THE EFFECT OF RELATIVE WEALTH CONCERNS ON THE CROSS-SECTION OF STOCK RETURNS*

IE Business School Working Paper WP08-12 15-02-2008

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Abstract
There are several economic reasons why investors might want to hedge local risk resulting from relative wealth concerns; namely, keeping up with the Joneses preferences and competition for local assets in short supply. In equilibrium, hedging for these purposes results in a negative risk Premium for the local risk factors. We study the empirical implications of this equilibrium at the level of the nine US census divisions. As a proxy for the local risk factor we use regional labor income growth. In explaining the cross-section of stock returns, the model performs substantially better than the CAPM, and as well as the Fama-French three factor model. For small and growth stocks our model outperforms the three factor model. JEL Codes: G15, G12, G11.

Key words
Relative wealth concerns, local risk, negative risk premium.

* *The usual caveat applies*

1 Introduction

We study and test the cross section implications of relative wealth concerns. There are two cases (not necessarily exclusive) suggested in the literature, in which relative wealth concerns can result in non-diversifiable local risk factors. First, if agents display "external habit formation" (EHF) and some agents face some type of market friction, as shown in Gómez, Priestley and Zapatero (2007) then relative wealth concerns will arise. EHF means that the individuals care about their wealth in relation to that of their neighbors in their optimal allocation decision. As a result of this, investors "keep up with the Joneses:" they bias their portfolio towards securities which are correlated with the wealth of their peers. These types of preferences are studied in Abel (1990) and Galí (1994). In equilibrium, if some investors face some market friction, (like a non-diversifiable source of income), securities that are correlated with the idiosyncratic component of local wealth (as opposed to the market portfolio) will have a negative risk premium in the local factor, since investors are willing to give up expected return in order not to distance themselves from their peers' wealth.

The second way in which relative wealth concerns arise is developed in DeMarzo, Kaniel and Kremer (2004). The idea is that individuals with standard preferences might care about the wealth of their peers because competition for non-diversifiable assets in limited supply drives their price up; if investors cannot compete in wealth with their peers they might be left out of the market. This, under certain conditions, will bias investors' portfolios towards those assets positively correlated with the local, non-diversifiable risk. In equilibrium, investors will pay a premium for those assets.

In this paper we study whether there exists evidence in favor of local risk-hedging at the domestic level within the US. As noted above, in equilibrium, portfolio externalities imply a negative risk premium for those securities positively correlated with the undiversified wealth of the peer group members. In particular, as peer groups, we consider the nine US census divisions for the US.[1] As a proxy for undiversified local wealth we use divisional labor income. We split all US public stocks across the nine divisions, depending on the location of the headquarters of the firms. Consistent with the model predictions, we find a statistically significant and sizeable negative risk premium associated with the proxy for local undiversifiable wealth. In terms of the average cross sectional $\overline{R}^2$ and pricing errors, the model performs substantially better than the CAPM and as well as the Fama and French (1993) three factor model when we consider all stocks. When we focus on small stocks and low book to market stocks, arguably more local that large stocks and value stocks, we find the model performs substantially better than the Fama and French (1993) three factor model.

Our paper is complimentary to the analysis of Gómez, Priestley and Zapatero (2007). They find evidence in favor of portfolio externalities at the international level on portfolios of US, UK, German and Japanese stocks. For all countries, prices of (mainly domestic) securities that help hedging the country-specific labor risk have a negative risk premium which agents willingly accept.

Focusing on divisional, rather than international portfolio choices, poses certain advantages and new challenges. First, unlike in an international setting, the purely domestic problem is free of a number of "usual suspects" for portfolio biases. Arguably, explicit (like regulation, taxes, financial or human capital

[1] We include a map of the nine US census divisions in Figure 1 as an appendix.

controls) or tacit (like information, language or culture) barriers cannot be invoked as a convincing explanation for domestic portfolio externalities. Second, additional risk sources, like exchange risk or country-specific political risk, disappear.

At the same time, in a domestic setting, new potentially relevant factors arise like, for instance, population density. Hong, Kubik and Stein (2008) find that prices of stocks in census divisions with high population density have, holding all else equal, significantly higher prices than shares in low population density divisions, although in their framework the calculated effect this has on expected returns is very small. Their explanation is similar to the short-supply argument in DeMarzo, Kaniel and Kremer (2004): low population density is strongly associated with low aggregate book value; shortage of local firms pushes their prices up driving returns down. More importantly, lower density is probably associated not only with fewer firms but, also, smaller firms. It is well documented (see, for instance, Brown and Medoff (1989) and Burdett and Mortensen (1998)) that smaller firms pay, other things equal, lower wages making them, in principle, less competitive in attracting workers from other divisions. In other words, firms in lower density divisions are more likely to be highly correlated with the local, non diversifiable labor risk. Investors, searching to hedge their exposure to this income risk, will pay a higher price for local firm shares. Thus, the negative premium will tend to be higher (in absolute value) in divisions with lower population density. Our tests capture this effect: the (absolute value) size of the negative premium is up to two times higher in lower population density divisions, like West North Central, West South Central, East South Central, and East North Central.[2] The differences in the estimated prices of risk for the low population density divisions and the high population density divisions are statistically significant.

