Growth in Australian Cities[*]

by

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This paper is an empirical investigation of the determinants of city growth in Australia from 1981 to 1991. Our basic goal is to explain the population and labour force growth of a cross section of cities in the time period using variables representing the initial characteristics of cities. While we find that city growth is negatively correlated with initial size, government sector employment and a city's level of specialisation, we also find it to be positively correlated with various measures for the degree of human capital investment in the city. Our results, while simple and non-structural, mirror the conclusions of studies in the U.S. indicating the importance of studying city level growth in order to understand economy-wide growth. *Journal of Economic Literature* Classification numbers: O18, O47 & R11.

Keywords. city growth, education, human capital, externalities, specialisation, initial conditions.

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I Introduction

In recent times, there has been renewed interest among economists in the determinants of economic growth. This resurgence has been motivated by theories predicting critical roles for innovation externalities and human capital as engines of growth.[1] With this there have been extensive cross-national studies of how the initial characteristics of national economies may explain differences in the growth of output per capita (Barro, 1991; Mankiw et. al., 1992).

Part of this empirical literature has chosen to focus on explaining differences in growth within countries by looking, in particular, at regional or city growth. Cities are a natural unit of analysis for studying growth in open economies as they have common non-economic characteristics. Almost all of these studies have focused on the United States. Its economic size gives the potential for empirical analyses with both a larger number of observations and wide heterogeneity of experience within a common political system and cultural heritage. Many of these studies have looked at whether growth rates tend to converge across time (Barro and Sala-i-Martin, 1992; Blanchard and Katz, 1992). But there have been a few papers that have explicitly attempted to look at the role of externalities and human capital in generating city growth (Glaeser et. al., 1992; Glaeser et. al., 1995; Henderson et.al., 1995; Bostic et.al., 1996).

In this paper, we combine the empirical frameworks of several of these papers to understand what makes Australian cities grow. Australia is one of the most urbanised countries in the world with over 85% per cent of its population residing in cities. This is despite the heavy emphasis on primary industries in its export mix. This makes it an especially interesting case to consider since externalities appear to be generated more by agglomerative forces than a first nature effect.[2]

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[1] See Lucas (1988) and Romer (1990).

[2] In urban economics, there is a distinction made between first nature (natural) and second nature (human-made) determinants of industrial location (see Krugman, 1993).

The analysis here will be conducted using cross-sectional city level data for the decade between 1981 and 1991. Our dataset comprises a total of 104 Australian cities and towns of minimum population size 10,000 in 1991. We will analyse growth by looking at population and labour force growth rather than output per capita. This is done for several reasons. First and foremost is a lack of output or income data for Australia at a city level.[3] But also, as noted by other researchers (e.g., Glaeser et.al., 1995), labour force growth is a potentially good proxy for urban income growth because of the mobility of labour within a country. This is not the case between countries and hence, population growth is essentially exogenous there. Below it will argued that labour force growth is a good measure of city success precisely because internal migration can reflect the trade-off between the positive externalities of productivity growth and the negative ones of urban congestion.

Our basic goal in this paper is to shed some light on what makes Australian cities grow. That is, when we look at the economic characteristics of a city, in terms of the composition of its labour force, its division among sectors, the city's specialisation and government influence, what can we say about its growth potential? In what follows, we pursue this goal by analysing the structure of correlation between initial characteristics and subsequent population and labour force growth. While our conclusions cannot be causal or structural, they will suggest that initial conditions are important in the Australian urban context.

The next section of the paper looks at the economic characteristics of cities that can theoretically drive labour force growth. We then link each of these to potential observables in our dataset. Section III describes our dataset in more detail, providing some overall facts about Australian urban growth in the 1980s. Section IV then turns to the empirical analysis of the structure of correlation between initial characteristics and city growth. A final section concludes.

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[3] While suburban data on income levels does exist, these do not provide sources of income. Hence, they are unsuitable as measures of the income generated within a locality.

II City Characteristics

Because both capital and labour are mobile within countries, differences in city growth will not arise because of the traditional national reasons of savings rates and labour endowments. Thus, the source of differences among cities comes from factors influencing the marginal product of labour and the marginal disutility of work. Glaeser et.al. (1995) call these factors "productivity" and "quality of life" issues and we will adopt their terminology here.

Suppose city output is generated by the following function:

$$Y_{i,t} = A_{i,t} L_{i,t}^{\alpha} K_{i,t}^{\beta}$$

where $A_{i,t}$ represents average productivity in city *i* at time *t*, $L_{i,t}$ is its population level, $K_{i,t}$ is its capital stock, and $1 > \alpha,\beta > 0$ are common Cobb-Douglas coefficients. *A* is a broad measure of all influences on the marginal productivity of labour including technological and socio-political variables. The demand for labour can be then determined and with it the income level of an average city resident:

$$w_{i,t} = \alpha A_{i,t} L_{i,t}^{\alpha-1} K_{i,t}^{\beta}.$$

The supply of labour to a city is a function of both the wage and the "quality of life." This quality of life is a function of a city-specific variable ($Q_{i,t}$) and the population level of the city. Once again, following Glaeser et.al. (1995):

$$\text{Quality of Life} = Q_{i,t} L_{i,t}^{-\delta}$$

where $\delta > 0$. The city-specific variable captures both variables associated with city congestion (rents, environmental degradation and crime) and those that might enhance city life ("bright lights," variety of services and local public goods).

