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An Empirical Analysis of Competing Explanations of Urban Primacy

Evidence from Asia and the Americas

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ABSTRACT

An Empirical Analysis of Competing Explanations of Urban Primacy Evidence from Asia and the Americas

This paper tests the relationship between primacy and economic development for countries in Asia and the Americas. It tests explanations for primacy drawn from several social-science disciplines--demography, economics, geography, political science, and sociology. The study is one of the first to use panel-data estimators for the tests. Economic and domestic political variables are found to be important determinants of primacy. In particular, rent-seeking and dictatorial governments are associated with primacy, but the association exists independent of the level of economic development. The implication from dependency and world-system theories that current international economic interactions promote primacy is not supported. It also examines the hypothesis that primacy first increases and then decreases with GDP per capita.

An Empirical Analysis of Competing Explanations of Urban Primacy
Evidence from Asia and the Americas

I. Introduction

Urban primacy refers to a country's largest one or two cities being"abnormally" large (using an adverb from Jefferson's (1939) seminal study) relative to the country's next largest cities. In discussing urbanization and development Bairoch considers both absolute and relative dimensions; he says,"Another direct consequence of the urban explosion is the great size of Third World cities. Today too great a proportion of the urban population lives in cities of excessive size . . ." (Bairoch 1988, 511). He further argues that rapid urbanization and concentration in large cities are largely independent of economic forces and harmful to economic performance. Mills and Hamilton (1994) agree that excessive primacy and excessive urbanization can result if there are negative externalities associated with urban size. They caution, however, that positive externalities also exist, and that there is no presumption that primacy is excessive. Part of this controversy arises from disagreements about the source of urban primacy. If the concentration of population in large cities arises from the economic calculations of individual decision makers responding to economic incentives, this concentration is more likely to benefit the economy than if it arises from noneconomic forces.

Carroll (1982) finds three major classes of explanations of urban primacy in the literature--economic, political, and world systems (including international dependency and ecology approaches). The main purpose of this paper is to develop empirical evidence related to Carroll's three major classes of explanations. We empirically examine these explanations and find support for internal economic and political explanations of primacy, as it has developed in the post-colonial era in countries in Asia and the Americas. We find little support, however, for the world-systems explanations, or more generally, explanations based on external economic or political forces. In sharp contrast to previous studies, such as Mutlu (1989), we find that primacy increases with GDP per capita and two other development indicators--industrialization and education.

This paper extends the existing literature on the empirical determinants of urban primacy in at least four ways. First, it examines three primacy measures that incorporate information about the upper end of

the size distribution of cities--the ratio of the size of the largest city to the size of the second largest city, the ratio of the size of the largest city to the next three largest cities, and the ratio of the size of the two largest cities to the size of the next two largest cities. Importantly, the results are robust with regard to the different primacy measures.

Second, the paper uses time-series, cross-section (panel) data. Its application of fixed- and random-effects estimators to panel data overcomes some statistical problems with cross-section studies. It also permits a cross-country comparison that is not possible with single-country studies, such as Alperovich's (1992) careful time-series study of urban concentration in Israel. Alperovich argues that a bell-shaped relation between concentration and development emerges in his study, and not in others, because the bell shape is a characteristic of individual countries over time, and not of a cross section. Thus, to capture important aspects of the relationship between primacy and development across countries, it is necessary to have time-series data for a cross-section of countries--panel data. The use of panel data and panel data techniques are important features of this study.

Third, we propose a simple economic model of primacy that permits a clear test of the proposition that primacy responds reasonably to economic considerations. The size of the estimated country effects in this model provides a measure of the degree of primacy. With this measure, we can say that adjusted for economic conditions, one country has more primacy than another, if it has a larger country effect. Although this does not provide the norm that Gilbert and Gugler (1992) say is missing from the primacy discussion, it does provide a measure of primacy differentials.

Fourth, an expansion of the basic economic model permits tests of additional economic, demographic, political, and other explanations of primacy. The social science literature on urban primacy and economic development is vast, spanning demography, economics, geography, history, political science, and sociology. We do not attempt to summarize or analyze this literature; instead, we summarize enough to motivate the empirical tests. (See, e.g., Alwosabi (1995), Carroll (1982), Gilbert and Gugler (1992), Mutlu (1989), and Sheppard (1982)) for extensive surveys.) For these additional tests, we take variables used in the literature by proponents of various positions, making our tests pertinent for the conversation.[1]

We continue by discussing the data and developing an empirical model for estimation. Although

we do not derive a formal model, our basic approach borrows from Brueckner (1990) and includes elements from Henderson (1988, 1996), Krugman (1996), and Moomaw and Shatter (1996). The fundamental premise of the model is that urbanization patterns derive from individual decision-making in response to market forces, which vary in systematic ways with economic variables. This model is estimated with country fixed effects, reducing bias problems associated with omitted variables under the assumption that any omitted variables are correlated with the fixed effects. The model is then expanded to test alternative explanations. Finally, a model of the determinants of the country effects is estimated.

II. The Data and the Problem

This paper is concerned with urban primacy in selected countries of Asia and North and South America. Our purpose in studying urban primacy is to isolate factors that, using Jefferson's (1939) adverb, cause a country's largest city to be "abnormally" large relative to other cities. No objective criterion exists, however, to measure what is"abnormally" large. One approach is to develop a measure of the deviation of the size distribution of cities from a norm, such as the rank-size rule or some other distribution derived from a stochastic model. Sheppard (1982), for instance, proposes an index that measures primacy as deviations from a rank-size relationship. Such measures are necessary in dealing with some size-distribution issues. For instance, Sheppard's purposes are to evaluate the use of a predetermined distribution as a norm and to evaluate various theories of urban size distribution. This paper, however, is not concerned with testing stochastic processes that generate particular size distributions or with central place theory.[2]

It, instead, is concerned with the size of the largest city compared with other cities. From an economic perspective, a city is too large if it reduces economic welfare. Although a large literature exists that suggests that large cities in developing countries are too large in this sense, the evidence, except for Ades and Glaeser (1995), who find that large main cities may inhibit growth, is not systematic. Moomaw and Shatter (1993) find urban concentration works both ways: a greater share of a country's population in cities of 250,000 or more population increases growth, but the share in the largest city decreases growth. This result may suggest that it is the size of the largest city compared with other cities--primacy--rather than absolute size that adversely affects economic performance. If the relative size of large cities does *not*

result from economic forces, it is plausible that they are too large from an economic perspective. Consequently, a failure to find economic determinants of urban primacy would place the burden of proof on people who contend that it is *not* excessive. Finding economic determinants, of course, does not demonstrate that primacy is *not* excessive; it may, however, change the presumption.

