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HOW ECONOMICALLY INTERDEPENDENT IS THE PORTLAND METRO CORE WITH ITS RURAL PERIPHERY? A COMPARISON ACROSS TWO DECADES.

by

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Introduction

Rural areas in many parts of this country have lagged economically relative to urban centers for many decades. This has been true particularly in the Pacific Northwest. The relative vitality of urban centers has led some to suggest that rural areas and rural policy ought to pursue a strategy of strengthening rural-urban economic linkages (Porter, 2004, Dabson, 2007). Not very much is known, however, about the economic relationship between urban centers and their rural hinterlands.

Better understanding of the linkages between rural and urban economies would aid policymakers in addressing interrelated problems such as declining economic opportunity in rural regions that is often combined with losses in quality of life in urban areas experiencing high rates of population growth (Harrison and Sieb, 1990). Rural and urban legislators, for example, might better understand how the economic fortunes of rural and urban areas are interrelated and how certain policy proposals directed to the rural economy have feedback effects on the urban economy. An example of such a policy in the Northwest is the planned phase out of Federal forest payments to county governments. This policy will have economic impacts in rural regions that spill over into nearby urban regions.

In 1992 Holland, Weber, and Waters studied the employment and trade interdependence between the Portland-Metro Core and its Periphery trade area using 1982 data. The questions at that time were: “How interdependent are Core and Periphery labor markets through commuting? How significant is each subregion in the overall demand structure of the other? Which sectors are most important in Core and Periphery

trade? To what extent is one subregion's demand for the other subregion's goods and services generated by households versus the business side of the economy?" (Holland et al., 1993). The objective of the current study is to re-examine the Core and Periphery economic linkage using recent data and investigate how the economic interdependence of the Portland-Metro Core and its Periphery trade area changed from 1982 to 2006.

The Portland, Oregon, Trade Area

The Bureau of Economic Analysis (BEA) (U.S. Department of Commerce) has mapped principal trading regions of the U.S. into economic areas (EA). The EAs use counties as the basic building block and provide a convenient picture of functional economic regions consistent with central place perspectives. According to central place theory (Christaller), regions are organized in a geographic hierarchy of central places. A place at a given level on the hierarchy provides not only goods and services that are specific to its level, but also all other goods and services of lower order. Goods and services supplied only by major central places are referred to as "central place goods and services." The rural periphery will not be self-sufficient in the supply of these goods and services and must, to some degree, depend on the central place for their supply. The EAs can be thought of as trade areas served by major central places.

The Portland, Oregon, trade area examined here includes (1) a metropolitan core defined as the four counties in the 1982 Standard Metropolitan Statistical Area: Multnomah, Washington, and Clackamas Counties in Oregon and Clark County in Washington and (2) a periphery: the trade area that is served by Portland, combining the EAs of Portland and Eugene. The Periphery trade area consists of Benton, Clatsop, Columbia, Coos, Crook, Curry, Deschutes, Douglas, Hood River, Jackson, Jefferson, Josephine, Klamath, Lake, Lane, Lincoln, Linn, Marion, Polk, Sherman,

Tillamook, Wasco, and Yamhill Counties in Oregon plus Cowlitz, Klickitat, Skamania, and Wahkiakum Counties in Washington. This region is bounded on the north by the Seattle trade area, which extends into southwestern Washington (Figure 1). The western boundary is defined by the Pacific Ocean, while the eastern boundary extends to the Boise trade area that dominates eastern Oregon. The region extends south down the 1-5 corridor until the southern border of Oregon. The region includes Eugene and portions of Southern Oregon which we feel have increasingly been drawn into the Portland trade area as a result of ease of north-south travel on 1-5.

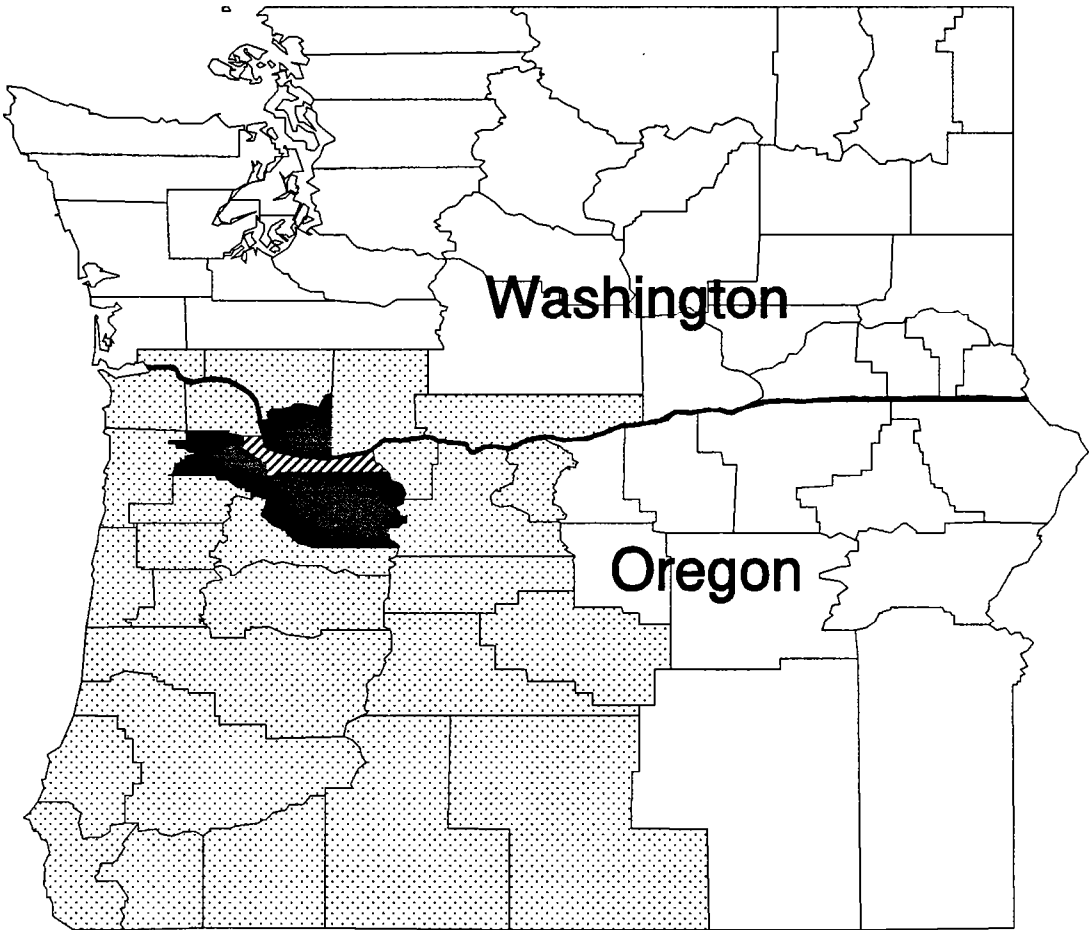

Figure 1. The Portland, Oregon Trade Area: Core and Periphery.