Since utility ($U_{i,t} = \alpha A_{i,t} Q_{i,t} L_{i,t}^{\alpha-\delta-1} K_{i,t}^{\beta}$) must be constant over space for a given unit of time:

$$\log \frac{U_{t+1}}{U_t} = \log \frac{A_{i,t+1}}{A_{i,t}} + \log \frac{Q_{i,t+1}}{Q_{i,t}} + (\alpha - \delta - 1) \log \frac{L_{i,t+1}}{L_{i,t}} + \beta \log \frac{K_{i,t+1}}{K_{i,t}}.$$

We suppose that productivity and quality of life growth are dependent upon a vector ($X_{i,t}$) of initial city characteristics and a mean zero (independently and identically distributed) error term. That is,

$$\log\frac{A_{i,t+1}}{A_{i,t}} = X'_{i,t}\phi + \varepsilon_{i,t+1}$$

$$\log\frac{Q_{i,t+1}}{Q_{i,t}} = X'_{i,t}\theta + \eta_{i,t+1}$$

Combining this with the utility growth equation:

$$\log\frac{L_{i,t+1}}{L_{i,t}} = \tfrac{1}{1+\delta-\alpha} X'_{i,t}(\phi+\theta) + \tfrac{\beta}{1+\delta-\alpha}\log\frac{K_{i,t+1}}{K_{i,t}} + \chi_{i,t+1}$$

where $\chi_{i,t+1} = \frac{1}{1+\delta-\alpha}(\varepsilon_{i,t+1} + \eta_{i,t+1} - \log(U_{t+1}/U_t)$, which is uncorrelated with city characteristics. Note, however, that without data on capital growth or good instruments for it estimating this equation would give rise to omitted variables bias. This would not pose a problem if the (shadow) price of capital was constant across cities and if its return were fixed by international capital market conditions (see Rauch, 1993; Ciccone and Hall, 1993). In this case, capital growth would be unrelated to city characteristics. Therefore, observing that a city characteristic had a significant correlation with labour force growth could be given either a productivity or quality of life interpretation.

It is possible, however, that the effective price of capital differed between cities -- say, because some locations had a greater variety of specialised intermediate input and services that were not tradable (Fujita, 1989; Ciccone, 1992). Let $r_{i,t}$ be the shadow price of capital. Firms and with them capital choose to locate in the city with the minimum unit costs. Minimum unit costs within a city are:

$$c(w_{i,t}, r_{i,t}) = A_{i,t}^{-\frac{1}{\alpha+\beta}}\left[\left(\frac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} + \left(\frac{\alpha}{\beta}\right)^{-\frac{\alpha}{\alpha+\beta}}\right] w_{i,t}^{\frac{\alpha}{\alpha+\beta}} r_{i,t}^{\frac{\beta}{\alpha+\beta}}$$

Free capital mobility means that costs are constant across space at any point in time to a level, c_t. Therefore,

$$\log\frac{c_{t+1}}{c_t} = -\tfrac{1}{\alpha+\beta}\log\frac{A_{i,t+1}}{A_{i,t}} + \tfrac{\alpha}{\alpha+\beta}\log\frac{w_{i,t+1}}{w_{i,t}} + \tfrac{\beta}{\alpha+\beta}\log\frac{r_{i,t+1}}{r_{i,t}}$$

Using Shepherd's Lemma, the demand for capital within a city is:

$$K_{i,t} = \frac{\partial c(w_{i,t}, r_{i,t})}{\partial r_{i,t}} Y_{i,t}^{\frac{1}{\alpha+\beta}} = \tfrac{\beta}{\alpha+\beta} A_{i,t}^{-\frac{1}{\alpha+\beta}} \left[\left(\tfrac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} + \left(\tfrac{\alpha}{\beta}\right)^{-\frac{\alpha}{\alpha+\beta}} \right] \left(\frac{w_{i,t}}{r_{i,t}} \right)^{\frac{\alpha}{\alpha+\beta}} Y_{i,t}^{\frac{1}{\alpha+\beta}}$$

$$\Rightarrow r_{i,t} = \left(\tfrac{\beta}{\alpha+\beta} \left[\left(\tfrac{\alpha}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} + \left(\tfrac{\alpha}{\beta}\right)^{-\frac{\alpha}{\alpha+\beta}} \right] \right)^{\frac{\alpha+\beta}{\alpha}} w_{i,t} L_{i,t} K_{i,t}^{-1}$$

Substituting this into the cost growth equation gives the growth in capital for a city.

$$\log\frac{c_{t+1}}{c_t} = (\tfrac{\alpha+\beta-1}{\alpha+\beta})\log\frac{A_{i,t+1}}{A_{i,t}} + \tfrac{\alpha(\alpha+\beta-1)}{\alpha+\beta}\log\frac{L_{i,t+1}}{L_{i,t}} + \tfrac{\beta(\alpha+\beta-1)}{\alpha+\beta}\log\frac{K_{i,t+1}}{K_{i,t}}$$

$$\Rightarrow \log\frac{K_{i,t+1}}{K_{i,t}} = -\tfrac{1}{\beta}\log\frac{A_{i,t+1}}{A_{i,t}} - \tfrac{\alpha}{\beta}\log\frac{L_{i,t+1}}{L_{i,t}} - (\tfrac{\alpha+\beta}{(1-\alpha-\beta)\beta})\log\frac{c_{t+1}}{c_t}$$