To explore further the "locality" of small firms, we sort portfolios within each division into two subsets by market capitalization: small and large. For each division, the twenty size-sorted portfolios are sorted into two groups of ten, the first group are firms with the lower market capitalization. We observe a striking difference between small and big firms across all divisions. The local factor risk premium is consistently negative and strongly significant for small firms. In terms of average cross-section $\overline{R}^2$ the model performs slightly better than the Fama-French 3-factor model. Moreover, except for the West North Central division, the differences in size for the local risk premium across divisions become negligible: once we concentrate on small firms, differences in population density look much less relevant. In contrast, for large firms, the risk premia for the local risk factors becomes statistically insignificant for all the divisions. For large firms, the average cross-section $\overline{R}^2$ is similar to that of the CAPM and much lower than that of the Fama-French three factor model. Therefore, our model seems to be capturing a distinctive risk factor for small firms beyond the pure market capitalization argument in Fama-French.

Another firm characteristic, which is also likely to be associated with locality, is a firm's book to market ratio. We separate the twenty book to market-sorted portfolios into two groups: portfolios between high (value firms) and low (growth firms) book to market. Once again, the differences between the two groups are quite remarkable. Across all divisions growth firms exhibit a negative and statistically significant risk premium for the local risk factor in all but one division. The cross sectional $\overline{R}^2$ for our model is three times higher than that of the Fama-French model. In fact, the Fama-French model performs no better than the CAPM in terms of pricing the growth stock portfolios. When we look at the value firms, none

[2] We include as an appendix (Figure 2) the latest Census map of population density published in 2000.

of the divisional risk premia are statistically significant. Hence, the local risk factors in our model are strongly supported by growth firms while they look irrelevant in pricing value stocks.

We undertake a number of robustness checks. First, we focus the tests on the four divisions with the lowest level of population density and find that the results are even stronger than when considering all divisions. These findings suggests that in low population density areas it is easier to observe the reference group and hence keeping up with the Joneses preferences have a stronger impact on asset prices. Second, we focus on the five smallest and five lowest book to market portfolios under the assumption that the smaller the firms and the lower the book to market ratio the more local the firms are. The empirical tests on these data sets show that the model performs even better than when using all stocks or the 10 smallest and 10 lowest book to market portfolios.

The paper is organized as follows. The related literature is discussed in section 2. We introduce the model and derive its testable implications in section 3. Section 4 presents the data and the main empirical results. Section 5 offers some conclusions.

2 Related literature

To our knowledge, this is the first paper to test the cross-section implication of relative wealth concerns for stock returns at the domestic level. Other papers have studied the theoretical asset pricing implications of relative wealth concerns: Gómez (2007) for the case of EHF and DeMarzo, Kaniel and Kremer (2006) for the case of price-driven wealth concerns. Gómez, Priestley and Zapatero (2007) test the cross-section performance of an international model with "Keeping up with the Joneses" preferences and restricted market participation of some agents. Keeping up with the Joneses preferences were introduced by Abel (1990) and further studied by Galí (1994). Evidence of this type of preferences is presented in Ravina (2005).

Our paper is closely related to the literature on portfolio under-diversification. Theory predicts that, in a frictionless model with full market participation and complete financial markets, investors should hold the same well-diversified portfolio. This prediction was first refuted at the international level by the seminal paper of French and Poterba (1991). This is known as the "home bias puzzle" and refers to the finding that investors over-invest in domestic stocks relative to the optimal global risk-diversification level.[3]

More recently, several papers have documented that this lack of diversification is also present at the domestic level within the US. This phenomenon has been dubbed the "home bias at home puzzle." Coval and Moskowitz (1999), for instance, study the investment behavior of money managers and observe that in their investments they favor (with respect to what would be optimal) local firms. Huberman (2001) uses the fact that individuals prefer to invest in their local Bell company to the other divisional Bell companies to argue that it is "familiarity" what drives this bias. Shore and White (2002) propose external habit formation as an explanation for the puzzle. Ivkovic and Weisbenner (2005) show that households exhibit a strong preference for local investments. Their empirical tests seem to suggest that investors exploit local information to obtain higher returns.

[3]For a literature review of this puzzle and the proposed explanations see Lewis (1999).

Our model, as well as the model in DeMarzo, Kaniel and Kremer (2004), derives partial equilibrium implications for portfolio holdings. Testing those predictions, however, would require to estimate expected returns, volatilities and risk-aversion. Those estimates have been shown to results in implausible portfolio holdings in a one-period, mean-variance setting like ours.[4] We overcome these problems by concentrating on the cross-section predictions of the model. Our results are consistent with the home bias at home literature: local risk factors command a negative risk premia and hence offer a hedging function to local investors.

The findings regarding the value and growth stocks are consistent with the well documented value premium puzzle (see, for example, Berk et al (1999), Cooper (2006), Zhang (2006), Xing (2007)), by which the risk-adjusted expected return of growth firms are smaller than that of value firms. Our analysis supports the idea that the value premium puzzle is the result of portfolio externalities. A possible explanation is the fact that firms with low book-to-market ratio also display high investment in R&D; see, for example, Lev (1999) and Hansen, Heaton and Li (2004). By definition, the investment in R&D is highly intensive in human capital, which results in the type of non-diversifiable wealth against which investors will want to hedge by holding the security (a growth stock) and accepting the resulting negative risk premium.

Zenger (1994) offers an alternative explanation by presenting a model of diseconomies of scale in R&D: smaller firms are more efficient in overcoming the agency problem of hidden information and hidden behavior in R&D. His empirical tests seem to support the model's prediction: small growth firms attract and retain engineers with higher ability and skill (human capital). Our asset pricing results corroborate this intuition.

3 The model

Let us assume a one-period economy. Agents in this economy live in a two-division country: they either live in the north, n, or the south, s. There exists a firm that produces a global good, tradable across divisions. Consumption is expressed in terms of this global good and takes place at the end of the period, $t = 1$.

