrap. This is because firms like Chaparral and RES that are integrated steel makers would eventually find it less costly to purchase processed scrap from othe sources rather than operate their own shredding facilities.

Appendix References

Takayama, T. and G. G. Judge. "Equilibrium among Spatially Separated Markets: A Reformulation." *Econometrica* (32:4, Oct. 1964): 510-524.

Appendix Table A.1. Definition of Scrap Supply Regions

Region/County Name	Virginia Cities Included
Accomack	
Albemarle	Charlottesville
Alleghany	Clifton Forge, Covington
Amelia	
Amherst	
Appomattox	
Arlington	
Augusta	Staunton, Waynesboro
Bath	
Bedford	Bedford City
Bland	
Botetourt	
Brunswick	
Buchanan	
Buckingham	
Campbell	Lynchburg
Caroline	
Carroll	Galax
Charles City	
Charlotte	
Chesterfield	
Clarke	
Craig	
Culpeper	
Cumberland	
Dickenson	
Dinwiddie	Colonial Heights, Petersburg
Essex	
Fairfax	Alexandria, Fairfax City, Falls Church
Fauquier	
Floyd	
Fluvanna	
Franklin	
Frederick	Winchester
Giles	
Gloucester	
Goochland	
Grayson	
Greene	
Greensville	Emporia
Halifax	
Hanover	

Appendix Table A.1. Continued

Region/County Name	Virginia Cities Included
Henrico	Richmond City
Henry	Martinsville
Highland	
Isle of Wight	
James City	
King and Queen	
King George	
King William	
Lancaster	
Lee	
Loudoun	
Louisa	
Lunenburg	
Madison	
Mathews	
Mecklenburg	
Middlesex	
Montgomery	Radford
Nelson	
New Kent	
Northampton	
Northumberland	
Nottoway	
Orange	
Page	
Patrick	
Pittsylvania	Danville
Powhatan	
Prince Edward	
Prince George	Hopewell
Prince William	Manassas City, Manassas Park City
Pulaski	
Rappahannock	
Richmond	
Roanoke	Roanoke City, Salem
Rockbridge	Buena Vista, Lexington
Rockingham	Harrisonburg
Russell	
Scott	
Shenandoah	
Smyth	
Southampton	Franklin City

Appendix Table A.1. Continued

Region/County Name	Virginia Cities Included
Spotsylvania	Fredericksburg
Stafford	
Surry	
Sussex	
Tazewell	
Warren	
Washington	Bristol
Westmoreland	
Wise	Norton
Wythe	
York	Williamsburg
Chesapeake	Chesapeake, Portsmouth
Hampton	Hampton, Newport News, Poquoson City
Virginia Beach	Virginia Beach, Norfolk
Suffolk	Suffolk
Eastern North Carolina	
Western North Carolina	
Southern West Virginia, Kentucky	
Great Lakes	
Washington, D.C. – Baltimore	
Northeast	

Insert Figure A.1 here

Figure A. 1 Initial Scrap Market Boundaries in Model

Insert Figure A.2 here

Figure A. 2 Predicted Scrap Market Boundaries After Entry by Chaparral

Insert Figure A.3 here

Figure A. 3 Increase in Producer Surplus From a Price Increase

Insert Figure A.4 here

Figure A. 4 Decrease in Consumer Surplus From a Price Increase

Insert Figure A.5 here

Figure A. 5 Geographic Distribution of Increase in Producer Surplus for Scrap Suppliers