Labor and Earnings Flows Between the Urban Core and its Periphery

An important set of economic linkages between the urban core and its periphery is the commuting into the core of workers who live in the periphery and the commuting of those living in the core to the periphery. The jobs and income flows between the Core and Periphery in Tables 1-3 were estimated using data from the Bureau of Economic Analysis and the US Census Bureau.[1]

The Holland et al (1993) estimates of labor and earnings flows for 1982 are shown in Table 1 with earnings reported in inflation-adjusted 2006 dollars. Each earnings flow appears below the corresponding labor flow that generated it. Reading across the rows, we see, for example, how many of the 568, 916 workers living in the core work in the core, periphery and elsewhere, and how much of the about $18 billion in labor earnings originating in the core stays in the core or leaves for the periphery or elsewhere. Likewise, reading down each region's column we can estimate the proportion of workers commuting into the region from other regions. The columns show where the people who work in each region live.

Our estimates of labor and earnings flows between core and periphery for 2006 are shown in Table 2. The number of periphery-to-core commuters has roughly tripled from 1982 to 2006 from about 16,000 to about 45,000 workers. The number of core-to-periphery commuters has also increased, though not nearly as quickly, from 8,500 to

[1] For 2006, we calculated labor flows using the information published by the US Census Bureau in the "United Stated Census 2000, County-To-County Worker Flow Files". Then, we constructed earnings flows using data from the Bureau of Economic Analysis, Regional Economics Accounts, in "CA04 — Personal income and employment summary"[1] for the year 2006 and our results of labor flows. A detailed

18,500 over this period. The proportion of Periphery residents who work in the Core increased from 2.7% in 1982 to 4.9% in 2006 (Table 3). This phenomenon of increased commuting is also present in labor flows of Core residents to the Periphery for work. Between 1982 and 2006, the percentage of Core residents that work in the Periphery increased from 1.5% to 2.3%. Although the Core and the Periphery are not strongly linked through flows of labor and income, we see that the regions have over time become more interdependent through labor commuting.

Table 1: Labor and Earnings Flows between the Core and Periphery 1982, ($000 of 2006 dollars)

Place of Residence	Flows	Place of Work				
		Core	Periphery	Elsewhere	Total Labor by POR	Total Earnings by POR
Core	Labor	555,857	**8,434**	4,625	568,916	
	$ Earnings	17,921,323	**345,977**	171,109		18,438,409
Periphery	Labor	**15,917**	547,431	33,013	596,361	
	$ Earnings	**340,857**	14,915,804	668,417		15,925,078
Elsewhere	Labor	14,300	5,949			
	$ Earnings	403,884	213,782			
Total Labor by POW		586,074	561,814			
Total Earnings by POW $		18,666,064	15,475,562			

Source: Holland et al (1993). U.S Department of Commerce, Bureau of Census (1980); U.S. Department of Commerce, Bureau Economic Analysis (1988)

Note: POR = place of residence; POW = place of work. Labor flows are for 1980 and earnings flows are for 1982. Gross Earnings by POR are inclusive of Social Security Insurance by POW. Labor Flows are Person. Earnings flows are in millions of dollars (1982) The Metro Region consists of Multnomah, Washington, and Clackamas Counties, as well as Clark County, Washington. The Periphery Region is an aggregation of 27 counties in Western Oregon and Southwestern Washington.

explanation about our estimation procedures and assumptions are in Appendix 1. A similar process was used in 1992 to estimate labor and income flows for 1982 (Holland et al. 1992b)

Table 2: Labor and Earnings Flows between the Core and Periphery, 2006 ($000)

Place of Residence	Flows	Place of Work				
		Core	Periphery	Elsewhere	Total Labor by POR	Total Earnings by POR
Core	Labor	866,761	**18,575**	7,839	893,175	
	$ Earnings	50,287,477	**888,001**	575,514		51,750,992
Periphery	Labor	**44,932**	793,472	9,166	847,570	
	$ Earnings	**2,368,396**	34,463,113	464,318		37,295,827
Elsewhere	Labor	6,151	5,949			
	$ Earnings	281,640	224,448			
Total Labor by POW		917,844	817,996			
Total Earnings by POW $		52,937,512	35,575,563			

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Accounts (2006); U.S. Census Bureau, Journey to Work and Place of Work (2000)

Table 3: Percent of Core and Periphery Jobs and Earnings Going to Residents of Each Region, 1982 and 2006

Place of Residence	Flows	Place of Work			
		1982		2006	
		Core	Periphery	Core	Periphery
Core	Jobs	94.8%	**1.5%**	94.4%	**2.3%**
	US$	96.0%	**2.2%**	95.0%	**2.5%**
Periphery	Jobs	**2.7%**	97.4%	**4.9%**	97.0%
	US$	**1.8%**	96.4%	**4.5%**	96.9%
Elsewhere	Jobs	2.4%	1.1%	0.7%	0.7%
	US$	2.2%	1.4%	0.5%	0.6%
Total Jobs by POW		100.0%	100.0%	100.0%	100.0%
Total Earnings by POW		100.0%	100.0%	100.0%	100.0%

Interregional Trade in Goods and Services

Trade in goods and services is a much more significant linkage between core and periphery than commuting. The trade in goods and services between the Core and its Periphery trade area, and between those two regions and the rest of the U.S. was estimated using Regional Commodity Reports from IMPLAN following procedures

summarized by Holland and Pirnique (2000)[2].

In 1982, both Core and Periphery economies were roughly the same size in terms of total sales (Table 4). The Portland core economy was quite open, exporting 37 percent of gross commodity supply. Portland imported slightly more than it exported, implying negative trade balance from goods and service trade. There was significant trade to the surrounding region: 20 percent of Portland's exports went to the trade area periphery. The periphery region was similarly open, exporting 38 percent of gross commodity supply and importing 44 percent of its regional demand. Only 8 percent of the Periphery's exports went to the Core. The net trade balance between Portland and the trade area periphery region was positive and large in favor of Portland. Portland's goods and service exports to the periphery ($2400 million) were more than two times its imports from the periphery ($1039 million). More than $1 billion flowed from the periphery to Portland on the trade account.

The value of goods shipped from Core to Periphery ($709 million) was about matched by the value of good shipped from Periphery to Core ($749 million). However, Portland sold nearly five times as much services to the periphery as the periphery sold to Portland (Table 4). Portland exports of services to the periphery were $1691 million while its imports of services from the periphery were only $290 million.

Between 1982 and 2006, both Core and Periphery grew but the Core grew much faster and was one and a half times as large as the Periphery is terms of total sales. In 2006 the Portland core continued to dominate in service trade with service exports of

[2] The original study was based on the expectation that central place goods will flow down the central place hierarchy from core to periphery. A detailed explanation of Holland's estimation procedures is found in Appendix 2.

$5533 million while its imports of services from the periphery totaled $855 million (Table 5). Portland Core's trade surplus with the Periphery grew almost five fold by 2006. The Core's exports to the Periphery were estimated to be $7,402 million and its imports from the Periphery were $1,807 million, which means a net trade surplus of more than five billions dollars in favor of the Core (Table 5).