Inserting this into the labour growth equation we have:

$$\log\frac{L_{i,t+1}}{L_{i,t}} = \tfrac{1}{1+\delta}\log\frac{Q_{i,t+1}}{Q_{i,t}} - \tfrac{1}{1+\delta}(\tfrac{\alpha+\beta}{(1-\alpha-\beta)})\log\frac{c_{t+1}}{c_t} - \tfrac{1}{1+\delta}\log\frac{U_{t+1}}{U_t}$$

Therefore, labour force growth depends *only* on quality of life and not productivity related city characteristics. With free capital mobility and varying shadow capital prices, a positive correlation between city characteristics and labour force growth should be interpreted as an quality of life rather than productivity effect.

Many urban growth researchers faced with a lack of capital data, tend to interpret the influence of city characteristics widely rather than as solely a quality of life effect. This paper presents no evidence on whether the shadow price of capital differs between locations. However, there is some evidence that it does (see Greif and Rodriguez-Clare, 1995 and the references therein). Therefore, in interpreting any positive correlations that follow we caution against any conclusions regarding the superior productivity of high growth cities.

III Productivity and Quality of Life Influences

The theories regarding why both productivity and quality of life growth will be influenced by certain initial city characteristics have been extensively developed and reviewed in recent years (see Krugman, 1991b, 1995 and Bostic et.al., 1996). As such, here we will provide only a brief summary of these influences relating each to potential observables.

(a) Congestion Effects

An increase in economic activity in a city can potentially be associated with productivity and quality of life reductions. Increased city population can cause increase congestion resulting in higher rents and commuting costs for workers (Isard, 1956; Mills, 1967 and Hall, 1991). Moreover, larger cities face more pollution and crime problems (Glaeser and Sacerdote, 1996). In many respects, this suggests that larger cities will be associated with a lower quality of life.

(b) Agglomeration Economies

Recently, there has been a renewed interest in the role of agglomeration economies in cities. Agglomeration economies are geographic proximity externalities to economic activity. This means that greater economic activity in a location can induce firms and workers to move to that location because such activity has a positive influence on productivity and quality of life growth. These stand in contrast to congestion effects.

There are three broad types of agglomeration economies in the literature. First, there are economies of *urbanisation*. The presence of such economies suggest that productivity and quality of life growth will be higher in larger cities. This could be because of labour risk pooling (e.g., Marshall, 1920; Krugman, 1991a), greater product variety and diversity (e.g., Jacobs, 1984; Fujita, 1989; Romer, 1990; Ciccone, 1992), interindustry knowledge spillovers (Rosenberg, 1963; Porter, 1990), or simply the effect of 'bright lights.' (Jacobs, 1961).

Second, there are economies of *localisation*. In contrast to urbanisation economies, these are industry-based effects. Localisation implies that the productivity of specialised inputs and also the quality of life of industry-specific workers will be higher when that industry is more concentrated in space. This could arise because of intra-industry knowledge spillovers (Marshall, 1920; Saxenian, 1994), specialised labour market pooling, and bargaining and transaction cost issues. Such economies can be measured by looking at the concentration of city production and employment in localised or footloose industries or more complex measures.[4]

Finally, there are economies of *specialisation*. Specialisation is a city level concept and differs from localisation in that it deals directly with a city's sectoral composition. It is not the opposite of urbanisation. Newcastle is a large but specialised city. Los Angeles is large, specialised in defense and electronics and localised in movie and television production. Specialisation does have negative risk implications but can also have higher productivity due to an uncongested exploitation of comparative advantages. This is certainly true of tourist cities. Empirical measures for specialisation must capture the degree to which a city is concentrated in a small number of sectors. A slightly modified Herfindahl index, used in industrial organisation as a measure of industry concentration, is well-suited to this task:

$$\text{SPEC}_{i,t} = \sum_{j=1}^{J} (L_{j,t} / L_{i,t})^2$$

where J is the number of industries operating in the city.

(c) Human Capital

The positive role that the level of human capital plays in spurring economic growth has been emphasised recently (Lucas, 1988; Romer, 1990). Human capital investment can be leveraged into knowledge spillovers which lead to higher productivity growth. Moreover, greater levels of human capital have been associated with lower crime levels and

[4] Krugman (1991a) uses a modified Gini coefficient while Bostic et.al. (1996) proposes a city level variable

hence, a higher quality of life (Rotemberg and Saloner, 1990; Rauch, 1993; Glaeser and Mare, 1994).

(d) Government

The role of the government in economic growth has been the subject of great debate (e.g., Barro, 1990). At a local level this role can be both positive and negative (see Glaeser, 1994). What is agreed is that it has a potential influence. Hence, it is an important characteristic determining the level and efficiency of public good provision in a city and thus, an influence on productivity and quality of life growth.