In each division, there are two types of agents: "investors" and "workers." At time $t = 0$, investors are endowed with shares of the firm that produces the global good. Call c_k^0 the aggregate value of those shares at the beginning of the period for agents in division k. For simplicity, let $c_k^0 = 1$ in both divisions. At the beginning of the period, workers in each division are endowed with human capital that produces a fixed number $\bar{w}_k$ of units of the local good at time $t = 1$. Workers face incomplete markets because they cannot trade their human capital (due to moral hazard and short-selling constraints) and have no access to financial markets; therefore, they cannot hedge their income risk.

Agents' utility over consumption for the two goods is given by:[5]

[4]See, for instance, Michaud (1989). Brandt (2004) surveys the literature.

[5]We use the single-parameter, CRRA utility function. It can be shown that the model yields the same predictions for the cross-section of stock returns if this utility function is replaced by the two-parameter, CES utility function in section IV.B of DeMarzo, Kaniel and Kremer (2004), page 1699.

$$u(c,w) = \frac{1}{1-\alpha}(c^{1-\alpha} + \delta w^{1-\alpha}).$$

The parameter $\delta > 0$ specifies the relative importance of the local good. In equilibrium, the relative price of the local good in terms of the global good at $t = 1$ is given by $p_k = \delta\left(\frac{c_k}{\bar{w}_k}\right)^{\alpha}$. As it would be expected, the scarcer the (fixed) local good endowment relative to the (stochastic) global good consumption, the higher the relative price of the former.

In addition to the firm's shares there are as many zero net supply stocks as needed for financial markets to be complete. Let r denote the shares excess return and $F(r)$ the distribution function. The bond (in zero net supply) has gross return R. Proposition 2 in DeMarzo, Kaniel and Kremer (2004) shows that the representative investor's marginal utility is given by:

$$u_c(c,p) = c^{-\alpha}\left(1 + \delta^{1/\alpha}p^{1-1/\alpha}\right)^{\alpha}. \tag{1}$$

Let $p^0 = \delta\left(\frac{c^0}{\bar{w}}\right)^{\alpha}$ denote the relative price at $t = 0$ of one unit of the non-diversifiable, local good endowment of workers at time $t = 1$. Recall that we normalized the initial investor's shares endowment $c^0 = 1$. Hence, $p^0 = \delta\bar{w}^{-\alpha}$. The present value of the workers endowment is therefore $\bar{w}^0 = \delta\bar{w}^{1-\alpha}$.

The relative wealth at $t = 0$ of the workers in division k as a proportion of the total country wealth is given by $\theta_k = \frac{\bar{w}^0}{1+\bar{w}^0}$. Call $\bar{w}p/\bar{w}^0$ the return on the workers wealth (in units of the global good) over the period. Under complete (financial) markets, there exists a portfolio X^w such that $\frac{\bar{w}p}{\bar{w}^0} = R + r'X^w$. After these definitions, we can write the approximate function for the country k investor's optimal portfolio as follows:[6]

$$x_k^* = \theta_k b_k X_k^w + \tau_k\,\Omega^{-1}E(r), \tag{2}$$

where the parameters $b_k = \frac{\alpha_k - 1}{\alpha_k}$ and $\tau_k = 1/\alpha_k$ represent the portfolio bias and the risk-tolerance coefficient, respectively. Notice that the optimal portfolio for the logarithmic investor ($\alpha = 1$) coincides with the benchmark, well diversified portfolio $\Omega^{-1}E(r)$. No relative wealth concern arises even in the presence of local, non-diversifiable wealth. Alternatively, assume that the representative investor is endowed with an utility function

$$u(c,C) = \frac{c^{(1-\alpha)}}{1-\alpha}C^{\gamma\alpha},$$

where c denotes the investor's consumption; C is the division average or per capita consumption; $\alpha > 0$ is the (constant) relative risk-aversion coefficient and $1 > \gamma \geq 0$ is the "Joneses parameter." For $\gamma > 0$, the constant average consumption elasticity of marginal utility (around the symmetric equilibrium), $\alpha\gamma$, is positive as well: increasing the average consumption per capita C makes the individual's marginal consumption more valuable since it helps her to "keep up with the Joneses." In short, we assume the

[6] Note that we can approximate $u_c(c,p)$ around the initial endowment/price (c^0, p^0) such that $u_c(c,p) \approx u_c(1, \delta\bar{w}^{-\alpha})\left[1 - \alpha(r'x + R - 1) + \frac{\bar{w}^0}{1+\bar{w}^0}(\alpha - 1)\left(\frac{\bar{w}p}{\bar{w}^0} - 1\right)\right]$. We replace $\frac{\bar{w}p}{\bar{w}^0} = R + r'X^w$ in the equation. After multiplying for r and taking expectations we obtain the investors first order condition for the optimal portfolio. The linear approximation for the optimal portfolio follows after solving for x^* and taking into account that $E(r'r) \approx \Omega$ and that $E(r)(R-1) \approx 0$ for small values of $E(r)$ and the (net) risk free rate, $R - 1$.

division's average consumption to be a positive consumption externality. By imposing $\gamma < 1$ we ensure a positive risk-aversion coefficient for the representative investor.[7]

Gómez, Priestley and Zapatero (2007) show that the problem's first order condition can be written as a function of the investor's consumption and the workers relative wealth, $\bar{w}/c$:

$$E\left(r\, c^{-\alpha(1-\gamma)}(1+\bar{w}/c)^{\alpha\gamma}\right) = 0.$$

Notice that, in the absence of keeping up with the Joneses behavior ($\gamma = 0$), the previous condition reduces to $E\left(r\, c^{-\alpha}\right) = 0$, the standard CRRA Euler equation.