In this paper, we measure primacy, the dependent variable, using different primacy ratios. Our first measure of primacy, PRIMACY1-2, is the ratio of the population of the largest city to that of the second largest city, where cities are defined as urban agglomerations. In recognition of countries where the two largest cities are of about the same size--biprimate countries--we also construct two other measures. PRIMACY1-4 is the ratio of the population of the largest city to that of the sum of the populations of the second through fourth largest cities. The third measure is PRIMACY2-2, which is the ratio of the sum of the population of the two largest cities to that of the third and fourth largest cities. The latter variable reduces the emphasis on the largest city, which we believe makes PRIMACY1-2 and PRIMACY1-4 preferred measures.

Before discussing the pragmatic reason for using these primacy measures and the choice of countries, a brief discussion of the basic model is appropriate. We hypothesize that an economic model of urban primacy implies that the *economic size* of a country is negatively associated with primacy. This *testable* hypothesis is crucial to our approach. The tradeoff between benefits due to agglomeration (or concentration) and costs due to distance (transportation costs) implies that three components of a country's size--output, population, and land area--are relevant. Therefore, the model including GDP, population (POP) and arable land area (LAND), is

$$\ln\text{PRIMACY} = \ln \alpha + \beta \ln\text{POP} + \chi \ln\text{LAND} + \delta \ln\text{GDP} + (\text{other variables, parameters, and an error term (1).}$$

An increase in *size*, by our definition, is a joint proportional increase in GDP, population, and land area. As the economic size of a nation increases, it enables several production sites, creating new urban centers, and, thus, reducing urban primacy.[3] The failure to find such a relationship would, we believe, discredit an economic approach to explaining urban primacy, suggesting that other explanations would be more powerful.

A problem arises because unmeasurable variables, such as geography, history, institutions, and politics, vary substantially over the cross section, but vary slowly, if at all, over time. The cross-sectional variation in these variables affects both agglomeration benefits and transportation costs, and thus affects the relationship between primacy and economic variables. The a priori importance of these unmeasurable variables implies that if they are omitted, as they must be in pure cross-section analysis, regression coefficients may suffer serious bias. As Carroll (1982) says, if unobserved, confounding variables vary over a cross-section, a time series analysis may be more appropriate. The contradictory findings of various cross section studies, e.g., El-Shaks (1972) and Sheppard (1982), may be due to the failure to control these important variables.

The confounding effects of unmeasurable variables in a cross section can be reduced or eliminated by using panel data and the fixed-effects estimator (Green, 1997). The unmeasured variables are controlled with dummy variables for each country--fixed effects. Within country variation over time then permits the calculation of the effects of various independent variables on the dependent variable, primacy. As Green (1997) discusses, to precisely estimate parameters that are identified by time-series variation, a long time series is important. Consequently, we decided to use data in five-year increments, beginning in 1960 and extending to 1990. This data requirement makes it very costly to use summary measures of the size distribution that require more than just a few of a country's largest cities. Obtaining individual city population data necessary to calculate summary measures of the size distribution for a set of developed and developing countries every five years would be a formidable research task. Thus, the cost of obtaining size-distribution data provides a pragmatic reason for using the primacy ratios rather than summary measures based on a large number of cities.[4]

We limited our sample to countries from Asia (excluding Middle East) and the Americas for several reasons. Most important, competing explanations of the sources of urban primacy have been applied to these countries. The effects of economic, political, and foreign factors on primacy, if they exist anywhere, should exist in the sample because of its large variation. Asia and Latin America include several countries that have had rapid economic growth, and several countries that have not. Moreover, the World Bank (1993) argues that openness to foreign influence is an important reason for Southeast Asian

development. Other Asian countries, such as India, have been more inward looking. Just as with economic variation, political factors vary substantially in the sample. Finally, both dependency theory and world-systems theory have been used to analyze economic development in South America and Asia.

Besides being appropriate parts of the world for examining the competing explanations, these countries comprise many of the countries in which urban concentration is a critical issue. Rapid urbanization and mega-cities exist in the sample. For instance, 13 of the 16 largest agglomerations (population of 10 million or more) in the world in 1995 are in countries in the sample.[5] According to World Bank data, rapid urbanization exists in the sample, particularly in Asia and Latin America. Rapid urbanization is important because the estimates below do not attempt to estimate lags; consequently, they assume that the primacy ratios are equilibrium ratios.[6] Because forces attracting urban residents differentially to the largest or the next-to-largest cities would be more likely to do so quickly in a rapid growth situation, the assumption may be better supported in periods of rapid urban growth.

The countries from Asia and the Americas in the sample were chosen systematically, meeting three conditions; they (1) had a total population of two million or more in 1990, (2) were a nation-state not a city-state, eliminating Hong Kong and Singapore, and (3) were not a socialist or ex-socialist country. These criteria give 33 countries. Because of substantial data unavailability, we drop Haiti, Jamaica, and Nepal, leaving the thirty countries--11 from Asia, 17 from Latin America, and 2 from North America--listed in the Appendix.

Two possible criticisms of limiting the sample are that the sample does not contain enough degrees of freedom or enough variation to estimate the proposed relationships and that the results might not be representative of the entire nonsocialist world. In response, we first note that by combining time-series and cross-section data for 7 years and 30 countries we have 210 observations, which provides adequate degrees of freedom. The fixed effects estimation implies that a parameter is estimated for each country, resulting in some panel estimations having about 165 degrees of freedom. Second, the sample exhibits large variation. (See Table 1 for means, standard deviations, and ranges for the data.) Population in India, for instance, is

INSERT TABLE ONE ABOUT HERE

about 850 million (1990) in contrast to about 2.5 million in Panama. The largest main cities in the sample, such as Tokyo with more than 25 million inhabitants, dwarf the smaller main cities, such as San Jose (capital of Costa Rica) with 297 thousand inhabitants. Development is another variable with wide variation; in 1990, GDP per capita in India, for instance, was $1,264 in (PPP) compared with $18,054 in the United States. Primacy also has a large variation. Some countries have extreme primacy, for instance Thailand (Bangkok is 26 times larger than the second largest city); others have low urban primacy, such as Canada (the largest city is only 20 percent larger than the second city). Consequently, neither degrees of freedom nor sample variation constrains the results for the countries in the sample. Nevertheless, use of the fixed-effects, panel-data estimator makes us reluctant to generalize outside the sample. We believe, however, that results for countries that account for most of the world's largest cities, for many of the countries where primacy is an issue, and for the continents of (noncommunist) Asia, South and North America have intrinsic interest.