(e) Persistence

Theories of agglomeration lead naturally to theories of path or historical dependence in cities (Arthur, 1988, 1990). Thus, city growth could be influenced heavily by past growth in that city. This is in contrast to neoclassical growth theories that imply a convergence effect as growth tends to its steady state value. Therefore, an initial city characteristic with a potential positive or negative influence is past population growth.

III Data Description

The dataset for this paper was compiled from the Australian Bureau of Statistics 1981 and 1991 Censuses and from a collection by Beer, Bolam and Maude (1994) involving 79 regional cities in Australia for the census years 1976 to 1991. The final sample included 104 Australian Urban Centres. In addition to the 79 regional cities in Beer et.al. (1994), capital cities and larger cities were added. Our focus is explicitly growth in the entire range of Australian cities. The smallest city in our sample was Craigieburn (Victoria) and the largest was Sydney (NSW).

This dataset was based on the Urban Centre definition of a city. The alternative ABS Statistical Local Area (SLA) and Local Government Area (LGA) definitions are

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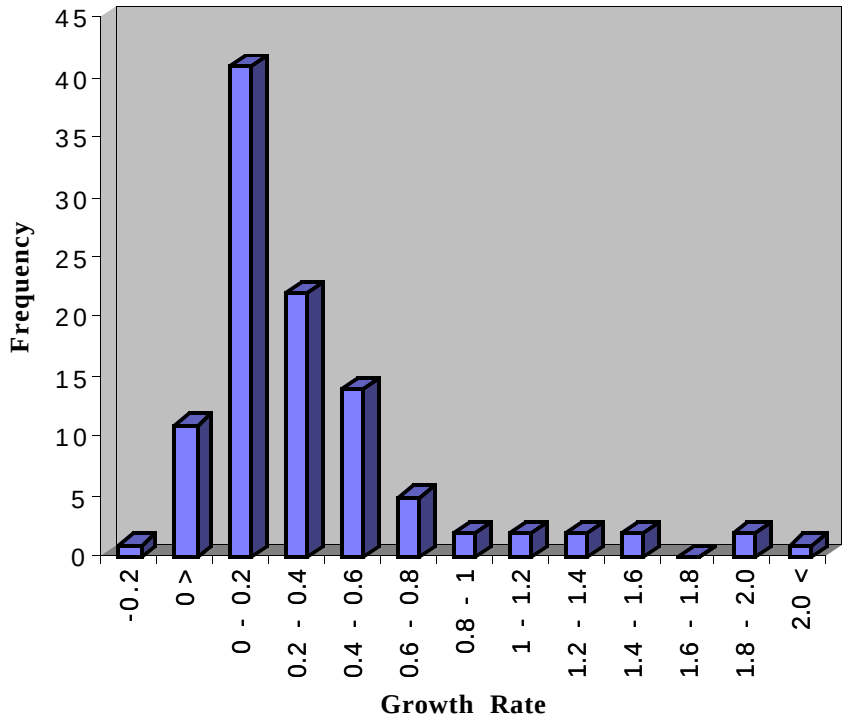
based on the share of production concentrated in localised industries.

generally too small to encompass an entire metropolitan area for which the theories relating initial characteristics to subsequent growth best apply. Moreover, some regional SLAs and LGAs include rural populations within their boundaries. Finally, the boundaries of cities under the Urban Centre definition are adjusted for every Census count. This means that the path of city growth is better represented, capturing increasing suburbanisation.

The dataset is quite extensive, including population and labour force statistics. Employment figures are also partially disaggregated into broad sectors (Agriculture, Fisheries and Forestry; Mining, Manufacturing; Electricity, Gas and Water; Construction; Wholesale and Retail Trade; Transport and Storage; Communication; Finance, Property and Business Services; Public Administration and Defense; Community Services; Recreational, Personal and Other Services) and also in terms of public versus private, and level of qualification attained. However, there was no data regarding capital, wages or output. Thus, as indicated earlier, our focus in this paper is on the growth in city labour force.

Over our period of study (1981 to 1991), there is a wide heterogeneity in the growth experiences of Australian cities. As indicated in Figure 1, labour force growth rates ranged from minus 16 percent (Broken Hill) to 186 percent (Kawana Waters in Queensland). The average growth rate was 30 percent (Table 1). Thus, in contrast to many other empirical studies of city growth (Glaeser et.al., 1992; Glaeser et.al., 1995; but not Bostic et.al., 1996), Australian cities were in an expansionary phase. This allows us to avoid the theoretical complications posed by asymmetries between urban expansion versus stagnation and decline.