When core-periphery trade is viewed in relative terms, however, we see that the trade linkages have declined over time. In 1982 the Core was exporting roughly 8% of its services output to the Periphery (Table 6). In 2006 the Core was exporting 4% of its services to the Periphery (Table 6). Over the same interval, the proportion of goods and services exported to the rest of the world by the Core increased from 30% to 34%.

The periphery was exporting 2% of its services to the Core in 1982 (Table 6), but only 1% of its service production in 2006 (Table 6). With the diversification of the economy over space in the last quarter of a century some specialized goods and services that were available only in large central places like Portland have decentralized to the Periphery. Examples are medical services and selected business services as well as wholesale and retail services. The result has been a relative weakening in the trade linkages between the Metro Portland Core and its Periphery, as the Periphery has become more self sufficient in the provision of goods and especially services. Goods and services produced and consumed in the Periphery increased from 62 percent of output in 1982 to 68 percent of output in 2006 (Table 6) indicating the Periphery became more self sufficient.

A comparison of Tables 4 and 5 shows that the Portland Core experienced a much faster rate of economic growth than the Periphery. The Periphery rate of total output

growth was only about one-half that of the Core. This growth in the Core was led by its expansion of goods exports to the rest of the world. In fact the Portland core experienced a faster rate of growth in goods production than service production, during a time when service sectors were nationally increasing faster than goods-producing sectors..

Goods exports from the Core to the rest of the world were growing at four times the rate of goods exports from the Periphery. However, the Periphery did exhibit a slightly higher rate of growth than the Core in the export of services to the rest of the world. By 2006, the Portland Core had transformed itself into an export-driven economy with a positive surplus of exports over imports, something that was not true in 1982 when imports exceeded exports. The Periphery, on the other hand, with its mix of resource-based goods was less successful in the expansion of exports and remained a regional economy with a negative trade balance, where exports are less than imports (Tables 4 and 5).

Table 4: Portland Core-Periphery Goods and Services Trade (1982, $millions)

From		**To**			
		Core	**Periphery**	**ROW**	**TOTAL SALES**
Core	Total	19,619	**2,400**	9,408	31,427
	Goods	4,017	**709**	5,630	10,356
	Services	15,602	**1,691**	3,778	21,071
Periphery	Total	**1,039**	20,029	11,487	32,555
	Goods	**749**	5,848	10,197	16,794
	Services	**290**	14,181	1,290	15,761
ROW	Total	11,313	13,447		
	Goods	7,650	8,958		
	Services	3,663	4,489		
TOTAL PURCHASES	Total	31,971	35,876		
	Goods	12,416	15,515		
	Services	19,555	20,361		

Source: Holland et al, 1993. Using IMPLAN data.

Table 5: Portland Core - Trade Area Periphery Goods and Services Trade (2006, millions of dollars)

From		To			
		Core	**Periphery**	**ROW**	**TOTAL SALES**
Core	Total	115,271	**7,402**	65,044	187,716
	Goods	19,610	**1,869**	40,667	62,146
	Services	95,661	**5,533**	24,377	125,570
Periphery	Total	**1,816**	81,874	36,331	120,022
	Goods	**961**	14,372	25,379	40,712
	Services	**855**	67,503	10,952	79,310
ROW	Total	61,712	46,900		
	Goods	36,191	31,116		
	Services	25,521	15,784		
TOTAL PURCHASES	Total	178,799	136,176		
	Goods	56,762	47,357		
	Services	122,037	88,820		

Source: 2006 IMPLAN data.

Table 6: Goods and Services Trade 1982 and 2006 (Percent of sales from each region to each region)

		1982				2006			
From		To				To			
		Core	Periphery	ROW	Total	Core	Periphery	ROW	Total
Core	Total	62%	**8%**	30%	100%	61%	**4%**	35%	100%
	Goods	39%	**7%**	54%	100%	32%	**3%**	65%	100%
	Services	74%	**8%**	18%	100%	76%	**4%**	19%	100%
Periphery	Total	**3%**	62%	35%	100%	**2%**	68%	30%	100%
	Goods	**4%**	35%	61%	100%	**2%**	35%	62%	100%
	Services	**2%**	90%	8%	100%	**1%**	85%	14%	100%

Source: Tables 4 and 5

The Multi-Regional Input-Output (MRIO) Model

Model Closure. In creating the Core-Periphery MRIO model, household income and household expenditures which occur in the two-region area were treated as endogenous (i.e., the spending from this income has the effect of increasing regional demand and output). Nine distinct household income classes were identified for each region from IMPLAN data. The resulting MRIO model identifies linkages across regions according to industry, factor of production, and household income class. Thus the model is able to show how an exogenous shock to the Periphery economy affects industry output and payments to households across the size distribution of income in the periphery region, and also how that same shock affects industry output and households in the various income classes in the Core.

The model is closed under the assumption that regional consumption for each household income class is a function of the personal income received by that household group. Personal income is the sum of employee compensation, proprietors' income, government transfers, and property income. The regional contribution to regional personal income is measured as the sum of employee compensation and proprietors' income from the IMPLAN input-output accounts.

All "other property income" generated in the region is assumed paid to capital owners outside the combined region. Payments of interest, dividends, and rent to households and government transfers in each region were treated as exogenous and were derived from the IMPLAN SAM constructed for each region.

In the MRIO model, each industry is assumed to pay a fixed proportion of earnings to commuting workers from each region. The proportion is assumed constant

for all industries in the region. (The standard IO assumption of fixed proportion distribution functions is used.) As is conventional in SAM-type models, employee compensation and proprietors' income are assumed distributed in fixed but different proportions across the size distribution of households in each region. The marginal propensity to consume is assumed equal to the average propensity to consume for each household income class. The average propensity to consume for each household income class is estimated by normalizing each regional household consumption vector with respect to the claim by that household income class on personal income in the region. Personal income is composed of an endogenous portion derived from earnings within the combined region, and an exogenous portion made up of government transfers and returns to capital outside the region. As is true for the standard input-output analysis, this model is static and does not trace the time path of changes generated by external economic shocks.

Output Multipliers. Households-endogenous output multipliers are derived from the Leontief inverse matrix of the multiregional transactions table. The own-region output multipliers are the column sums of interindustry coefficients in the diagonal blocks of this matrix. These multipliers capture both within-region interindustry linkages and feedback effects from changes in other-region activity induced by a shock in the first region. The cross-regional multipliers are the column sums of interindustry coefficients in the off-diagonal blocks of the inverse matrix. They show the output change across regions for a one-unit change in the exogenous demand of the opposite region.

Own- and cross-regional output multipliers for the Portland Core and the trade area Periphery regions are shown in table 7. The own-region effect in 2006 of a $1 increase in crop exports in the Periphery, for example, is a $1.59 increase in total output in the Periphery economy. Simultaneously, because the cross-regional multiplier for the Core is 0.12, there would be a $0.12 increase in total output in the core resulting from a $1 increase in crop exports from the periphery. This is referred to as Periphery linkage across to the Core. The total effect on the entire Trade Area economy of the increase in exports is the sum of the own-region and the cross-region effects. Thus, in our example, a $1 increase in periphery crop exports would generate a $1.71 increase in output in the trade area.