Since financial markets are complete, there exists a mimicking portfolio X^w that maps the workers relative income onto the investment opportunity set such that $\bar{w}/c = \bar{w}^0(R + r'X^w)$. Following the same approximation as before, Gómez, Priestley and Zapatero (2007) show that the investor's optimal portfolio coincides with equation (2) where $b_k = \frac{\gamma_k}{1-\gamma_k}$ and $\tau_k = \frac{1}{\alpha_k(1-\gamma_k)}$.

Let $\theta_k > 0$ for $k = \{n, s\}$. We regress the workers non-diversifiable wealth return, $r_k^w = r'X^w$, onto the market portfolio return plus a constant:[8]

$$r_k^w = a_k + \beta_k\, r_M + \xi_k. \tag{3}$$

Portfolio $\beta_k\, x_M$ represents the projection of the workers income onto the security market line spanned by the market portfolio x_M. Define the portfolio $F_k \equiv X_k^w - \beta_k\, x_M$ as a "residual" factor portfolio with return $r_k^F = r'F_k$. Define the matrix $\boldsymbol{F}$ of dimension $N \times 3$ as the column juxtaposition of the market portfolio and the orthogonal portfolios, $\boldsymbol{F} \equiv (x_M, F_n, F_s)$.

Given equations (2) and (3), Gómez, Priestley and Zapatero (2007) show that, in equilibrium,

$$E(r) = \boldsymbol{\beta}\,\boldsymbol{\lambda}, \tag{4}$$

where $\boldsymbol{\beta} = \Omega\, \boldsymbol{F}\, (\boldsymbol{F}'\Omega\, \boldsymbol{F})^{-1}$ denotes the 2×3 (in general $N \times (1+K)$, with N the number of assets and K the number of divisions) matrix of betas, with the first column as the market betas for both assets. The model has testable implications for the risk premia ($\boldsymbol{\lambda}$) and betas ($\boldsymbol{\beta}$).

With respect to the risk premia, the model predicts:

$$\begin{aligned}
\lambda^M &= H\left(1 - \sum_k \omega_k\theta_k\, b_k\, \beta_k\right)\sigma_M^2, \\
\lambda^n &= -H\left(\omega_n\theta_n\, b_n\, \mathrm{Var}(r_n^F) + \omega_s\theta_s\, b_s\, \mathrm{Cov}(r_n^F, r_s^F)\right), \\
\lambda^s &= -H\left(\omega_n\theta_n\, b_n\, \mathrm{Cov}(r_n^F, r_s^F)) + \omega_s\theta_s\, b_s\, \mathrm{Var}(r_s^F)\right),
\end{aligned} \tag{5}$$

[7] Notice that, by rewriting $\gamma = (\alpha - 1)/\alpha$, $\alpha \geq 1$, the representative investor's utility function becomes the standard "ratio-habit" representation in Abel (1990):

$$u(c, C) = \frac{(c/C)^{(1-\alpha)}}{1-\alpha},$$

with average consumption elasticity of marginal utility $(\alpha - 1)$. Our formulation is more convenient for the empirical tests of the model.

[8] See the Appendix in Gómez, Priestley and Zapatero (2007) for an analysis of the effect of the orthogonalization on the prices of risk and the betas of our estimation.

with H the aggregate risk-aversion coefficient. The country market portfolio, x_M, is partially correlated with each division's non-diversifiable risk. That correlation is captured by the coefficient β_k. That correlation offers partial hedging against deviations from the local, non-tradable risk (in case $\theta b > 0$). The parenthesis in equation (5) captures the net price of risk on the country-wide risk factor, after discounting the (capitalization weighted) hedging effect. If the weighted value of the betas is higher than the market beta (i.e., 1), the model predicts that the market price of risk could turn negative. Intuitively, if the hedging properties of the market portfolio against local risk outweigh the compensation for systematic risk the *net* expected market price of risk becomes negative.

Furthermore, if there is a relative wealth concern ($b > 0$) in the economy and workers income is not diversifiable ($\theta > 0$), there should be two additional risk factors together with the market risk factor. Regarding their sign, the model predicts that if $\mathrm{cov}(r_n^F, r_s^F) > 0$, then λ^n and λ^s will be negative. To understand this result, suppose for the moment that the zero-beta portfolios were orthogonal ($\mathrm{Cov}(r_n^F, r_s^F) = 0$). Then, the price of risk would be easily isolated and strictly negative. The intuition for the negative sign would be as follows: An asset that has positive covariance with portfolio F_k will hedge the investor in division k from the local, non-diversifiable income risk. This investor will be willing to pay a higher price for that asset thus yielding a lower return. In equilibrium, the price of risk for F_k would be, in absolute terms, increasing in b_k and the volatility of the hedge portfolio. If the covariance between both zero-beta portfolios is positive, this just increases the absolute value of the negative prices of risk for every division's hedge portfolio.

With respect to the betas, for a given asset $i \in 1, 2, .., N$, the model predicts three betas: the standard market beta and two additional, division-specific betas:

$$\begin{pmatrix} \beta_i^n \\ \beta_i^s \end{pmatrix} = \frac{1}{D} \begin{pmatrix} \mathrm{Var}(r_s^F)\mathrm{Cov}(r_i, r_n^F) & - & \mathrm{Cov}(r_n^F, r_s^F)\mathrm{Cov}(r_i, r_s^F) \\ \mathrm{Var}(r_n^F)\mathrm{Cov}(r_i, r_s^F) & - & \mathrm{Cov}(r_n^F, r_s^F)\mathrm{Cov}(r_i, r_n^F) \end{pmatrix},$$

with $D = \mathrm{Var}(r_n^F)\mathrm{Var}(r_s^F) - \mathrm{Cov}^2(r_n^F, r_s^F) > 0$.