III. An Econometric Model of Urban Primacy

Equation 1 provides the essence of the model to be estimated--a negative association between size and primacy. Notice, however, that the definition of a size increase--a proportional increase in GDP, population, and arable land area--implies GDP per capita and population density do not change when size increases. Consequently, the effects of GDP per capita and population density on primacy can be tested holding constant the effects of size. Through algebraic manipulation Equation (1) becomes

$$LnPRIMACY = \ln \alpha + \chi \, ln\,(POP/LAND) + (-\beta-\chi)\, ln\,(GDP/POP) + (\delta + \beta + \chi)\, GDP + (\text{other terms}) \quad (2).$$

In this equation the coefficient of GDP per capita (GDP/POP) gives the effect of development on primacy, and the coefficient of GDP gives the effect of size on primacy. Unlike in most studies, the specification used here permits a straightforward distinction between the effects of *development* and *size*. The hypothesis regarding development and primacy requires a brief repetition. As an economy develops and moves away from agriculture, internal and external economies of scale dictate increases in urbanization and perhaps a geographical concentration of economic activity. As development starts, it may be more efficient to concentrate infrastructure and investment in one place to exploit agglomeration economies, reduce

transportation costs, and have a focal point for manufacturing and commerce. As output per capita increases, the demand for services provided only by the central place may increase--services for which economies of scale are important relative to the demand for them--increasing the importance of the largest city. As development proceeds, urban primacy and development are hypothesized to be positively associated (e.g., Alonso 1980 and El-Shakhs 1972). Their hypothesis further suggests that eventually primacy or other measures of concentration will decrease with development, as economic activity spreads to other cities and rural areas. The evidence for the hypothesized relation between development and primacy, going back to Berry (1961) and as summarized by Carroll (1982), Gilbert and Gugler (1992), and Sheppard (1982), is inconclusive. We provide an additional test of this bell-shaped relationship between primacy and development by including GDP per capita squared in some models.

In addition, we assume that interurban transportation cost and population density are negatively related. When population density decreases, transportation cost increases, putting a premium on large concentrations of economic activity. Consequently, population density is a proxy for transportation cost and is expected to have a negative coefficient. The hypothesis is that higher population density--lower interurban transportation cost--has a negative effect on primacy.

Another aspect of development that may affect primacy is industrialization. Ades and Glaeser (1995) suggest that an agricultural economy with its ties to geographical resources is apt to be more dispersed and that the shared use of infrastructure by industry is apt to lead to greater urban concentration in an industrialized economy. In their view, industrialization increases primacy. In contrast, Carroll (1982) reports that others have suggested that an agricultural economy is apt to have more urban primacy and an industrialized economy less primacy because the industrialized economy will have more urban interconnections and networks. We test these hypotheses using the percentage of employment outside agriculture to measure industrialization.

Finally, in many countries, the largest city is the capital city. Public administration and government offices increase the employment in the largest city, and thus may increase the total population of the largest city. In addition, rent-seeking activities may make the capital city larger than it would otherwise be (Benson and Faminow 1988). In Southeast Asia, the capital and primate city emerged in the

19th century both as the city through which resources were shipped from the interior to Europe and as the colonial administrative city. With independence these cities became the countries' capitals. The inclusion of a capital city indicator captures the effect of changing to a new capital in the study period. The country fixed effects captures the effect of past colonial status. Although we do not measure it directly we do control these important historical forces. They are, however, captured by the country fixed effects. Thus, if significant, a positive coefficient would suggest that countries such as Brazil (in the sample period) and the United States (much earlier) that have created new capitals have probably decreased primacy.

In short, in our simplest model, urban primacy depends upon *size* (gross domestic product, population, and land area), economic *development* (GDP per capita), population density, industrialization, and whether the largest city is the capital city.

Basic equation:

We specify two equivalent equations for urban primacy,

$$LPRIMACY = a + b\,LPOP + c\,LGDP + d\,LLAND + e\,LINDUST + f\,DCAP + v \quad (3)$$

$$LPRIMACY = a + g\,LPOPLAND + h\,LGDP + i\,LGDPC + e\,LINDUST + f\,DCAP + v \quad (4)$$

where,

LPRIMACY = the natural logarithm of one of three primacy indices: PRIMACY1-2, the ratio of the largest city's population to that of the next largest city, or PRIMACY1-4, the ratio of the largest city's population to that of the sum of the next three cities' populations, or PRIMACY2-2, the ratio of the sum of the two largest cities' populations to that of the next two largest cities.

LPOP = the natural logarithm of a country's population.

LGDP = the natural logarithm of gross domestic product.

LLAND = the natural logarithm of a country's arable land area.

LINDUST = the natural logarithm of a country's nonagricultural employment as a proportion of total employment.

DCAP = a dummy variable equals one if the capital city is the largest city in a country, and equals

zero otherwise.

LPOPLAND = the natural logarithm of population density which is a country's population divided by arable land area.

LGDPC = the natural logarithm of gross domestic product divided by population

LGDPCSQ = $(LGDPC)^2$, which is added to equation (4) to test the bell-shaped hypothesis.

a - i are coefficients, and **v** is an error term assumed to have classical properties.

All variables are for country i at time t.

The equation is estimated with dummy variables for each country, because a country's urbanization pattern may be situation specific. As Henderson puts it,"the impact of trade on national space is situation specific, depending upon the precise geography of the country" (Henderson 1996, p. 33). Just as with trade, we believe that the urbanization response of a country to GDP per capita, population density, and GDP may be idiosyncratic, depending upon history, including colonial history, geography, and other aspects of a country that do not change over time. Rather than saying that these influences are unimportant as might be inferred from their omission in a pure time-series study or as is implied in cross-section studies that do not include such variables, the panel approach takes them very seriously and controls them with country fixed effects.[7] Although the idiosyncrasies may be difficult or impossible to measure, to ignore them in a cross-section regression is to risk omitted-variable bias. We therefore use country effects to control variables that are situation specific.

Spatial correlation is an econometric problem that arises with cross-sectional spatial data. Following Kelejian and Robinson (1997) and Rickman and Partridge (1997), we test for spatial correlation of the error term v_{it} by assuming that the error term has two components: one that spills over to other countries and one that is contained within the country. The Kelejian-Robinson test is a test of the null hypothesis of no spatial correlation. The null is not rejected if the t-statistic in the appropriate test is less than 1.65. In model 1 in both Tables 2 and 3 below, the t-statistic is 1.09 and 0.98. (Results were similar for other models). Thus, this test reveals no problem with spatial correlation.