The range of Core-to-Periphery cross-regional output multipliers for 2006 (excluding household industry) is from .03 for Forest Products and Logging to .09 for Other Manufacturing (Table 7). The magnitude of the cross-regional output multiplier is a rough indication of that sector's backward linkage (input purchases) with the other region's economy.

The cross-regional output effects (and thus the economic linkages) from the Periphery to the Portland Core generally are stronger than the linkages in the opposite direction (Table 8). The largest cross-regional multipliers from the Periphery to the Core are in Other Manufacturing and Forest Products & Logging sectors. The range of cross-regional output multipliers (excluding household industry) is from .11 for Insurance and Real Estate to .22 for Other Manufacturing. As a general rule, unit changes in final demand for periphery region supply generate output changes ranging from .15 to .2 in the Portland Core economy. The Periphery-to-Core cross-regional output multipliers are

uniformly two or more times larger than the corresponding Core-to-Periphery multipliers. This reflects the generally stronger backward linkages from the Periphery to the Core versus the generally weaker backward linkages from the Core to the Periphery. For most industries the Periphery is a more important market for the Core than the Core is for most Periphery industries.

When multipliers from the 1982 period are compared with 2006, the cross regional multipliers from the Core to the Periphery are almost all considerably smaller in 2006 than was the case in 1982 (Table 7). This reflects a general weakening of Core imports from the Periphery relative to the size of the Core economy. In contrast the cross regional multipliers from the Periphery to the Core are for many industries larger in 2006 than they were in 1982. This results from a relative strengthening of Periphery imports from the Core relative to the size of those industries in the Periphery.

In contrast to the Core (where many own-region multipliers declined from 1982 to 2006), the Periphery own-region multipliers often increased over this time period. This was especially true for the Periphery's service industries where virtually all multipliers increased over the time period (Table 7). This is consistent with a story of import substitution on the part of many Periphery industries where formerly imported inputs were replaced by goods and services produced by other industries in the Periphery region.

Table 7: Own-region and Cross-region multipliers for Portland Oregon Trade Area Core and Periphery, 1982 and 2006

Sector	1982						2006					
	Core			Periphery			Core			Periphery		
	Core	Periphery	Total	Periphery	Core	Total	Core	Periphery	Total	Periphery	Core	Total
Crops	1.82	**0.13**	1.95	1.63	**0.18**	1.81	1.57	**0.04**	1.61	1.59	**0.12**	1.71
Livestock	1.65	**0.13**	1.78	1.77	**0.18**	1.95	1.65	**0.09**	1.75	1.90	**0.17**	2.07
Forest Products & Logging	1.78	**0.18**	1.96	1.84	**0.14**	1.98	1.78	**0.03**	1.80	1.91	**0.20**	2.11
Commercial Fishing	1.53	**0.06**	1.59	1.37	**0.13**	1.50	1.81	**0.04**	1.85	1.89	**0.18**	2.07
Landscaping & Ag. Services	1.75	**0.11**	1.86	1.60	**0.18**	1.78	1.81	**0.06**	1.87	1.79	**0.15**	1.94
Mining	1.58	**0.08**	1.66	1.48	**0.14**	1.62	2.04	**0.06**	2.09	1.58	**0.17**	1.75
Construction	1.80	**0.08**	1.88	1.60	**0.20**	1.80	1.76	**0.06**	1.82	1.70	**0.14**	1.83
Other Manufacturing	1.60	**0.08**	1.68	1.50	**0.19**	1.69	1.78	**0.09**	1.87	1.86	**0.22**	2.08
Food Processing	1.69	**0.19**	1.88	1.79	**0.25**	2.04	1.71	**0.04**	1.75	1.56	**0.15**	1.71
Wood Products	2.12	**0.25**	2.37	2.18	**0.21**	2.39	1.88	**0.06**	1.94	1.87	**0.19**	2.06
Pulp & Paper Products	1.69	**0.13**	1.82	1.66	**0.19**	1.85	1.65	**0.04**	1.69	1.68	**0.19**	1.87
Electronics & Instruments	1.68	**0.07**	1.75	1.55	**0.20**	1.75	2.01	**0.05**	2.06	1.75	**0.21**	1.97
Transportation	1.94	**0.07**	2.01	1.58	**0.18**	1.76	1.76	**0.05**	1.81	1.74	**0.14**	1.88
Communications	1.46	**0.05**	1.51	1.41	**0.12**	1.53	1.78	**0.04**	1.82	1.73	**0.14**	1.88
Utilities	1.61	**0.21**	1.82	1.32	**0.08**	1.40	1.72	**0.04**	1.76	1.51	**0.17**	1.68
Wholesale Trade	1.72	**0.08**	1.80	1.59	**0.19**	1.78	1.69	**0.05**	1.74	1.67	**0.14**	1.81
Retail Trade	1.67	**0.07**	1.74	1.57	**0.17**	1.74	1.71	**0.05**	1.76	1.70	**0.13**	1.83
Financial	1.80	**0.07**	1.87	1.61	**0.19**	1.80	1.78	**0.05**	1.83	1.76	**0.12**	1.89
Insurance & Real Estate	1.42	**0.03**	1.45	1.23	**0.06**	1.29	1.67	**0.04**	1.71	1.62	**0.11**	1.73
Eating, Drinking & Lodging	1.79	**0.11**	1.90	1.63	**0.22**	1.85	1.73	**0.07**	1.79	1.75	**0.16**	1.92
Other Services	1.67	**0.07**	1.74	1.54	**0.16**	1.70	1.82	**0.05**	1.87	1.79	**0.15**	1.94
Business Services	1.72	**0.07**	1.79	1.60	**0.18**	1.78	1.84	**0.06**	1.90	1.83	**0.16**	1.99
Health Services	1.84	**0.08**	1.92	1.69	**0.19**	1.88	1.78	**0.06**	1.84	1.76	**0.14**	1.91
Govt. Industry & Enterprise	1.74	**0.09**	1.83	1.64	**0.18**	1.82	1.74	**0.07**	1.81	1.75	**0.14**	1.89
Household Industry & Other	1.05	**0.01**	1.06	1.05	**0.01**	1.06	1.37	**0.02**	1.38	1.42	**0.07**	1.48

Conclusion[3]

Over the past quarter of a century, the Portland, Oregon trade area has grown rapidly and experienced significant changes in industrial structure and in the relationship between the Core economy and the Periphery. Our core-periphery multi-regional input-output analysis suggests four major conclusions about rural-urban economic interdependence in this region.

The Core has grown faster than the Periphery

Fueled by rapid growth in goods exports, the Core has grown more rapidly than the Periphery. Whereas in 1982 Core sales were just slightly smaller than Periphery sales, the Core in 2006 sold half-again as much as the Periphery.

Commuting flows have grown over the 1980-2000 period.