To understand the model's prediction in terms of these betas, assume first that both zero-beta portfolios are pairwise orthogonal, $\mathrm{Cov}(r_n^F, r_s^F) = 0$. In this case, an asset positively correlated with division n non-diversifiable local risk ($\mathrm{Cov}(r_i, r_n^F) > 0$) and with no, or negative, correlation with division s non-diversifiable local risk ($\mathrm{Cov}(r_i, r_s^F) \leq 0$) will have $\beta_i^n > 0$ and $\beta_i^s \leq 0$ (the symmetric result follows for an asset i with $\mathrm{Cov}(r_i, r_n^F) \leq 0$ and $\mathrm{Cov}(r_i, r_s^F) > 0$). Notice that if $\mathrm{Cov}(r_n^F, r_s^F) > 0$ the second term in the computation of the first beta is negative, and the second term in the computation of the second beta is positive, which (along with the minus sign in front of the second terms), goes in the same direction as our previous conclusion about the signs of the betas.

The sign of these betas together with that of the expected price of risk on the orthogonal portfolios in (5) explains the equilibrium expected returns in our model. Besides the market risk premium, investors require a premium for holding stocks with no, or negative, correlation with the non-hedgeable local labor or entrepreneurial income. In addition, investors are willing to give up expected returns (that is, pay a premium) for the stocks that are correlated with the idiosyncratic component of the local risk and, therefore, help them to hedge against that risk. This result depends in a fundamental way on the market friction that prevents some agents from participating in the markets.

We name the model presented in this paper KEEPM, which stands for “KEEping up Pricing Model.” The rest of the paper deals with testing the asset pricing implications of the model.

4 Empirical Results

We consider all firms in the COMPUSTAT/CRSP data base. Using the information on headquarters location in COMPUSTAT, each firm is assigned into one of the nine Census Bureau Divisions. We index the divisions with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. For each division we sort stocks into two sets of portfolios. The first set sort stocks into twenty portfolios in year t according to market capitalization at the end of year $t-1$. The second set sorts stocks into twenty portfolio in year t according to the firms book to market ratio using accounting information on book values from year $t-1$ and market value from the end of year $t-1$. We calculate excess returns by subtracting the one month t-bill rate from the actual returns.

The proxy for local non-diversifiable wealth that we use is quarterly state level personal income which is aggregated to the divisional level. The source of this data is the divisional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce. We calculate the growth rate in personal income at the divisional level as the proxy for non-diversifiable wealth. Because the personal income data is at a quarterly frequency all the data are sampled quarterly from the second quarter of 1979 to the final quarter of 2002. In addition to the local risk factors we also require the excess return on the aggregate stock market portfolio. We compare the performance of our model to that of the Fama-French three factor model that uses the excess return on aggregate stock market portfolio, the small minus big (smb) portfolio and the high minus low (hml) book to market portfolio. The premia on the smb and hml are 0.23 and 1.17 per cent per quarter respectively.

The asset pricing implications of the model state that local, divisional risk factors that proxy for orthogonal local wealth should be priced in the cross-section of stock returns with a negative risk premium. In order to test this proposition the model can be consistently estimated by the cross-sectional methods due to Fama and MacBeth (1973). Given that there are nine divisions this implies that the expected returns on stock i depend on ten estimated risk premiums:

$$E(r_i) = \lambda^M \beta_i^M + \sum_{d=1}^{9} \lambda^d \beta_i^d,$$

where $E(r_{i,t})$ is the expected return on asset i, λ^M is the market price of risk, β_i^M is the market beta of stock i, λ^d is the price of risk associated with orthogonal local personal income in division d, and β_i^d is the beta of stock i to the measure of orthogonal local personal income in division d. The model predicts that $\lambda^d < 0$.

The first assessment of the KEEPM's performance is to consider whether the division risk factors are negative and statistically significant. In addition, we appraise the performance of the model by considering the ability of the model to explain the cross-sectional variation in the test assets. To accomplish this we report the R^2 of the cross-sectional regression which calculates the amount of cross sectional variation that is captured by the model. Following Jagannathan and Wang (1996) and Lettau and Ludvigson (2001) we calculate the R^2 as $\left[Var_c(\overline{r}_i) - Var_c(\overline{e}_i)\right]/Var_c(\overline{r}_i)$ where Var_c is the cross-sectional variance, $\overline{r}_i$ is the average return and $\overline{e}_i$ is the average residual. Due to the large number of risk factors, we report the adjusted $R^2, \overline{R}^2$. Whilst the $\overline{R}^2$ indicates the general fit of the model it is not a direct test of the model. An appropriate test of the model is to examine whether the models' pricing errors are zero. It is also useful to consider the performance of the model relative to existing models that pertain to describe the cross section of stock returns. To this end we estimate the CAPM and the Fama-French three factor model.

The Fama and MacBeth (1973) procedure involves a first step in which time series regressions are used to estimate the betas, and a second step in which cross-sectional regressions are used to estimate the lambdas. When data is available over a long sample period it is usual to undertake a rolling regression approach of using sixty observations up to time t in the first step to obtain the first beta. This beta is then used in the second step to estimate a cross-sectional regression of average returns at time $t+1$ on the beta estimated up until time t. The data is then rolled forward one month and the procedure is repeated. This results in a time-series of cross section estimates of the market price of risk. However, this rolling procedure is not appropriate when using quarterly the time series data over a relatively short sample. Rather, the beta coefficients are estimated over the entire sample and used in all of the T cross-sectional regressions. Estimating a single beta over the sample period when employing quarterly data is also employed in Lettau and Ludvigson (2001) and this methodology is discussed in Cochrane (2001).