Estimates

The least squares estimates (with country dummy variables) of equation (3) for each primacy

measure, PRIMACY1-2, PRIMACY1-4, and PRIMACY2-2, are shown in the first 3 columns of Table 2. The elasticity of primacy with respect to population is negative and significant in all equations. For the

PLACE TABLE 2 ABOUT HERE

ratio of the populations of the first and second largest cities, PRIMACY1-2, it is -0.63; for comparison, it is -0.74 for PRIMACY1-4 and -0.56 for PRIMACY2-2. The point estimates for the elasticity with respect to GDP are 0.11, 0.14. and 0.11, but significant with a two-tailed test only for the PRIMACY1-4 equation. Furthermore, the estimates of the elasticity with respect to land are 0.07, 0.17, and 0.19, but significant (at 0.10) only for the PRIMACY1-4 equation.[8] For this sample of countries, an increase in population reduces urban primacy, and, although not generally significant at conventional levels, increases in GDP and land area increase it. Furthermore, a one percent increase in both population and GDP, which increases both densities because land area is held constant, reduces primacy by from 0.5 to 0.6 percent (the sum of the population and GDP coefficients). This is a result consistent with the underlying economic approach because it states that a joint increase in population density and GDP density reduces primacy. The greater population density lets firms locate closer to their markets, while the greater GDP density allows firms to realize economies of scale at more locations because of the greater demand density.

The equivalent estimates of equation (4)—the equivalence is demonstrated in our previous discussion of equations (3) and (4)—in columns 4-6 help in interpretation by providing an estimate of the effect of an increase in development—GDP per capita— holding GDP and population density constant. This thought experiment is conducted by reducing population and land area by the same proportion, which implies an increase in GDP per capita. As the coefficients of GDP per capita (0.56, 0.57, and 0.37) show, increased development leads to an increase in primacy in the three estimates. This positive association between primacy and development is consistent with the hypothesis in the literature, regarding the initial effect of development on primacy. (We examine the bell shape later.)

The pure *size* hypothesis implies that same proportional increase in GDP, population, and land area reduces primacy. With this thought experiment, GDP increases, but GDP per capita, population density, and other variables in the model are unchanged. The coefficients of GDP in columns 4-6 test the *size* hypothesis. They are negative and significant, further supporting the economic approach.

The two remaining sets of coefficients in columns 1-6 are those of the capital city indicator and the industrialization measure (the share of nonagricultural employment); these are identical in the two sets of equations, as shown algebraically in equations 3 and 4. The coefficients indicate that primacy increases as the nonagricultural (industrial) share of the economy increases, and is greater if the largest city is also the capital city. Note, however, that industrialization is significant only for PRIMACY1-2 and PRIMACY1-4, showing that the effect exists for the largest city relative to the next largest cities, but not for the largest two cities relative to the next largest cities.

In columns 7-9 we test for the bell-shaped relationship between primacy and development by including the square of the logarithm of GDP per capita. As Table 2 shows, the coefficient of the squared variable is small and insignificant. The correlations between and among it, GDP per capita, and industrialization probably explain why the coefficient of GDP per capita becomes insignificant. Other coefficients are essentially unaffected. This set of regressions provides no support for the bell-shaped relationship between primacy and development.

The results in this section support the proposed simple economic model of primacy. Primacy responds to economic forces in a systematic and reasonable way. Furthermore, the results for industrialization are consistent with the hypotheses suggested by Ades and Glaeser (1995). Finally, the capital-city result is consistent with the idea that political forces affect urbanization patterns. In the next section, we briefly present and test several additional hypotheses, including political ones, regarding urban primacy. We take the economic model as the base and expand it.

IV. Alternative Explanations of Urban Primacy

Social scientists--economists, geographers, political scientists, and sociologists--have offered additional explanations of urban primacy, which focus on international economic relations, internal political factors, and demographic factors. Krugman (1996) has developed models that imply that primacy decreases with the openness of a national economy. In contrast, dependency theory implies that economies, particularly developing economies, that are more open to foreign trade, will experience increased primacy because (dependent) trade concentrates production in the larger cities. According to Castells, dependent urbanization, which implies that developing countries rely on industrialized countries for trade, investment,

aid, and technology transfer, ”causes a superconcentration in the urban areas” (primate cities) (Castells 1977, 47-48). In the extended model, openness (dependency) is measured by the logarithm of the export/GDP ratio. Krugman’s model predicts a negative sign, but dependency theory predicts a positive sign. World-systems theory has similar implications. It divides nations into core, semiperiphery, and periphery, with the core countries exploiting the periphery and to a lesser extent the semiperiphery, resulting in uneven development and uneven urbanization. It asserts that peripheral and semiperipheral nations have higher levels of urban primacy than core nations. London (1987), London and Smith (1990), and Lyman (1992) present empirical evidence in support of the theory.

Internal political forces are expected to result in urban primacy in developing countries, according to the theory of urban bias, as developed by Lipton (1977). A variable used by London and Bradshaw (and others) to proxy for urban bias is itself a proxy for the ratio of nonagricultural to agricultural productivity. The proxy for nonagricultural productivity is the nonagricultural output as a percent of GDP divided by nonagricultural employment as a percent of total employment. Agricultural productivity is proxied in a corresponding way. Urban disparity, the logarithm of nonagricultural to agricultural productivity, is assumed to increase with urban bias. The assumption is that large investments (public and private) in large urban areas and neglected investment opportunities in rural areas cause increases in nonagricultural productivity relative to agricultural productivity and promote urban primacy.

Others, however, have implied that an urban political bias may increase primacy in some developing countries and not others, depending upon internal political forces. Benson and Faminow (1988) have suggested that rent seeking is more effective in the capital, which is often the largest city. Although Gilbert and Gugler do not use rent-seeking terminology, they argue ”In many countries . . . it is the location of government and the paraphernalia of modernization rather than industrial growth per se that is the principal source of urban and regional concentration” (Gilbert and Gugler 1992, 56).

As mentioned earlier, Bairoch states that excessive urbanization has resulted in an excessively large proportion of the urban population living in very large cities. Although this might suggest that the greater the percent urban the greater the primacy, Richardson and Schwartz (1988) argue the opposite. They suggest that a higher urban percentage implies that cities other than the primate city can develop and

attract population from it. They imply that primacy is largely a demographic phenomenon, resulting from small national populations and low degrees of urbanization. Because population is in the basic model, the only new variable needed to test this is the logarithm of urbanized population.

Furthermore, a more educated population and large cities interact positively (Henderson 1988; Rauch 1993). More educated and skilled people may opt for jobs and services that are not available in smaller cities and towns. With a higher proportion of such people in the economy, the preference for living in large cities may be greater. As a result, any premium necessary to attract people to large cities will be less and large cities will be more profitable locations. Moreover, this concentration of human capital in large cities may have external effects (Rauch 1993) that increase the productivity and thus size of the largest cities. Our variable is the logarithm of the country's average years of education of people more than 25 years of age.