Commuting linkages between core and periphery have grown stronger as the core region has grown. From 1980 to 2000 the commuting linkage grew stronger both in numbers of jobs and relative to the size of the respective labor forces. In 2000, 2.3 percent of those working in the Periphery lived in the Core, while five (4.9) percent of those working in the Core lived in the Periphery. As expected many more people commute from the Periphery into the Core (45,000) than the other way (around 19,000).

At the same time, both the Portland and periphery regions represent relatively self-contained labor markets. In 1982, only 1.5 percent of the resident Portland labor force worked in the periphery, while roughly 2.7 percent of periphery residents worked in Portland.

Core-Periphery trade flows have weakened as Core has expanded trade to other regions and the Periphery has become more self-contained.

[3] This section of the paper draws on Holland and Weber, 1996

Since 1982, core-periphery trade linkages have generally grown weaker, at least with respect to the relative size of output sales in the regional economies. For example, in 1982 the Core was estimated to sell eight percent of its service output to the Periphery. In 2006 the Core was estimated to sell only four percent of its service output to the Periphery. Likewise, in 1982 the Periphery sold four percent of its goods output to the Core. In 2006 the Periphery sold only two percent of its goods output to the Core. Interregional trade between the two regions has grown smaller relative to the economic size of the regions: each region sells a smaller share of its output to the other region. The Core sells a larger share of its output to the Rest of the World. And the periphery sells an increasing share of its total output within its own boundaries.

Spillover impacts of exports have generally weakened in both core and periphery, although at a much greater rate in the core.

In a core-periphery input-output model, the spillover coefficient shows what portion of total indirect and induced effect occurs in the opposite region. For example, the spillover coefficient for the livestock sector in the metro region in 1982 is .17 (Table 8). This means that 17 cents of every dollar of indirect and induced effect associated with core livestock exports "spills over" into the periphery region. The spillover coefficient measures the strength of cross-regional impact associated with expansion or contraction of an own-region sector. The spillover coefficient for a given sector is calculated as the cross-regional multiplier for that sector (.13 for 1982 core livestock sector from Table 8) divided by the total periphery livestock multiplier from Table 8 minus one (1.78-1 = .78). So the spillover coefficient is .17 (.13/.78)

The average (unweighted) spillover coefficient in 1982 was much larger for the periphery than for the core: 22 percent of the total regional (core plus periphery) indirect and

induced effects of exports from the periphery spilled over to the core, whereas only 13 percent of core export impacts occurred in the periphery. The metro sectors with the largest spillover coefficients in 1982 were food processing and utilities (Table 8) because these sectors purchased important production inputs from the periphery economy. The spillover coefficients for these two industries indicate that more than 20 percent of every dollar of indirect and induced economic impact of core exports from the core actually took place in the periphery. This may be contrasted with rapidly expanding metro service and electronic industries. Here the spillover coefficients were less than 10 percent, so very little of the economic impact from expansion in these sectors spilled out to the periphery. The small numerical value of these coefficients shows that, with the exception of its resource processing sectors, the Portland metro region did not serve as a growth pole to the rural periphery. In other words, very little impact of Portland's economic growth was felt in the periphery in 1982.

On the other hand, in 1982, most periphery sectors exhibited spillover coefficients greater than 20 percent (Table 8). For many periphery sectors, most of the cross-regional impact is in the form of induced rural household spending for Portland produced services. A good rule of thumb for the Portland functional region is that for most sectors in the periphery, about 20 percent of the indirect economic effect will manifest itself in the core region.

Table 8 Spillover Coefficients for Portland Oregon

Metro Core and Trade Area Periphery, 1982 and 2006

Sector	Core 1982	Periphery 1982	Core 2006	Periphery 2006
Crops	0.14	0.22	0.07	0.17
Livestock	0.17	0.19	0.12	0.16
Forest Products & Logging	0.19	0.14	0.04	0.18
Commercial Fishing	0.10	0.26	0.05	0.17
Landscaping & Ag. Services	0.13	0.23	0.07	0.16
Mining	0.12	0.23	0.06	0.23
Construction	0.09	0.25	0.07	0.17
Other Manufacturing	0.12	0.28	0.10	0.20
Food Processing	0.22	0.24	0.05	0.21
Wood Products	0.18	0.15	0.06	0.18
Pulp & Paper Products	0.16	0.22	0.06	0.22
Electronics & Instruments	0.09	0.27	0.05	0.22
Transportation	0.07	0.24	0.06	0.16
Communications	0.10	0.23	0.05	0.16
Utilities	0.26	0.20	0.05	0.25
Wholesale Trade	0.10	0.24	0.07	0.17
Retail Trade	0.09	0.23	0.07	0.16
Financial	0.08	0.24	0.06	0.13
Insurance & Real Estate	0.07	0.21	0.06	0.15
Eating, Drinking & Lodging	0.12	0.26	0.09	0.17
Other Services	0.09	0.23	0.06	0.16
Business Services	0.09	0.23	0.07	0.16
Health Services	0.09	0.22	0.07	0.15
Govt. Industry & Enterprise	0.11	0.22	0.09	0.16
Household Industry & Other	0.17	0.17	0.05	0.15
Average Spillover Coefficient	**0.13**	**0.22**	**0.07**	**0.18**

Between 1982 and 2006, the average spillover effect of exports declined in both core and periphery. The average core spillover effect declined over 45 percent from .13 to .07. The average periphery spillover, on the other hand, declined by less than 20 percent, from .22 to .18.[4] For several natural resource sectors and utilities, the Periphery to Core spillover effects

[4] This fact of much greater declines in spillovers in the core than the periphery seems inconsistent with the evidence of roughly proportional declines in shares of cross-regional exports in core-periphery trade. The

increased from 1982 to 2006: for Logging the spillover coefficient increased from .14 to .18; for Wood Products, it increased from .15 to .18, and for utilities, from .20 to .25. For all other Periphery sectors, the spillovers declined or stayed the same. And for all the Core sectors, spillovers declined, and in the case of natural resource industries and utilities, declined significantly. For Logging, for example, the spillover coefficient declined from .19 in 1982 to .04 in 2006. For Wood Products and Pulp and Paper the declines were from .18 and .16 to .06 and .06 respectively. The decline for Utilities was from .26 to .05.

Both Core and Periphery have a significant interest in the economic health of the other region: 18 percent of the economic impact of a shock to the Periphery economy leaks across to the Core regional economy and 7 percent of the impact of a shock to the Core economy spills over to the Periphery.

Implications

In general, Portland has not been an important market for the periphery. However, certain goods and services in the periphery were strongly linked to Portland markets. Utility services (electricity); livestock; eating, drinking and lodging; and pulp and paper all sold an important part of their output to Portland. Most natural resource and manufacturing industries in both regions were estimated to serve markets largely outside the functional economic region.