Table 1, panel A reports estimates of model using twenty size sorted portfolios from each of the nine divisions. All of the prices of risk associated with the nine divisions are estimated to be negative and all are statistically significant. This offers strong support for the theory that local risk is important, whether this is driven by keeping up with the Joneses preferences or by local goods being in short supply. Interestingly, the divisions that have the highest prices of risk (≥ 0.01) are West North Central, West South Central, East South Central, and East North Central. These divisions and the states within them are characterized by low population density. Panel B reports an F-test of the restriction that the prices of risk on the high population density divisions are the same as the average price of risk across the low density divisions (-0.0117). In every case we reject the null hypothesis of equal prices of risk in favour of the alternative that the prices of risk in the low population density are larger (absolutely).

The result regarding population density are consistent with the findings in Hong, Kubik and Stein (2008) who show that the prices of shares in census divisions with high population density have higher prices than shares in low population density divisions. This explanation is similar to the premium argument in DeMarzo, Kaniel and Kremer (2004) who argue that low population density is strongly associated with low aggregate book value. A shortage of local firms pushes their prices up driving returns down. In the context of our model, lower density is probably associated with not only fewer firms but, more importantly, these firms are likely to be more local. Investors are willing to pay a higher price for those assets (in short supply) because they are positively correlated with the local, non-diversifiable risk. The aggregate stock market price of risk is positive and significantly different from zero. At least as far as the signs and statistical significance of the prices of risk are concerned, the model has strong empirical support. The $\overline{R}^2$ is 50% which is reasonable for size sorted portfolios.

The next two rows of table 1 report estimates from the CAPM and the Fama-French three factor model. The market price of risk in the CAPM is positive and statistically significant at the 10% level. However, according to the $\overline{R}^2$ it can only explain 1% of the cross-sectional variation in the average excess returns of the test assets. This inability of the CAPM to explain the cross section of stock returns is a well known result. The Fama-French three factor model does considerably better than the CAPM in terms of explaining the cross section of stock returns. All three prices of risk are statistically significant, although the price of risk on the *smb* factor is negative. Recall from the discussion of the data above that over the sample period that we consider the *smb* premium is very small. It is evident from the $\overline{R}^2$ of the Fama-French model, which is 52%, that the model that incorporates local non-diversifiable divisional risk does just as well at describing the cross-section of returns as the Fama-French model.

Presumably, we could get stronger tests of the model if we distinguish between stocks that we, a priori, consider to be more sensitive to local risk factors. In the presence of portfolio externalities investors want to buy stocks that hedge them against movements in the non-diversifiable local wealth. Arguably, small capitalization stocks are more highly correlated to local wealth/goods. It is well documented (see, for instance, Brown and Medoff (1989) and Burdett and Mortensen (1998)) that smaller firms pay, other things equal, lower wages making them, in principle, less competitive in attracting workers from other divisions. In contrast, large firms, with more competitive salaries, are more likely to attract more mobile workers. They are, at the same time, more likely to be diversified geographically, have subsidiaries in other states and even abroad. In light of this, we would expect the model to price small stocks better than large stocks.

Table 2 reports results from estimation of the model (along with the CAPM and the Fama-French model) using the 10 smallest portfolio from each of the nine divisions (Panel A) and the 10 largest portfolios from each of the nine divisions (Panel B). Regarding the small stocks on panel A, all the prices of risk are negative and statistically significant and the $\overline{R}^2$ is 50%. For these small stocks the CAPM does slightly better than when including all stocks, recording a $\overline{R}^2$ of 7%. When considering just the small stocks the Fama-French model does slightly worse that the local model with a $\overline{R}^2$ of 48%, although all three risk factors in the Fama-French model are statistically significant and have positive signs.

The results from the small stock portfolios become striking when compared to those in panel B that use the remaining 10 portfolios which we call the large firms. In this case only two of the prices of risk on the local factors are negative and only one of these is statistically significant at the 10% level (West South Central). The $\overline{R}^2$ falls by half to 25% and, moreover, for these large stocks, the $\overline{R}^2$ from the CAPM is 18%, so including the local factors does very little to improve the $\overline{R}^2$ relative to that of the CAPM. In sharp contrast, in panel A the $\overline{R}^2$ rose from 7% in the CAPM to 50% in the local model. Note also that the Fama-French model produces a $\overline{R}^2$ of 46% and therefore does much better than the local model in pricing the large stocks. This results is particularly supportive of the proposed model since we find strong support for the model using data where we a priori expect stronger results and no support for the model when using data where we do not expect the model to work. Note that for the large stocks the premium on the *smb* factor becomes negative.

Firm size is not the only characteristic that might help to differentiate local from more diversified firms. The book-to-market of a firm might also work given that firms with a low book-to-market are growth firms that tend to be younger and might have more human capital specific factors, or unique technology that is specific to a particular geographical area (like Silicon Valley in California). In contrast, firms with a high book-to-market ratio are value firms and are more likely to diversified geographically with production and sales across divisions and internationally. Another explanation is the fact that firms with a low book-to-market ratio also display high investment in R&D (see, for example, Lev (1999) and Hansen, Heaton and Li (2004)). By definition, the investment in R&D is highly intensive in human capital, which results in the type of non-diversifiable wealth against which investors will want to hedge by holding the security (a growth stock).