Another factor that may be related to primacy is the degree of political freedom. Strong, undemocratic political leaders may concentrate power in administrative centers, particularly the largest city, to serve the interests of the military, political, and economic elite, much as the colonial powers concentrated resources in the primate city. These undemocratic leaders have greater ability to ignore the wishes of the politically weak hinterland--smaller cities and rural areas (Ades and Glaeser 1995). We use the Gastil classification of countries as free, partially free, and not free as a political freedom indicator: depending upon the category, countries are assigned the number 1, 2, or 3 (3 is not free).

It is not our purpose to discuss these theories and empirical studies in depth. Instead we take the variables suggested by the proponents of the various theories and add them to equations (3) and (4). The intent is to see if these variables are significant, which would provide support for the underlying theories, and to decide if their addition affects or eliminates the relationship between primacy and economic factors reported in the previous section. (We use the ratio of foreign direct investment to GDP and dummy variables to directly test dependency and world-system theories in the next section)

The relationships between primacy and *development* and primacy and *size* in the estimates in Table 3 are stronger than in Table 2. The coefficients of GDP and GDP per capita in columns 4-6 are larger

PLACE TABLE 3 ABOUT HERE

(in absolute value) and have larger t-statistics than the corresponding coefficients in Table 2. The coefficient of population density is also larger and more precisely measured; in two of the estimates, however, it is significant only at 0.10. In short, the expanded model provides greater support for the basic economic approach to primacy.

Compared to Table 2, the coefficient of the capital city indicator falls in absolute value in all equations in Table 3; it retains significance, however, as long as the largest city is the only city used for the dependent variables (PRIMACY1-2 and PRIMACY1-4). This reduction in size suggests that some of the capital-city effect in Table 2 is captured by the variables added in Table 3. As might be expected, the addition of variables associated with development, e.g., education and urbanized population, apparently reduce the size and significance of the coefficients of industrialization. Its coefficient retains significance for the two-city primacy ratio (0.10), but not for the four-city ratio.

As in Table 2, the coefficient of GDP per capita squared is not significant in this set of equations. (The results are not tabulated here, but are available upon request). Its addition affects the coefficients of population density and, naturally, of GDP per capita. Nevertheless, it has almost no impact on the coefficients of GDP or the capital city indicator. Similarly, the results for the additional variables in this model (discussed below) are not sensitive to the addition of LGDPCSQ. Thus, neither Table 2 nor Table 3's results support the bell-shaped relationship between primacy and development.

The variables added in Table 3 are the logarithm of exports as a share of GDP as a measure of the openness of the national economy, the logarithm of nonagricultural relative to agricultural productivity as a measure of urban bias, the logarithm of the total urbanized population as a demographic control, the logarithm of the average years of education, and the indicator variable for political freedom. (Recall that the coefficients of these variables are identical for the two sets of equations (Columns 1-3 and 4-6).)

The competing hypotheses about the effects of openness do not fare well in Table 3. Although the coefficients of export's share are negative, they are not precisely estimated. The strongest result is for the two-city primacy ratio, but even there the coefficient is only slightly larger than its standard error. Thus, these results do not support Krugman's openness hypothesis nor do they support dependency theory.

In contrast, the urban bias variable has a significant coefficient, but its sign suggests that the

proposed measure of bias is associated with less rather than more primacy. This result is consistent for all the estimates. If internal policies enhance nonagricultural productivity and increase urbanization, their effect is not to increase primacy. Instead, if these policies exist, they favor smaller cities relative to the primate and second city. Consequently, using its proponents' measure of bias, there is no support for the hypothesis that "urban bias" is source of primacy.

An increase in the urbanized population, however, has a positive effect on primacy, in contrast to Richardson and Schwartz's hypothesis. This finding provides mixed support for Ingram's (1998) position that large cities in large developing countries grow at the same or slower rate than the urban population. Our result says that an increase in the urbanized population, holding total population constant, increases the size of the largest city relative to the next largest cities and the size of the two largest cities relative to the next two largest cities. The absolute value of the negative coefficient of population for the two-city ratio (-1.33) is more than four times as large as the coefficient of urbanized population (0.30). This implies that so long as the urbanized population grows no faster than about four times faster than the total population, primacy will not increase. Thus, Ingram's position is consistent with our results because we expect the effect of total population on primacy to more than offset the effect of urbanized population.

The education coefficients suggest that higher levels of education are associated with greater primacy using the two- and four-city primacy ratios but not with the biprimacy ratio. The pattern of the coefficients and their significance suggests that education increases the size of the largest city relative to the second and the second through fourth cities.

Finally, the results are consistent with the idea that political freedom is associated with a decrease in the two-city primacy ratio, but not in the other ratios. The coefficient of the measure of political freedom for PRIMACY1-2 in Table 3 is significant and positive. The combined results suggest that more dictatorial regimes suppress the second largest city, but do little to affect the other primacy ratios.

At this point, the paper provides little support for the theories that urban primacy varies systematically with international economic relations or that urban bias causes primacy in developing countries. Indeed, the evidence regarding development suggests that primacy increases with economic development, in contrast to the conventional wisdom that it is characteristic of the least developed

countries. Evidence is presented, however, that more dictatorial regimes are associated with greater primacy and that increases in urbanization can lead to greater primacy.

Nevertheless, international relations as they affect primacy may change slowly. Consequently, they may be measured better as an average over the period rather than as changing every five years. The perception of, as well as the actuality of, trade policy, the behavior of foreign investors, rent seeking and so on might affect location decisions, suggesting that a measure of these factors averaged over a longer time period might be more appropriate. In the next section, we associate average measures of these factors with the estimated fixed effects; the purpose is to provide additional tests of the alternative explanations.

V Further Tests of Competing Explanations

In this section we provide further tests of world-systems theory, the effect of international trade and the effects of political factors on primacy. With a country specific effect for each country, we have primacy differentials for a cross section of 30 observations. These differentials, in effect, are holding the variables in Table 3 constant (except for export's share).[9] We test the world-systems hypothesis, the openness vs. dependency hypothesis, and the political hypotheses sequentially.

To test world-systems theory, we rely on Lyman's (1990) study of the relationship between world systems and primacy to allocate countries to the appropriate part of the world system. A country can be in the periphery, the semiperiphery, or the core. (We arbitrarily placed Bangladesh and the Dominican Republic in the periphery and Taiwan in the semiperiphery; Lyman did not include these countries.) As another measure of world systems ideas or of openness versus dependency, we use an average of the ratio of foreign direct investment to GDP from 1960 to 1990. (In this analysis we have foreign direct investment for the 30 countries but not for every year for every country; so for a few countries the average is over a subset of the period.) Finally, to test Krugman's openness hypothesis vs. dependency theory, we use an average of the ratio of exports to GDP from 1960 to 1990.