Figure 1: Labour Force Growth, 1981-91



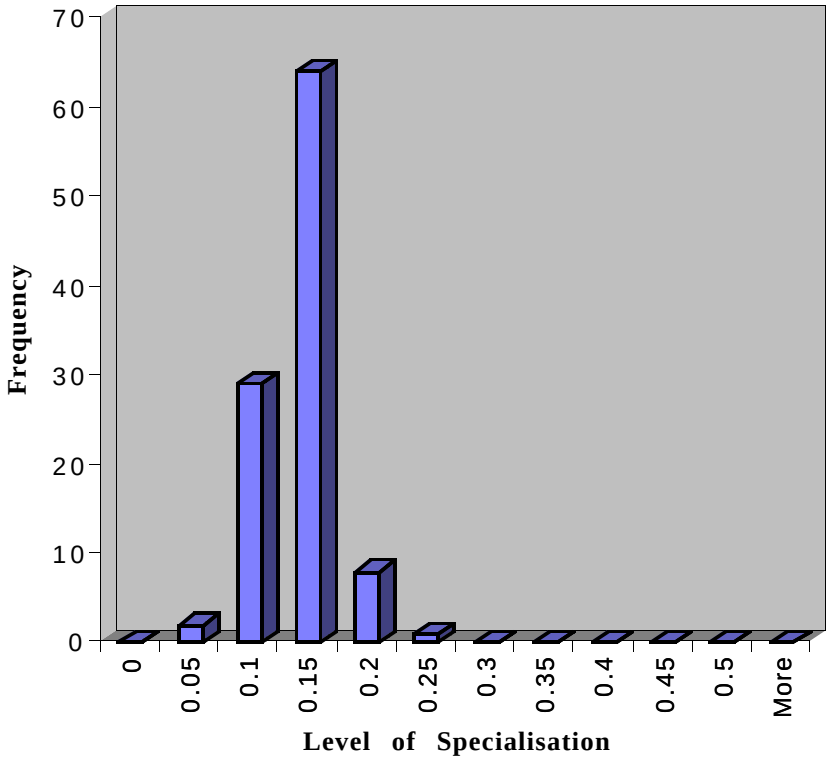
The size of the labour force in cities in our sample in 1981 averaged around half a million (Table 1) with the smallest only 1,949 (Craigieburn) while the largest was, not surprisingly, Sydney with 1,392,960. The distribution of population essentially matched the labour force distribution. There was a slight negative correlation between initial labour force size of a city and its subsequent growth (Table 2). This was not significant, therefore, one could not draw a priori conclusions regarding whether large cities grew faster or slower over the decade.

We measured the degree of specialisation of a city using the modified Herfindahl index stated above. The most specialised cities were Whyalla (S.A.) in mining and Moe-Yalloum (Vic.) in electricity, gas and water. Figure 2 illustrates the degree of specialisation of Australian cities in 1981. While at appears that Australian cities were not very specialised the skewness of the distribution is in part caused by the nature of the index. Interestingly, most cities' level of specialisation fell over the sample period. Two exceptions were Brisbane (Qld) and Warrnambool (Vic.). In many ways, these two cities

represented significant outliers but their presence did not alter the qualitative results presented below. Once again, specialisation in 1981 was only slightly negatively correlated with labour force growth (Table 2).

Our dataset made measuring the degree of localisation in Australian cities very difficult. This was because of the high degree of aggregation of sector data. Therefore, most localised industries were concentrated in Sydney and Melbourne. Instead, we use a simple measure of localisation suggested by Henderson (1981) -- the proportion of total employment in a footloose city-industry. Following the approach of Glaeser et.al. (1995), we will focus on manufacturing for this purpose. In 1981, an average of 15 percent of a city's labour force was concentrated in manufacturing. Nonetheless, this measure of localisation had a negative correlation with labour force growth (Table 2).

Figure 2: Specialisation, 1981



Finally, it was also possible to construct a measure of the qualification level of city labour forces from our dataset. The level of highest qualification of the labour force was broken down (higher degree, post-graduate diploma, bachelor's degree, undergraduate diploma, associate diploma, skilled vocational, basic vocational) allowing a wide possible range of measures. Our study focused on two measures of qualification. First, we look at the labour force share of all qualified persons ranging from higher level university to basic vocational skills. In 1981, the average qualified labour force share was 17 percent ranging from a low of 10 to a high of 30 percent. Not surprisingly, the share of qualified persons rose over the period of study. Second, we looked at the share of the labour force with different levels of post-secondary qualifications only (University and other). The rationale behind the inclusion of this was to ascertain whether a diverse range of qualifications as opposed to average qualifications was important. On average 4.5 percent of a city's labour force had higher university level qualifications. Both broad levels of qualification were correlated with each other and with labour force growth.

In summary, our dataset allowed us to identify a number of observables of theoretically suggested city characteristics that could be driving sources of growth. Looking at simple correlations, however, yielded limited information as to their importance. Moreover, given the correlations among those city characteristics (Table 2), it would be inappropriate to draw any conclusions regarding the nature of city growth at this stage. In the next section, we present regression results that do allow us to identify significant correlations and their signs.

IV Empirical Analysis

We know turn to a more detailed empirical analysis of the structure of partial correlations between initial conditions and population and labour force growth in our sample. It is important to be cautious in interpreting these results given the theoretical considerations in Section II. That is, a positive partial correlation between an initial condition and growth is evidence of an association with quality of life as opposed to

productivity. In addition, given that may of the initial conditions here are labour force sectoral compositions, they may reflect the good or poor performance of a particular sector over the decade rather than any long-term structural relationship.