For each division we also sort stocks into twenty book-to-market portfolios. Panel A of table 3 reports the parameter estimates from the three models using all twenty portfolios. As was the case for the size sorted portfolios, each of the local risk factors command a negative price of risk and each one is statistically significant. The market price of risk is positive and statistically significant and the $\overline{R}^2$ is 25% which is half the size of the $\overline{R}^2$ when using size portfolios. However, the $\overline{R}^2$ from the Fama-French model is also 25% , which is about half of that of the $\overline{R}^2$ when using size portfolios. The CAPM, which records an $\overline{R}^2$ of 10%, does much better in terms of describing the cross sectional patterns of book to market portfolio than size portfolios.

Panel B presents results using 10 portfolios with the lowest book-to-market in each division. As expected, the local model does well in explaining the cross-section of these low book-to-market portfolios. All of the local prices of risk are negative and all by one (New England) are statistically significant. The $\overline{R}^2$ is 35%, somewhat higher than when including all of the book-to-market portfolios. Estimation of the CAPM results in a negative market price of risk and a $\overline{R}^2$ of 10%. The Fama-French model offers little improvement over and above that of the CAPM with a $\overline{R}^2$ of 11% which is considerably smaller than for the Fama-French model with all stocks and the local model. Considering all of the three models, the local model provides a clear advantage in pricing low book-to-market portfolios, even when compared to the Fama-French model.

Now turning to the 10 high book-to-market portfolios for each division, panel C shows that seven of the nine local risk factors have a negative sign but only one of them (West South Central) is marginally statistically significant. Interestingly, given the lack of statistical significance of the local risk factors, the $\overline{R}^2$ is 55%. However, this is explained when considering the CAPM in the next row of the panel which produces a positive market price of risk and a $\overline{R}^2$ of 43%. Thus, much of the good performance of the local model comes from the role of the market price of risk. In fact, this is a surprising results given the poor performance of the CAPM in general when considering size portfolios and the results using all the book to market portfolios. The final row of the panel reports the results from the estimation of the Fama-French model. There is little improvement in this model relative to the CAPM. Therefore, at least as far as stocks with high book to market ratios are concerned, the CAPM does a reasonable job at explaining the cross-section of stock returns.

The discussion thus far has focussed on the sign and statistical significance of the prices of risk and the $\overline{R}^2$ in order to assess the performance of the models. In table 4 we report the square root of the average absolute pricing errors of the model along with standard errors in parentheses. Each column of the table reports a particular model and each row a division. Columns 2 through to 4 report the pricing errors for model reported in table 1 that uses all twenty of the size portfolios from each division. The row called All reports the pricing errors across all 180 portfolios, the other rows report the pricing errors for each division. The local model and the Fama-French model have similar pricing errors which are much lower than the pricing errors from the CAPM. All three models do poorly in terms of having large pricing errors in the Pacific division. The Mountain division also have a high pricing error for the local model. Otherwise for the remaining divisions the pricing errors are similar to the results for all divisions.

Columns five through to seven report the pricing errors for the 10 small stock portfolios in each division. The pricing errors for the small stock portfolios follow a similar patter to those for all of the portfolio in the previous three columns. The local model has slightly smaller pricing errors than the Fama-French three factor model. Both of these models have substantially smaller pricing errors than the CAPM. Turning next to the large size portfolios in the final three columns of the table, the Fama-French model has the smallest pricing error but it is very close to the local model (0.006 as opposed to 0.007). Interestingly, the pricing errors of the CAPM are much smaller for the large size portfolios. The patterns in the pricing errors match those of the $\overline{R}^2$ in that the CAPM appears to perform better for large stocks.

The pricing errors associated with the book-to-market portfolios are reported in table 5. The CAPM has slightly higher pricing errors when considering all the book-to-market portfolios relative to the local model and Fama-French model. The local model and the Fama-French model also have slightly smaller pricing errors when considering only the low book-to-market portfolios. Finally, when considering the high book to market portfolios the local model has a slightly lower pricing error, but it is very similar to the CAPM and the Fama-French model.

4.1 Robustness Tests

In Table 6 we undertake some robustness tests. We argued earlier that the divisions that had the highest estimated price of risk were in divisions that had low population density. To assess this further we re-estimate the model using the 10 small stock portfolio in the four regions with low population density. These are West South Central, East South Central, East North Central and West North Central. Panel A reports the results and shows that when we consider only these divisions the $\overline{R}^2$ 59%, nearly 20% larger than when including the 10 small stock portfolio in all divisions. There is also an increase in the estimated prices of risk and their statistical significance is somewhat higher. These findings add weight to our earlier argument that population density is an important determinant of the cross-section of expected returns. In our model this is most likely working through the observation that in low population density areas it is easier to observe the reference group and hence keeping up with the Joneses preferences have a stronger impact on asset prices

Panels B of Table 6 considers a further robustness checks based on firm size. Under the assumption that the smaller the stocks the more local the firms are, we would expect to find stronger evidence in favour of the model if we were to look at the smallest firms in isolation. Therefore, in Panel B we split the small stock portfolios further and consider the five smallest stock portfolios in each division. All the prices of risk are negative and statistically significant. In this case the $\overline{R}^2$ increases to 54%, a modest increase of just under 10%.

5 Conclusion

Relative wealth concerns can lead to an equilibrium in which securities that load on a local non-diversifiable risk factor have a negative risk premium. We perform this analysis for portfolios of securities for the nine US census divisions. We find strong empirical support for our conjecture. Especially, for small and growth firms. In addition, our results seem to be related to the finding of Hong, Kubik and Stein (2008), who show that population density helps explaining the cross-section of stock returns. A possible explanation is that relative wealth concerns are stronger in areas with low population density because, for example, it is easier to identify the reference group (the "Joneses") with respect to which each particular investor has relative wealth concerns.