The existence of a centralized rather than a federated national government has been shown to be associated with increased urban concentration. Presumably, in a federal system the subnational units will use political influence to enhance the size of their capitals (Henderson 1988), decreasing the influence of the national capital. Another political variable that we use is Mauro's (1995) index of bureaucratic

efficiency as a measure of the opportunity for rent seeking. This index is derived from the Business International (BI) part of the Economist Intelligence Unit. It is the average of BI's subjective ranking of the judiciary system, red tape, and corruption indices that Mauro considers (1995, 686)"a more precise measure of corruption than the corruption index on its own." This index is an average over 1980 to 1983, ranges from 1 to 10, and is available for only 24 countries in our sample.

We regress primacy differences on position in the world system, importance of foreign direct investment, importance of exports, the existence of a centralized national government and the degree of bureaucratic efficiency. We believe that world-systems theory requires a positive coefficient on peripheral location that is larger than the expected positive coefficient on semiperipheral location. World-systems theory and dependency theory require a positive coefficient on both the foreign direct investment and export shares, whereas the economic theory regarding openness requires a negative coefficient on the export share. Finally, the political theories call for a positive coefficient for a central national government and a negative coefficient on bureaucratic efficiency.

PLACE TABLE 4 ABOUT HERE

In the first column of Table 4 we show a regression of primacy differentials on location in the world system for the 30 countries. Although both coefficients are positive, the coefficient on the semiperipheral location is larger. Column 4 gives the same estimate for sample of 24 countries for which we have bureaucratic efficiency data. (We include the estimates in columns 4 and 5 so that examine the effects of adding the bureaucratic efficiency without concern for the fact that 6 countries must be dropped to do so) The coefficients and significance levels are similar to those in column 1. In columns 2 and 5 we add the importance of exports and the existence of a centralized government to the model. The coefficients of the export variable are negative and highly significant in both samples, but the coefficients of the centralized government variable are insignificant in these and subsequent estimates. Controlling export share and centralized government, however, increases the size and precision of the coefficients of the world systems variables. The coefficients of the semiperiphery indicator attain significance at 0.10 and remain larger than those of the periphery indicator. The addition of the foreign direct investment share (column 3) to the model in column 2 leaves the estimate essentially unchanged.

Addition of the variable that measures the opportunity for rent seeking, bureaucratic efficiency,

makes an important difference (columns 6 and 7). Greater bureaucratic efficiency is associated with less primacy, and the addition of the variable wipes out the emerging significance of the world system variables. Bureaucratic efficiency and the importance of exports are highly significant in all equations. Results (not reported here, but available upon request) are essentially the same if the primacy differential is measured using the estimates based on the four-city primacy ratio or the biprimate ratio.

The results in Section II support a model of urban primacy that relies on economic factors. In addition, they support a political role in primacy because countries whose largest city is also the capital have greater primacy. In Section III measures of the importance of exports, urban bias, the urbanized population, education, and political freedom are added to the basic model. These estimates are stronger for the basic economic model and show that education, the urbanization of the population, and lack of political freedom are positively associated with primacy, but there is no evidence of urban bias or of an effect of exports on primacy. In this section, we find that openness to exports is associated with less primacy, but that the potential for political corruption (the inverse of bureaucratic efficiency) is associated with enhanced primacy. After accounting for such factors as political freedom, education, possible corruption, and other variables we find no evidence that current external political forces, as summarized in world system and dependency theories, are associated with greater primacy. This finding does not imply that past international relations, particularly colonialism, did and do not affect primacy; such past events are controlled by the fixed effects.

VI. Conclusions

Primacy is an important phenomenon. Although huge cities result from demographic and economic considerations, it is sometimes argued that excessive primacy is inherent in low-income countries because of urban bias, dependent urbanization, and/or world systems considerations. Our results suggest that there can be an urban political bias, but that this bias is not an integral part of underdevelopment. As more data become available, it will be interesting to determine if these results hold for Africa. Because nothing in the analysis is particularly tailored to development status in South America and Asia, it is probable that these results will extend to Africa. Similarly, the basic economic model relying on centralizing and decentralizing forces as they are reflected in size variables— population, land area, and GDP—should play similar roles in other countries. The remaining results, dealing with industrialization, government structure,

and so on may be unique to the sample.

If primacy were not a result of economic and demographic considerations, there would be good reason to believe that it has an adverse effect on development. The costs of large cities, however, must be balanced against the benefits. If, as we find, much primacy can be explained by economic and demographic considerations, there is no longer prima facie evidence that extremely large cities are parasitic. This paper's fundamental conclusion is that straightforward economic considerations related to economies of scale and transportation cost are the major determinants of primacy. World systems theory, dependency theory, and theories of urban bias are not necessary to explain observed primacy.

Because of the increasing vehemence in the popular debate about globalization, the results regarding dependency, world systems, and the degree of openness—globalization's effect on primacy, if you like—are becoming increasingly relevant. Although we find no evidence that globalization increases primacy, our finding that openness reduces primacy only shows up in one approach. We believe that these results are important enough to call for additional research on the interrelationships between primacy and international policies...

Larger countries--GDP, population, and land area--and countries with greater density of GDP and greater density of population per unit of land have less primacy. These results are consistent with expectations from simple economic models of urban structure. Primacy increases with GDP per capita at a decreasing rate. The point estimates suggest that this relationship is positive over observed ranges of GDP per capita. This indication that primacy increases with development may be a reflection of the increasing demand for services with higher income and the provision of these higher-level services by the central place. It may also reflect the interrelationships between education, productivity, and large cities.

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Appendix

Countries:

The 30 countries, in alphabetical order, are: Argentina (SEMI, CEN) Bangladesh (PERI, CEN), Bolivia* (PERI, CEN), Brazil (SEMI, FED), Canada (CORE, FED), Chile (SEMI, CEN), Colombia (SEMI, CEN), Costa Rica* (PERI CEN), Dominican Republic (PERI, CEN), Ecuador (PERI, CEN), El-Salvador* (PERI, CEN), Guatemala* (PERI, CEN), Honduras* (PERI, CEN), India (SEMI, FED), Indonesia (PERI, CEN), Japan(CORE, CEN), Korea (south)(SEMI, CEN), Malaysia (SEMI, FED), Mexico (SEMI, FED), Pakistan (SEMI, CEN), Panama (PERI, CEN), Paraguay* (PERI, CEN), Peru (PERI, CEN), Philippines (SEMI, CEN), Sri Lanka (PERI, CEN), Taiwan (SEMI, CEN), Thailand (SEMI, CEN), United States (CORE, FED), Uruguay (PERI, CEN), and Venezuela (SEMI, FED). Countries with an asterisk are not in the 24-country sample in Section V. Countries labeled CORE, SEMI, or PERI are core, semiperipheral, and peripheral countries in the world-systems allocation. Countries labeled CENT or FED have centralized or federal governments.