In Table 3 we present some initial regressions. Regressions (a) and (b) show that initial population was negatively correlated with both population and labour force growth in cities. This is evidence that the congestion effects of urbanisation outweighed the agglomerative effects in the 1980s. However, it may also be the result of neoclassical factor convergence. Nonetheless, this negative correlation is a robust conclusion of our analysis, in contrast to work on U.S. cities that have were inconclusive regarding the relationship between city size and subsequent growth (Henderson et.al., 1995; Glaeser et.al., 1995).[5]

Also, in Table 3 we look at the role of immediate past population growth on growth during the 1980s. We find a strong positive partial correlation between past and present growth. This suggests that positive growth rates may persist over time. As such, it may be evidence of the importance of urbanisation scale economies. Nonetheless, a complete analysis of such persistence would require a longer time series than we had available.

In all the regressions that we present, we have used dummies for the State a city is located in. While the coefficients on these rarely had any significance, their presence added to the joint explanatory power of all regressions. As such, we chose to leave them in the presented results of this paper.

Next we turned to consider the role of manufacturing and externalities in urban growth. Table 4 shows that while the share of employment in manufacturing was not significantly correlated with labour force growth, it was negatively correlated with city manufacturing labour force growth and positively correlated with city non-manufacturing labour force growth. This suggests that manufacturing potentially influenced the composition of subsequent growth although not its level. Once again this latter result was relatively robust to later specifications where we left manufacturing share in as control.

[5] In contrast, Bostic et.al. (1996) find that labour force growth in the U.S. in the late nineteenth century was postively correlated with city size.

Thus, while the negative correlation in regression (b) may reflect the poor relative performance of manufacturing as compared with services, the positive correlation in regression (c) might be evidence of the role of manufacturing in stimulating the development of non-tradable services in cities (Greif and Rodriguez-Clare, 1995). Hence, it could represent the positive spillovers from localisation.

Included in regression (d) of Table 4 is our specialisation proxy. Although only one specification is represented there, we find that specialisation is generally negatively correlated with labour force and population growth. Thus, cities whose employment tended to be concentrated in a relatively small number of sectors, experienced a relatively poor growth performance during the 1980s. This result is consistent with other studies' results regarding the negative effects of specialisation and the benefits of urban diversity (see Glaeser et.al., 1992; Bostic et.al., 1996).

Our most interesting set of results concerned the role of human capital and education. Table 5 shows a number of regressions on city labour force and population growth demonstrating a positive correlation with various measures of the initial share of qualified workers. Such significant correlations also existed with levels as opposed to shares of qualified persons under various alternative specifications. Some joint explanatory power is lost if manufacturing share is dropped from these regressions, hence, they are included in Table 5. The first two regressions look at the total qualified share in secondary and tertiary education. Observe that in these regressions the coefficient on manufacturing share becomes significantly positive. This suggests that lack of correlation in manufacturing was not simply a reflection of relative poor manufacturing performance but poor performance in manufacturing using unskilled labour. Nonetheless, when disaggregating the qualification measure, we find that a diversity of skills was important as opposed to an emphasis on University as opposed to other tertiary education.

The positive correlation between initial human capital and subsequent growth has also occurred in other studies based on the U.S. experience (Rauch, 1993; Glaeser and Mare, 1994; Glaeser et.al., 1995). Combined with our results here this suggests that the positive influence of human capital may not simply reflect the relatively good performance

of human capital intensive industries (e.g., services) over the decade but important spillovers on the quality of life and perhaps on productivity growth. This is certainly an aspect worthy of further study given recent work on the role of education on welfare within cities (Benabou, 1993; Gregory and Hunter, 1995).

Finally, we present some regression results on the role of the government sector on urban growth performance. While we did not have data on government expenditure and taxation variables at the city level, there was data on the share of employment in the government sector in cities. In Table 6, we present results of regressions that show a significant negative correlation between the share of employment in government and labour force growth. Similar results are occur for population growth. Once again, these results do not necessarily suggest a negative implication of government presence but may simply be the result of the reduced employment prospects in government during the 1980s, say, due to fiscal restraint. Breaking this effect up into the different impacts of Commonwealth, State and Local government employment, while there was a weak positive correlation between Local government employment and labour force growth, there was a strong negative correlation on the part of State government. Once again, this might reflect the poor performance of capital cities in each State rather than some negative structural influence of greater government presence. Nonetheless, this does suggest that a beneficial direction for future investigation would be to look at the effects of government consumption and capital expenditures on urban growth taking into account the level of government.

The wide variety of city sizes and also, the close proximity of some cities lead us to be concerned as to the possible presence of heteroscedasticity in the above regressions. Moreover, several cities displayed very different growth experiences from the sample -- as indicated earlier with Brisbane and Warrnambool. Bradley (1995) looked in detail at these potential problems and while she found evidence that they could exist for some regressions, she also showed that they did not alter the qualitative results presented here. A complete analysis of the bias caused by clusters of cities is beyond the scope of the paper here.

VI Conclusions and Future Directions

This paper has two main contributions. First, it has clarified the influence of quality of life and productivity related variables and labour force growth. In particular, we showed that under the usual assumptions of urban economics, labour force growth will be positively related to quality of life variables and independent of productivity within a city. As such, we argued that when looking at the role of initial conditions on city growth, we should be cautious in our interpretation of significant correlations in this regard.

Second, we have conducted the first analysis of the role of initial conditions on Australian data, extending recent studies conducted in the U.S.. Our findings demonstrated a number of robust correlations. In particular, population and labour force growth was negatively correlated with city size while positively correlated with the initial level of human capital in a city. Nonetheless, our findings are of a preliminary nature and should not be interpreted as prescriptive for policy measures.