Possibilities for increased trade "periphery to core." One implication of these findings is that given the current structure of subregional trade, very little growth of the metro Portland economy will trickle across to the periphery. The economic linkage (metro market for periphery products) in general is weak. Whether these linkages can be strengthened with

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explanation lies in the different rates of economic growth in the two regions. The Core grew faster than the Periphery. While Periphery *imports* from the Core declined only slightly as a percent of total purchases in the Periphery (from 6.7 percent to 5.4 percent), Core imports from the Periphery declined as a share of total Core purchases from 3.1 percent to 1.0 percent.

public intervention is an open question. Part of the problem is getting an accurate assessment of possible trading opportunities between core and periphery regions. Regional trade accounts such as those developed for this study have not been used in rural development planning, and perhaps could be helpful in attempting to increase periphery to core sales. The problem is complicated because, even with a relatively detailed sectoring scheme such as that used in this study, what appears to be the same commodity in the input-output accounts may in reality not be suited for periphery to core trade. For example, the periphery may have excess supply of food grains and the core excess demand, but trade really is not possible because the core wants rice and the periphery sells wheat. The agricultural sectors in the periphery exhibited important linkages to the metro core, but most sales are estimated to be made in raw product form to business rather than household markets.

One strategy to increase periphery sales to core business would be to explore the nature of periphery agricultural sales used as inputs into food processing into the core region. It is also possible that selected crops would lend themselves to increased marketing to households, especially if niche markets satisfying demand for organic and local produce can be exploited. Of course the strategy of increased processing of agricultural commodities in the periphery may be an effective way to penetrate metro household markets with processed agricultural products rather than raw products. The study data indicate strong economic linkage between the periphery eating, drinking and lodging sector and the Portland metro region. This is a reflection of the tourism and recreation services that the periphery provides to the core. There is little doubt the demand for these services will continue to expand.

Porter has suggested a need for a “holistic policy framework” for rural economic development “that would address the specific circumstances of particular regions” (Porter, 2004, p. 59). Such a framework should “incorporate linkages between the rural region and

nearby urban areas" (op. cit., p. 60). In the literature on rural economic development, "there is a growing understanding that the central issues is competitiveness, and there is widespread agreement on the importance of cluster thinking" (op. cit. p 61). The most pressing research priorities related to rural economic policy are for better "knowledge about how rural areas relate to nearby urban economies on the level of specific clusters… Each rural area will differ in its cluster composition and in the opportunities created by the cluster strengths in nearby urban areas." (op. cit., p.63)

Importance of healthy rural economy to urban core. In cases where there are important trade linkages from periphery to core, such as Portland's processing of periphery-produced agricultural commodities, core industries have some interest in a healthy periphery but would act to minimize the impact of possible agricultural shortages from the periphery. Assume, for example, a reduction in output from periphery natural resource sectors which resulted in reduced sales from periphery to core industries. In the short-run, core processing firms might be forced to restrict output due to periphery shortages, but if alternative sources of resource supply from other regions could be found at sufficiently attractive prices, those inputs would be purchased and core output would be produced to meet demand. The impact of resource supply shortages in the periphery on core processing industry depends on the availability of substitutes from other regions. In cases where there were no alternative sources of supply, core processing sectors would be restricted and even eliminated.

It is important to note that even in this extreme case, the economic impact is likely to stop at supplies to the processing industry itself. For example, in the case of a restriction on timber harvest in the western Oregon periphery, it is possible that sawmills in Portland would have to reduce output, but the shock would not extend to lumber users (construction) in Portland. The response to a shortage of Oregon lumber would likely be increased imports of

lumber, with much of the increase in construction cost passed on to consumers, rather than reduced construction in Portland. In an input-output analysis of the effects of timber supply shocks in western Oregon using the 1982 model, about 15 percent of the functional (total) regional economic impact was estimated to occur in Portland. Most of this impact was generated from the induced effect of reduced periphery household spending for core-produced services rather than reduced output of wood products in Portland.

The central place dominance of the core over the periphery suggests that Portland metro core has reason to be interested in a healthy periphery economy. This study shows that the rural demand for central place services derives from both rural business and rural households. If rural business sales decline and/or the disposable income of rural households declines, it will be felt as declining demand for Portland based services. Given the central place nature of these services it is likely that there will be limited alternative demand outside the Portland functional economic region. A declining periphery will place a drag on the service economy in the urban region, all other things equal.

Are rural and urban areas economically interdependent? In a global sense, the answer is certainly yes. Urban areas in the aggregate depend on rural areas for their supply of natural resources, certain manufactured goods and recreational services, and as markets for urban-produced goods and services. Rural areas depend on urban areas for their supply of central place services, many specialized manufactured goods, and as markets for their natural resource-based goods and services. In the case of a major central place such as Portland, however, the labor market and trade interdependence with the trade area periphery is more limited. For most goods producing industries in both the core and periphery, the bulk of trade is outside the functional economic region. Even for the majority of core service sectors, our estimates indicate that most exports were outside the functional region. Yet for selected major

urban sectors-such as wholesale and retail trade, financial services, and consumer services in which the majority of export sales are made to the rural periphery-the health of the rural economy is important. A major downturn in the periphery economy will produce a regional impact in the urban center. The spillover coefficients estimated for this study show that around 20 percent of the total indirect effect of economic shocks in the periphery actually occur in the Portland core. An impact in the periphery would have to be quite substantial in order to greatly affect the core, of course. For example, an analysis of the reduction in periphery timber harvest stemming from protection of the Northern Spotted Owl using the 1982 model estimated that the impact of that significant policy shock would have been a loss of 4,400 jobs in Portland. While this is a lot of jobs, the Portland jobs base in this analysis was 534,000, so the total impact would have only constituted 0.8 of total jobs in Portland.

Summary

As the larger Portland trade area has grown over the past quarter century, the Core has grown faster than the Periphery. Whereas the Core was slightly smaller than the Periphery in 1982, it was 50 percent larger than the Periphery in 2006 in 2006.

The Portland core depends increasingly on the periphery as a source of labor for its workforce. It depends less than in previous decades on the periphery as a market for its goods and services.

The periphery, in turn, increasingly depends on the Portland core as a source of personal income for its residents, and has continued to purchase needed inputs from the core while increasing its local production. The periphery depends less than previously on Portland as a market for its output.

Yet the fortune of each region is affected by growth or decline in the other region. Growth in exports from the Periphery have a significant cross-regional impact on the Portland

core: about one-sixth of the total economic impact of the periphery exports accrues to the Portland core. The Portland core benefits more from a growth in periphery exports than vice versa. Nonetheless, growth in Portland Core exports does affect the Periphery: less than one-eighth of the total economic impact of Core exports spills over to the Periphery. Each region benefits from growth in the other region's economy and is harmed by declines in the other region. The future of Core and Periphery in the Portland trade area is inextricably intertwined.

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Appendix 1: Labor and Earning Flows Estimations

Labor Flows Estimation

We calculated labor flows using the information published by the US Census Bureau in the "United Stated Census 2000, County-To-County Worker Flow Files"[5]. Specifically, we used the tables "Residence County to Workplace County Flows Sorted by Residence State and County" and "Residence County to Workplace County Flows Sorted by Workplace State and County" for Oregon and Washington.