Variables and Sources

PRIMACY1-2*: the ratio of the largest city's population to that of the second largest city. Urban population data are from The *UN World Urbanization Prospects: The 1992 Revision, The Europa World Yearbook, The Statesman's Yearbook, and the World Development Report.*

PRIMACY1-4: the ratio of the largest city's population to that of the next three largest cities. See above for source.

PRIMACY2-2: the ratio of the two largest cities' population to that of the next two largest cities. See above for source.

GDP: gross domestic product. GDP is calculated from the *Penn World Tables (Mark 5.6*).

GDPC: gross domestic product per capita. Source: The *Penn World Tables (Mark 5.6).*

POPLAND: population density which is the ratio of the total population to the arable land. Sources: total population data are from *The UN World Urbanization Prospects: The 1992 Revision*; arable land data are from *FAO Production Yearbook* (see www.fao.org.).

DCAP: dummy variable that equals 1 if the capital city is also the largest city and equals 0 otherwise. Sources: *UN Demographic Yearbook, and World Urbanization Prospects: The 1992 Revision.*

EXPORT exports of goods and nonfactor services as a percentage of GDP. Sources: *World Tables, 1994* and different issues of *World Development Report.*

INDUST: share of labor outside agriculture. It is calculated as 1 minus the percentage of economically active population in agriculture. Source: *FAO Production Yearbook.*

FREE: freedom variable (1 = free, 2 = partially free, 3 = not free). Sources: different issues of Gastil's *Freedom in the World*, and Bollen (1990), for cross-sectional data, it is averaged over 1975, 1980, 1985, and 1990.

BE: a measure of bureaucratic efficiency. It is an index of subjective rankings of the efficiency of the judiciary system, red tape, and corruption. Source: Mauro (1995)

EDUC: is average years of schooling of people 25 years and older from Barro and Lee (1993), and from different issues of the *UN Human Development Report*

URBDISP: The urban-rural disparity is the ratio of ratio of output per worker in nonagriculture (i.e., the percentage of nonagriculture GDP divided by percentage of labor force in nonagriculture) to output per worker in agriculture (i.e., the percentage contribution of agriculture to total GDP divided by the percentage of the labor force in agriculture). The data for percentage contribution of agriculture to total GDP are from various issues of *World Tables and World Development Report*, and data for percentage of the labor force in agriculture are from *FAO Production Yearbook*

FDI: Foreign direct investment as a proportion of GDP. FDI data are from various issues of *IMF Balance Of Payments Yearbook and IMF International Financial Statistics.*

* Data for the Republic of China (Taiwan) are from different issues of The Republic of China Statistical Yearbook, The Europa Yearbook, and The Statesman's Yearbook.

TABLE 1
Descriptive Statistics
1990 Values

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
PRIMACY1-2	30	5.1778	5.5609	1.138	25.49
PRIMACY1-4	30	2.1917	1.9998	0.5050	9.399
PRIMACY2-2	30	5.2737	3.2285	1.7056	15.4721
Bureaucratic efficiency	24	4.96	3.00	2.25	9.75
GDP*	30	368570	867790	6983	4520000
GDP per capita	30	4612.0	4426.7	1264	18050
GDP per capita squared*	30	40213	82746	1598	325900
Population*	30	75700	158300	2418	849500
Land area*	30	20127	44544	285.0	187900
Population density	30	8.2797	7.3156	0.5782	29.98
Education	30	6.0290	2.6825	1.900	12.30
Capital city indicator	30	0.80000	0.40684	0.0000	1.000
Export's share of GDP	30	27.600	18.301	7.00	91.00
Share of nonagricultural employment (Industrialization)	30	0.67073	0.19089	0.3150	0.9720
Ratio of nonagricultural to agricultural productivity	30	3.1794	2.2842	0.7768	13.21
Foreign Direct Investment as a share of GDP	28	0.0095	0.0140	-0.0260	0.05884
Political freedom	30	1.5000	0.50855	1.000	2.000

*(000)

TABLE 2
Estimates of the Basic Economic Model

Variables	PRIMACY 1-2 1	PRIMACY 1-4 2	PRIMACY 2-2 3	PRIMACY 1-2 4	PRIMACY 1-4 5	PRIMACY 2-2 6	PRIMACY 1-2 7	PRIMACY 1-4 8	PRIMACY 2-2 9
Capital city	0.60***	0.62***	0.36**	0.60***	0.62***	0.36**	0.64	0.63***	0.38**
indicator	(3.79)	(4.13)	(2.13)	(3.79)	(4.13)	(2.13)	(3.70)	(4.03)	(2.16)
Ln population	-0.63***	-0.74***	-0.56***						
	(4.39)	(5.42)	(3.61)						
Ln GDP	0.11	0.14**	0.11						
	(1.56)	(2.06)	(1.36)						
Ln arable land	0.07	0.17*	0.19						
	(0.66)	(1.67)	(1.66)						
Industrialization	0.54***	0.47**	0.23	0.54***	0.47**	0.23	0.52**	0.46**	1.19
measured as ln of	(2.53)	(2.34)	(1.02)	(2.53)	(2.34)	(1.02)	(2.19)	(2.03)	(0.72)
the share of nonagricultural employment									
Ln population				-0.07	-0.07	-0.19	-0.07	-0.17	-0.18
density				(0.66)	(0.66)	(1.66)	(0.60)	(1.58)	(1.50)
Ln GDP				-0.46***	-0.46***	-0.26*	-0.45***	-0.43***	-0.26*
				(3.39)	(3.39)	(1.84)	(3.38)	(3.40)	(1.83)
Ln GDP per				0.56***	0.57***	0.37**	0.65	0.65	0.66
capita				(3.81)	(4.08)	(2.32)	(0.94)	(0.98)	(0.88)
The square of ln							-0.01	-0.00	-0.02
GDP per capita							(0.14)	(0.12)	(0.40)
R^2	.96	.94	.94	.96	.94	.94	.96	.95	.95

t statistics in parentheses below the coefficient ***, **, * significant for two tailed tests at 0.01, 0.05, and 0.10, respectively.