These significant correlations do, however, indicate that looking at the role of initial conditions in the Australian context is a fruitful area for future research. There are several directions that are immediately suggested by the empirical analysis of this paper. First, looking at more disaggregated labour force data could yield insights regarding the effects of localisation and specialisation on Australian city growth. Second, adding capital data to the analysis may help us distinguish between the quality of life and productivity related aspects of city size, human capital and governmental variables. Finally, the influence of the government sector on city growth is potentially important and a consideration of more detailed local public good and taxation data is a potentially interesting area for empirical analysis.

Table 1: Sample Statistics

	Mean	Standard Dev.	Minimum	Maximum
Population Growth, 1981-91	0.24134	0.32014	-0.14832	1.74928
Labour Force Growth, 1981-91	0.30434	0.36753	-0.16366	1.86306
Population Growth, 1976-81	0.20288	0.39059	-0.10363	3.45760
Population Level, 1981	107705	398309	4296	2876508
Manufacturing Employment Share, 1981	0.15170	0.085894	0.021352	0.46788
Specialisation, 1981	0.11119	0.026082	0.013100	0.21644
Qualified Employment Share, 1981	0.16809	0.028763	0.10012	0.27048
Government Employment Share, 1981	0.26399	0.088302	0.10745	0.59401

Table 2: Sample Correlations

	Pop. Gth 1981-91	Lab. Force Gth, 81-91	Pop. Gth, 1976-81	Population, 1981
Population Growth, 1981-91	1.00000			
Labour Force Growth, 1981-91	0.98448	1.00000		
Population Growth, 1976-81	0.41655	0.43647	1.00000	
Population Level, 1981	-0.09759	-0.09274	-0.06437	1.00000
Manufacturing Employment Share, 1981	-0.00848	0.00926	-0.07860	0.14795
Specialisation, 1981	-0.11561	-0.10931	-0.16347	-0.02573
Qualified Employment Share, 1981	0.06797	0.05466	0.16993	0.18977
Government Employment Share, 1981	-0.31771	-0.27921	-0.17351	-0.03412

	Manufact., 1981	Specialisatn, 1981	Qualifed, 1981	Govt Emp. 1981
Specialisation, 1981	0.44352	1.00000		
Qualified Employment Share, 1981	-0.30156	0.02584	1.00000	
Government Employment Share, 1981	-0.21128	0.10159	0.13086	1.00000

Table 3: Initial Regressions and Persistence
Independent Variable: Log of Growth Rate (1981 - 1991)

Dependent Variable:	(a) City Population	(b) City Labour Force	(c) City Population	(d) City Labour Force
Intercept	**1.0912**	**0.8517**	**0.4209**	**-6.2033**
	(0.0239)	(0.2428)	(0.0765)	(0.7814)
Population, 1981 (Log)	**-0.0068**	**-0.0535**	**-0.0036**	**-0.0213**
	(0.0018)	(0.0184)	(0.0013)	(0.0134)
Population Growth, 1976-81 (Log)			**0.6209**	**6.555**
			(0.0701)	(0.7159)
State Dummies:				
NSW	-0.0063	-0.1329	-0.0001	-0.0654
	(0.0137)	(0.1385)	(0.0096)	(0.0977)
Vic	-0.0020	-0.0775	0.5089	-0.0047
	(0.0140)	(0.1419)	(0.0098)	(0.1001)
Qld	0.0100	0.0332	0.0098	0.0384
	(0.0140)	(0.1419)	(0.0097)	(0.1001)
SA	-0.0116	-0.1266	0.0009	0.0011
	(0.0151)	(0.1534)	(0.006)	(0.1088)
WA	0.0014	-0.0375	0.0034	-0.0180
	(0.0149)	(0.1514)	(0.0104)	(0.1065)
Tas	-0.0158	-0.2261	-0.0035	-0.0970
	(0.0172)	(0.1745)	(0.0121)	(0.1235)
Number of Observations	104	104	103	103
Adjusted R-Squared	0.1527	0.0991	0.5151	0.5022

Boldface indicates significance at 5%.

Table 4: City Growth, Manufacturing and Specialisation
Independent Variable: Log of Growth Rate (1981 - 1991)

Dependent Variable:	(a) City Labour Force	(b) City Manu-facturing Labour Force	(c) City Non-Manufact. Labour Force	(d) City Labour Force
Intercept	**0.8820**	**1.1529**	**1.1044**	**1.1723**
	(0.2451)	(0.0538)	(0.0315)	(0.2782)
Population, 1981 (Log)	**-0.0573**	**-0.0119**	**-0.0079**	**-0.0619**
	(0.0189)	(0.0041)	(0.0024)	(0.0187)
Manufacturing Share, 1981	0.2710	**-0.1824**	**0.0928**	**0.5601***
	(0.2939)	(0.0645)	(0.0377)	(0..3202)
Specialisation, 1981				**-2.0576**
				(0.9861)
State Dummies:				
NSW	-0.1622	-0.0003	-0.0219	-0.2217
	(0.1422)	(0.0312)	(0.0183)	(0.1427)
Vic	-0.1191	0.0169	-0.0178	-0.1758
	(0.1489)	(0.0327)	(0.0191)	(0.1489)
Qld	0.0080	0.0238	-0.0016	-0.0654
	(0.1446)	(0.0317)	(0.0186)	(0.1464)
SA	-0.1802	-0.0193	-0.0211	-0.2245
	(0.1632)	(0.0358)	(0.0209)	(0.1618)
WA	-0.0708	0.0094	-0.0121	-0.1319
	(0.1557)	(0.0942)	(0.0200)	(0.1558)
Tas	-0.2690	-0.0182	-0.0353	**-0.3271***
	(0.1806)	(0.0396)	(0.0232)	(0.1797)
Number of Observations	104	104	104	104
Adjusted R-Squared	0.0977	0.1942	0.1102	0.1285