Using data from the table "Residence County to Workplace County Flows Sorted by Residence State and County", we added the number of commuters from each place of residence by place of work to obtain the labor flows inside the core and the periphery; between the core and the periphery; between the core and elsewhere; and between the periphery and elsewhere. For example, to estimate the number of workers that live and work in the core, we added for each county in the core the number of people living there that commute to any county in the core including itself. In the same way, to estimate the number of workers that live in the core and work in the periphery, we added for each county in the core the number of people living there that commute to work in any county in the periphery. Correspondingly, the flow of labor from the core to elsewhere was calculated adding the number of workers that live in each county in the core and commute to anywhere out side the core and the periphery. To estimate the number of workers that live in the periphery and commute to the core, the periphery and elsewhere we used the same procedure as that used to estimate the flows from the core.

In order to estimate the number of workers that live elsewhere and commute to the core or the periphery, we used data from the table "Residence County to Workplace County Flows

[5] http://www.census.gov/population/www/cen2000/commuting/index.html#OR

Sorted by Workplace State and County". We added the number of commuters from outside the study area to each workplace county in the core or the periphery. For example, to estimate the number of workers that live elsewhere and work in the core, we sum up for each workplace county in the core the number of workers that reside outside the core and the periphery. In the same way, to calculate the labor flow from elsewhere to the periphery, we add for each workplace county in the periphery the number of workers that live outside the periphery and the core.

The results of these calculations are shown in Table 1.

Table 1: Labor Flows between the Urban Core and its Trade Region

Place of Residence	Place of Work			
	Core	Periphery	Elsewhere	Total Labor by POR
Core	866,761	18,575	7,839	893,175
Periphery	44,932	793,472	9,166	847,570
Elsewhere	6,151	5,949		
Total Labor by POW	917,844	817,996		

Source: US Census Bureau, Journey To Work and Place of Work (2000)

Earnings Flows Estimation

We constructed earnings flows using data from the Bureau of Economic Analysis, Regional Economics Accounts, in "CA04 — Personal income and employment summary"[6] for the year 2006, and information from Table 1.

From the table "CA04 —Personal income and employment summary" we obtained the earnings by place of work, the contributions for government social insurance, the adjustment for residence, and the net earnings by place of residence. Then, for each county in the study area, we calculated the net earnings by place of work subtracting the contributions for government social insurance to the earnings by place of work. Next, we found the total net earnings by place of work and the total net earnings by place of residence for the core and the periphery adding the values obtained for each county in each region. Thus, the total net

earnings by place of work are $52,937,512 in the core and $35,575,563 in the periphery, and the total net earnings by place of residence are $51,750,992 in the core and $37,295,827 in the periphery.

We constructed earnings flows distributing proportionally the total earnings by place of work to the labor flows by place of work estimated in Table 1. For example, the total net earnings by place of work in the core is $52,937,512 and there are 866,761 workers that live and work in the core which correspond to 94% i.e. 866,761 / 917,844. Thus, the earnings for workers that live and work in the core is $49,991,252, i.e. $52,937,512 x 94%. Following the same procedure, we estimated the earnings of workers that work in the core and live in the periphery ($52,937,512 x 5%), work in the core and live elsewhere ($52,937,512 x 1%), work in the periphery and live in the core ($35,575,563 x 2%), work and live in the periphery ($35,575,563 x 97%), work in the periphery and work elsewhere ($35,575,563 x 1%).

In order to estimate the earnings flows of workers that work elsewhere and live in the core and the periphery we used the total earnings and total labor by place of residence. There are 7,839 and 9,166 workers from the core and the periphery that work elsewhere, respectively. Thus, the earnings for workers that work elsewhere and live in the core is $454,195 i.e. $51,750,992 x 0.88%; and that work elsewhere and in live in the periphery is $403,334 i.e. $37,295,827 x 1.08%

However, if we sum by place of residence and by place of work the flows obtained using this procedure, the result does not match the total net earnings by place of residence and by place of work that we originally obtained summing up the information of each county. Therefore, we used the RAS technique approach[7] to modify slightly each estimated flow to

[6] http://www.bea.gov/regional/reis/default.cfm?catable=CA04
[7] This technique is well described on Miller, R. and Blair, P. 1985. *Input-Output Analysis, Foundations and Extensions*. Prentice-Hall, Inc. New Jersey, USA (page 276).

ensure that the sum of earnings flows by place of work and by place of residence match their respective totals obtained from the data set. Table 2 presents our results.

Table 2: Earnings Flows between the Urban Core and its Trade Region

Place of Residence	Place of Work			
	Core	Periphery	Elsewhere	Total Earnings by POR
Core	50,287,477	888,001	575,514	51,750,992
Periphery	2,368,396	34,463,113	464,318	37,295,827
Elsewhere	281,640	224,448		
Total Earnings by POW	52,937,512	35,575,563		

Source: Bureau of Economic Analysis, Regional Economic Accounts (2006)

Combining both Table 1 and Table 2, we obtained Table 2 presented in the main part of this paper.

Appendix 2: Procedure for Estimating Goods and Service Trade between Regions[8]

Estimating Interregional Commodity Trade Flows

To obtain empirical estimates of excess commodity supply and demand for core and periphery regions, estimates of regional supply and demand as measured by IMPLAN are constructed. Gross regional commodity demand is defined in the IMPLAN system as the sum of intermediate demand, household demand, federal government demand, state and local government demand, and gross private investment and inventory changes. Household demand, federal government demand, state and local government demand and investment are all treated as part of final demand.

Net regional commodity supply is defined as gross regional commodity supply less foreign exports for the region. Gross regional commodity supply is determined as the sum of commodity supply from industrial sources (from the regional make matrix) and commodity supply from inventory sales, federal government sales and state and local government sales. Excess supply for a given region for a given commodity is simply defined as the difference between net commodity supply and gross regional commodity demand as defined above. Positive numbers indicate excess supply and negative numbers indicate excess demand. According to central place theory we would expect to find excess supply in the core region and excess demand in the periphery for central place goods and services.

Estimation of Interregional Trade: 1982 Model

For the 1982 model, Holland used software that he developed that took information from the IMPLAN regional trade report summarizing regional supply, demand, regional purchase coefficient (RPC) and regional imports and exports, and calculated several alternative estimates of possible core-periphery trade. Each interregional trade estimate is

[8] Appendix 2 contains excerpts from two unpublished papers: Holland et al., 1993, Appendix A and Holland and

consistent with underlying estimate of core and periphery single region imports and exports. A different interregional trade determination method was used depending on whether the commodity was judged to be a central place commodity or a "specialized" (Parr) commodity.

Specialized goods are commodities that are able to take advantage of very low production costs at a given location and as a result their location is not determined by central place considerations. Examples are low energy cost for aluminum plants in Oregon and Washington or an especially favorable climate for agriculture as in the case of wheat in the Palouse in Washington. Trade in specialized goods may occur across the central place hierarchy or even up the hierarchy as in the case of agricultural commodities shipped from the periphery to the core or exported out of the region entirely. There is no reason to expect central place dominance in the case of specialized commodities.

The method used to estimate interregional trade for "specialized" commodities in core-periphery central place models can be described as a two-stage approach. In the first stage, three different models are estimated as follows:

(a) a core model;

(b) a periphery model; and

(c) an aggregate model of core and periphery regions.