Variables	PRIMACY1-21	PRIMACY1-42	PRIMACY2-23	PRIMACY1-24	PRIMACY1-45	PRIMACY2-26
Capital city indicator	0.44***	0.46***	0.23	0.44***	0.46***	0.23
	(2.67)	(2.90)	(1.24)	(2.67)	(2.90)	(1.24)
Ln of population	-1.33***	-1.44***	-1.15			
	(5.53)	(6.28)	(4.36)			
Ln GDP	0.16**	0.18**	0.11			
	(2.13)	(2.54)	(1.37)			
Ln arable land	0.19	0.26**	0.22*			
	(1.76)	(2.44)	(1.80)			
Industrialization measured as ln of the share of nonagricultural employment	0.38*	0.25	-0.07	0.38*	0.25	-0.07
	(1.70)	(1.17)	(0.26)	(1.70)	(1.17)	(0.26)
Ln population density				-0.20*	-0.26*	-0.22*
				(1.76)	(2.44)	(1.80)
Ln GDP				-0.97***	-1.00***	-0.82***
				(4.56)	(4.90)	(3.49)
Ln GDP per capita				1.13***	1.18***	0.93***
				(5.05)	(5.51)	(3.78)
Ln of exports share of GDP	-0.05	-0.04	-0.01	-0.05	-0.04	-0.01
	(1.04)	(0.91)	(0.18)	(1.04)	(0.91)	(0.18)
Ln of nonagricultural relative to agricultural productivity	-0.12**	-0.11**	-0.04	-0.12**	-0.11**	-0.04
	(2.13)	(2.08)	(0.69)	(2.13)	(2.08)	(0.69)
Ln urbanized population	0.30**	0.37***	0.43***	0.30**	0.37***	0.43***
	(2.19)	(2.85)	(2.87)	(2.19)	(2.85)	(2.87)
Ln of average years of schooling	0.24**	0.19*	0.11	0.24**	0.19*	0.11
	(2.07)	(1.70)	(0.90)	(2.07)	(1.70)	(0.90)
Political freedom indicator	0.07***	0.04	-0.02	0.07***	0.04	-0.02
	(2.57)	(1.47)	(0.67)	(2.57)	(1.47)	(0.67)
R^2	.97	.96	.97	.97	.96	.96

t statistics in parentheses below the coefficient

***, **, * significant for two tailed tests at 0.01, 0.05, and 0.10, respectively.

TABLE 4
Estimates of the Determinants of Primacy Differentials

Variable	1	2	3	4	5	6	7
Intercept	6.30***	7.05***	6.85***	6.30***	7.04***	10.99**	10.68***
	(8.76)	(10.53)	(7.34)	(8.36)	(10.02)	(7.47)	(6.88)
Centralized government indicator		0.31	0.40		0.28	0.31	0.52
		(0.75)	(0.79)		(0.58)	(0.76)	(1.02)
Average export share		-0.06***	-0.06***		-0.06***	-0.04**	-0.05**
		(3.50)	(3.39)		(3.22)	(2.61)	(2.67)
Average foreign direct investment share			0.00				0.01
			(0.32)				(0.71)
Bureaucratic efficiency						-0.44***	-0.46***
						(2.94)	(2.96)
Peripheral indicator	0.08	0.56	0.70	0.50	0.97	-0.89	-0.64
	(0.10)	(0.78)	(0.82)	(0.56)	(1.22)	(0.97)	(0.64)
Semiperipheral indicator	1.04	1.33*	1.49*	1.04	1.33*	-0.45	-0.18
	(1.31)	(1.95)	(1.76)	(1.30)	(1.86)	(0.53)	(0.20)
OBS	30	30	30	24	24	24	24
R^2 ADJ	0.08	0.34	0.32	-0.00	0.29	0.49	0.48

t statistics in parentheses below the coefficient
***, **, * significant for two tailed tests at 0.01, 0.05, and 0.10, respectively

ENDNOTES

[1]Other recent reviews of the literature are available. Lemelin and Polese (1995) examine the bell-shaped, primacy-development hypothesis and review the economics and geography literature. Smith (1996) emphasizes the sociological literature, and Varshney (1993) overviews the urban bias literature.

[2] Sheppard (1982) reviews theoretical and empirical analyses of size distribution and Mulligan (1984) surveys theoretical contributions to central place theory.

[3]Mutlu (1989) includes size of country as one of the primary determinants of primacy. He defines it, however, as area or population. He also measures economic development as per capita GNP and includes it in his model. Our approach differs because we include three dimensions of size–population, area, and GDP. Our approach therefore is more flexible.

[4]El-Shakhs (1972), Rosen and Resnick (1980), and Wheaton and Shishido (1982) use summary measures of the size distribution to measure urban concentration, but they do not interpret their measure as a deviation from a rank-size relationship. El-Shakhs limits his cities to the five largest, Rosen and Resnick use the 50 largest, and Wheaton and Shishido used enough of the largest cities to account for 70 percent of

the urban population. These data were collected only for one year--a cross section. Constructing a 30 year time-series of urban size distributions for the countries in our sample using as many cities as Rosen and Resnick and Wheaton and Shisshido did, even in five-year increments, was not practical.

[5]Two Chinese cities (Shanghai and Beijing) are excluded because the sample omits socialist or formerly socialist countries. Similarly Lagos is excluded because of the omission of African countries. The included cities are, in order of size, Tokyo, Mexico City, Sao Paulo, New York, Bombay, Los Angeles, Calcutta, Buenos Aires, Seoul, Osaka, Delhi, Rio de Janeiro, and Karachi.

[6] Africa was excluded from the sample for two reasons. First, colonialism, in general, was just ending for the African countries in 1960, whereas it ended somewhat earlier for most of the relevant Asian countries in our sample and much earlier for the American countries. Our purpose is to analyze primacy in countries where market forces have more scope to operate. Although the dead hand of the external political effects of colonialism affects most of the countries, we control that effect with dummy variables. By excluding the African countries, we concentrate more on the post-colonial period. Second, we excluded the African countries because we thought it would be less likely that we could find the necessary data for most of the countries beginning in 1960. In an earlier study using data for 1960, 1970, and 1980, Moomaw and Shatter (1996) concentrated on urbanization and included African countries in the sample. Although the urbanization data were available, when they attempted to get data on metropolitan population about one-half of the African countries had to be dropped (See Shatter, 1992). Because the data for this study requires population data for individual large cities in 5-year increments, as well as other variables that were not collected in the Shatter study, we judged that the availability of data for African countries would preclude us from obtaining a representative sample from Africa. Moreover, the quality of the data is probably lower for these countries. The benefit of including more countries did not, in our opinion, outweigh the cost of collecting the incomplete and lower quality data.

[7] Two of the variables that Mutlu (1989) finds important, income distribution and ethnic homogeneity, are controlled, arguably, by the fixed effects. Both variables would have little variation over three decades.

[8] Land is measured as arable land and it taken from the FAO Production Yearbook. (See www.fao.org.) The variation in arable land over time for countries is limited but great enough to estimate the model. It is remarkable that the coefficient of the land variable is estimated as precisely as it is.

[9]The fixed effects are recovered from an estimate of the equation in column 1, Table 3 except that the export share is excluded.

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