Boldface indicates significance at 5%.
* Significance at 10%

Table 5: City Growth and Education
Independent Variable: Log of Growth Rate (1981 - 1991)

Dependent Variable:	(a) City Population	(b) City Labour Force	(c) City Population	(d) City Labour Force
Intercept	**1.0580**	**0.5417**	**1.0482**	**0.0502**
	(0.0266)	(0.2725)	(0.0274)	(0.2835)
Population, 1981 (Log)	**-0.0089**	**-0.0717**	**-0.0078**	**-0.0675**
	(0.0018)	(0.0192)	(0.0020)	(0.0208)
Manufacturing Share, 1981	**0.0589**	**0.509***	0.0453	0.4546
	(0.0293)	(0.3008)	(0.0308)	(0.3185)
Share Qualified, 1981	**0.2456**	**2.2683**		
	(0.0862)	(0.8826)		
Share University Education, 1981			**0.2044**	**2.1014**
			(0.0911)	(0.9396)
Share Non-University Education, 1981			**0.3540**	**2.7080**
			(0.1172)	(1.2099)
State Dummies:				
NSW	-0.0042	-0.1071	-0.0093	-0.1276
	(0.0136)	(0.1399)	(0.0141)	(0.1456)
Vic	-0.0042	-0.0365	-0.0004	-0.0456
	(0.0136)	(0.1483)	(0.0145)	(0.1498)
Qld	0.0165	0.0966	0.0120	0.0783
	(0.0141)	(0.1447)	(0.0144)	(0.1492)
SA	-0.0119	-0.1261	-0.0137	-0.1332
	(0.0156)	(0.1601)	(0.0156)	(0.1612)
WA	0.0050	0.0004	0.0011	-0.0158
	(0.0150)	(0.1538)	(0.0152)	(0.1574)
Tas	-0.0125	-0.1907	-0.0152	-0.2018
	(0.0174)	(0.1782)	(0.0174)	(0.1800)
Number of Observations	104	104	104	104
Adjusted R-Squared	0.2142	0.1480	0..2212	0.1415

Boldface indicates significance at 5%.
* Significance at 10%

Table 6: City Growth and Government
Independent Variable: Log of Growth Rate (1981 - 1991)

Dependent Variable:	(a) City Labour Force	(b) City Labour Force	(c) City Labour Force	(d) City Labour Force
Intercept	**1.0899**	**0.7844**	**1.0152**	**0.6808**
	(0.2677)	(0.2938)	(0.2567)	(0.2858)
Population, 1981 (Log)	**-0.0566**	**-0.0689**	**-0.0473**	**-0.0577**
	(0.0186)	(0.0189)	(0.0181)	(0.0182)
Manufacturing Share, 1981	0.0706	0.2961	-0.0119	0.2317
	(0.2978)	(0.3074)	(0.2815)	(0..2921)
Share Qualified, 1981		**2.0045**		**2.0211**
		(0.8757)		(0.8347)
Government Employment Share, 1981	**-0.7594**	**-0.6935**		
	(0.2977)	(0.2925)		
Cth Government Emp. Share, 1981			0.3412	0.3326
			(0.4235)	(0.4126)
State Government Emp. Share, 1981			**-1.486**	**-1.3911**
			(0.3388)	(0.3324)
Local Government Emp. Share, 1981			2.6877	**3.5773***
			(2.0481)	(2.0289)
State Dummies:				
NSW	-0.1428	-0.1441	-0.1908	-0.1822
	(0.1656)	(0.1625)	(0.1624)	(0.1582)
Vic	-0.0899	-0.0375	-0.0935	-0.0532
	(0.1704)	(0.1682)	(0.1624)	(0.1591)
Qld	-0.0141	0.0478	-0.0747	-0.0324
	(0.1706)	(0.1691)	(0.1672)	(0.1639)
SA	-0.1136	-0.0897	-0.1347	-0.1160
	(0.1814)	(0.1777)	(0.1706)	(0.1664)
WA	-0.0946	-0.0478	-0.0898	-0.0531
	(0.1796)	(0.1768)	(0.1701)	(0.1664)
Tas	-0.2422	-0.1938	-0.2450	-0.2088
	(0.1982)	(0.1949)	(0.1881)	(0.1838)
Number of Observations	103	103	103	103
Adjusted R-Squared	0.1516	0.1886	0.2542	0.2920

Excludes Canberra
Boldface indicates significance at 5%.
* Significant at 10%

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