The objective of the first stage analysis is to determine the existence of interregional (core-periphery) trade. For a given commodity, if the sum of core exports and periphery exports is equal to the independently estimated exports from the aggregate model it must mean that core-periphery trade for that commodity must be zero. However, if the sum of core and periphery exports exceeds aggregate model exports this can only be consistent with trade between the two regions.

Pirnique, 2000.

If there is interregional trade as determined by stage one, the second stage determines the direction of the trade flows of commodity i between core and periphery regions. Is the trade from the periphery to the core, from the core to the periphery or in both directions simultaneously? In general, in such cases, there is excess supply of the commodity in one region and excess demand in the other, and the model assigns the commodity as flowing from the excess supply region to the region of excess demand.

In the case of central place commodities, several alternative core-periphery trade estimating procedures may be chosen. One method estimates an upper bound on possible core-periphery trade flows consistent with each region's imports and exports. A second method gives increased weight to supply-demand pool methodology. Excess supply of a given commodity is exported to excess demand in the opposite region to the maximum extent consistent with supply, demand and RPC conditions for the given commodity in each region.

For this study all services (SIC codes 40 and above) were grouped into the central place category. For this group, core-periphery trade was determined with the modified supply-demand pool method. All goods (SIC codes less than 40) were placed into the specialized category. Interregional trade for this group was determined with the two-stage method as described above.

Estimation of Interregional Trade: 2006 Model

For the 2006 model, goods and services trade between regions was estimated following Holland and Pirnique (2000) and using the information produced in the IMPLAN Commodity Trade Report and the Commodity Summary Report. As described in Holland and Pirinque, there are three approaches to estimating interregional trade: Maximum Possible Trade Approach, the Supply-Demand Pool Approach, and the Three Region Approach.

Maximum Possible Trade Approach This approach identifies the maximum possible trade between the core and periphery. The core exports and imports are the Domestic Commodity Exports and Total Commodity Imports, respectively, of the model defined by user to be the core region. The periphery exports and imports are the Domestic Commodity Exports and Total Commodity Imports, respectively, of the model defined by user to be the periphery region. The maximum exports from the core to the periphery are defined as the minimum of core exports and periphery imports of a particular commodity. The maximum periphery exports to the core are defined as the minimum of periphery exports of the commodity and core imports.

The Supply-Demand Pool Approach The approach assumes trade will only take place between two regions when one of the regions is in excess supply and the other region is in excess demand of a particular commodity. Excess supply is defined as net commodity supply being larger than gross regional commodity demand. Excess demand is defined as gross regional commodity demand exceeding net commodity supply.

The Supply-Demand Pool Approach determines only the levels of exports and assumes that trade will flow from the region of excess supply to the region of excess demand. The Supply-Demand Pool Approach does not allow for transhipments between the core and periphery for a given commodity. If the core region has an excess demand for natural resource commodities and the periphery and excess supply of those commodities, then the expected trade would be from the periphery to the core. Likewise, if the periphery has an excess demand for higher ordered commodities and the core has excess supply, then the expected trade flow would be from the core to the periphery.

The Supply-Demand Pool Approach calculates the exports using three steps. The first step calculates the excess demand and supply of commodities from both the core and the periphery. The

core's Net Commodity Supply and Gross Regional Commodity Demand are taken from the Commodity Trade and Commodity Summary reports for the core region. The periphery's Net Commodity Supply and Gross Regional Commodity Demand are likewise taken from the Commodity Trade and Commodity Summary reports for the periphery region.

The second step identifies the imports and exports of the core and the periphery (Domestic Commodity Exports and Total Commodity Imports, respectively). The final step calculates the exports between the core and periphery. If the core is in excess supply and the periphery is in excess demand, the core will export to the periphery **but** the periphery will not export to the core. If the periphery is in excess supply and the core is in excess demand, the periphery will export to the core **but** the core will not export to the periphery.

The Supply-Demand Pool Approach uses two different methods for determining these exports. The Strong approach uses the minimum of excess demand and excess supply to determine the export levels. The Weak approach first identifies whether the core exports to the periphery or the periphery exports to the core. If the core exports to the periphery, the exports are defined as the minimum of core exports and periphery imports. If the periphery exports to the core, the exports are defined as the minimum of the periphery exports and the core imports." We followed the Strong Supply-Demand Pool Approach.

The Three Region Approach This approach uses the trade information from the core, periphery, and the functional economic area to estimate trade between the core and periphery. The functional region is simply the sum of core and periphery regions. A separate model is estimated in IMPLAN for the functional region.

The approach is based on the idea that if the exports from each of the three regions are known, the exports between the core and periphery can be estimated as a residual after exports out of the combined region have been estimated.

This approach is similar to the Supply-Demand Pool approach in that it assumes that trade will only take place between two regions when one of the regions is in excess supply and the other region is in excess demand of a particular commodity.

The Three Region Approach calculates the exports using three steps. The first step calculates the excess demand and supply of commodities from the core, the periphery and the functional economic area.

The second step identifies the imports and exports of the core and the periphery. The exports and imports are Domestic Commodity Exports and Total Commodity Imports in the IMPLAN reports, respectively.

The final step calculates the exports between the core and periphery. If the exports from the functional economic area are less than the sum of exports from the core and periphery, this implies that the core must have exported to the periphery and the periphery must have exported to the core to account for the additional exports associated with the core and periphery total. These interregional exports must be accounted for by core exports to the periphery plus periphery exports to the core. If the interregional exports equal zero (i.e., the exports from the functional economic area are equal to the sum of the exports from the core plus the periphery), this implies that all the exports from the

core and periphery were shipped outside the functional economic area. In other words there would be no core exports to the periphery and no periphery exports to the core.

Cases could arise where the interregional exports are less than zero (i.e., the exports from the functional economic area are greater than the sum of the exports from the core plus the periphery). Currently, the best explanation of this anomaly is that the underlying data are inconsistent and/or IMPLAN miscalculates the trade flows. IMPLAN calculates the trade flows using Regional Purchase Coefficients (RPC). If exports from the functional economic area are greater that the sum of exports from the core plus the periphery then the three region trade flow procedure described in this paper will not work. The user should then examine the data and calculations used by IMPLAN. External data sources should be used to check and modify the data or the RPCs.

The basic rule in determining the exports is that if one region has an excess supply and the other has an excess demand then the interregional exports flow from the region with excess supply to satisfy the other region's excess demand.

For the 2006 model, we use the three region approach for most goods and services that would be expected to trade nationally and internationally. When the three region approach presented problems (i.e. when exports from the functional economic area were greater that the sum of exports from the core plus the periphery), we used the supply-demand pool approach. Also, we used the supply-demand pool approach for central-place-type goods and services where considerable one way trade is expected; for example: furniture and home furnishings stores, personal care services, etc. Finally, we used the maximum trade approach for central-place-type goods with high weight and low value, for example concrete block and brick manufacturing; and for central place type services like dry-cleaning and laundry services, fitness and recreational sports centers, elementary and secondary schools.