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Table 1
Size Sorted Portfolios

This table reports results from estimating cross-sectional regressions of average excess returns on the nine divisional betas and market beta. We use returns on twenty size portfolio for each of the nine divisions. λ_i is the estimated price of risk for division i. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. λ_m is the market price of risk, λ_{smb} is the price of risk associated with the small minus big factor, λ_{hml} is the price of risk associated with the high minus low book to market factor. Data are sampled 1979Q2 to 2002Q4. Numbers in parentheses are t–statistics. $\overline{R}^2$ is the adjusted R^2.

Panel A: Estimates

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.013	−0.007	−0.011	−0.008	−0.010	−0.005	−0.016	−0.008	−0.008	0.038			0.50
(5.49)	(3.53)	(5.97)	(3.33)	(5.88)	(2.74)	(6.67)	(4.48)	(4.26)	(3.31)			
									0.016			0.01
									(1.92)			
									0.072	−0.017	0.032	0.52
									(5.58)	(2.72)	(3.44)	

Panel B: Testing Restrictions

	$\lambda_{PA} = -0.0117$	$\lambda_{MO} = -0.0117$	$\lambda_{SA} = -0.0117$	$\lambda_{MA} = -0.0117$	$\lambda_{NE} = -0.0117$
F-Test	10.404	4.341	20.368	5.441	5.965
	[0.00]	[0.04]	[0.00]	[0.02]	[0.02]

Table 2
Small and Large Size Portfolios

This table reports results from estimating cross-sectional regressions of average excess returns on the nine divisional betas and market beta. Panel A reports results using the returns on the 10 smallest size portfolios. Panel B reports results using the returns on the 10 largest portfolios. λ_i is the estimated price of risk for division i. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. λ_m is the market price of risk, λ_{smb} is the price of risk associated with the small minus big factor, λ_{hml} is the price of risk associated with the high minus low book to market factor. Data are sampled 1979Q2 to 2002Q4. Numbers in parentheses are t–statistics. $\overline{R}^2$ is the adjusted R^2.

Panel A: Small Stock Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.009	−0.009	−0.008	−0.009	−0.008	−0.006	−0.010	−0.006	−0.006	0.042			0.50
(3.74)	(4.39)	(4.09)	(3.55)	(4.86)	(2.94)	(4.77)	(3.18)	(2.98)	(3.31)			
									0.042			0.07
									(3.38)			
									0.047	0.019	0.033	0.48
									(3.62)	(2.56)	(3.25)	

Panel B: Large Stock Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.004	0.000	0.001	−0.002	0.000	0.000	0.000	0.000	0.000	−0.019			0.25
(1.77)	(0.01)	(0.30)	(0.87)	(0.14)	(0.14)	(0.09)	(0.12)	(0.07)	(1.60)			
									−0.026			0.18
									(2.07)			
									0.012	−0.016	0.018	0.46
									(0.99)	(2.76)	(1.97)	

Table 3
Book-to-Market Sorted Portfolios

This table reports results from estimating cross-sectional regressions of average excess returns on the nine divisional betas and market beta. Panel A reports results from using twenty portfolio ranked by the firm's book to market ratio. Panel B reports results using the returns on the 10 portfolios with the lowest book to market ratio. Panel C reports results using the returns on the 10 portfolios with the highest book to market ratio. λ_i is the estimated price of risk for division i. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. λ_m is the market price of risk, λ_{smb} is the price of risk associated with the small minus big factor, λ_{hml} is the price of risk associated with the high minus low book to market factor. Data are sampled 1979Q2 to 2002Q4. Numbers in parentheses are t–statistics. $\overline{R}^2$ is the adjusted R^2.

Panel A: All Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	R^2
−0.007	−0.006	−0.007	−0.008	−0.005	−0.008	−0.008	−0.005	−0.007	0.027			0.25
(3.54)	(3.16)	(4.50)	(3.56)	(3.38)	(4.40)	(3.85)	(2.90)	(4.02)	(2.24)			
									0.027			0.10
									(2.11)			
									−0.015	−0.006	−0.036	0.25
									(1.19)	(0.90)	(3.52)	

Panel B: Low Book-to-Market Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.005	−0.004	−0.005	−0.008	−0.005	−0.005	−0.008	−0.004	−0.003	−0.032			0.35
(2.57)	(2.05)	(2.83)	(3.14)	(2.77)	(2.76)	(3.65)	(2.13)	(1.54)	(2.36)			
									−0.052			0.10
									(3.53)			
									−0.052	−0.016	0.022	0.11
									(3.51)	(2.05)	(2.43)	

Panel C: High Book-to-Market Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.004	−0.001	0.003	−0.003	−0.002	−0.002	0.000	−0.000	−0.002	0.034			0.55
(1.71)	(0.33)	(1.78)	(1.13)	(1.08)	(1.12)	(0.14)	(0.20)	(0.91)	(2.64)			
									0.036			0.43
									(2.74)			
									0.028	0.004	−0.021	0.47
									(2.21)	(0.52)	(2.43)	

Table 4
Pricing Errors Size Portfolios

This table reports analysis of pricing errors. KEEPM is the Keeping-up-with-the-Joneses model, CAPM is the CAPM, FF is the Fama and French model. All includes size sorted portfolios from all 9 divisions. We report the square root of the average squared pricing error for all divisions aggregated together and for the 20 portfolios in each division. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. Standard errors are reported in parenthesis. Data are sampled 1979Q2 to 2002Q4.

	Size All			Size Small			Size Large		
	KEEPM	CAPM	FF	KEEPM	CAPM	FF	KEEPM	CAPM	FF
All	0.013	0.022	0.013	0.012	0.020	0.013	0.007	0.008	0.006
	(0.012)	(0.015)	(0.011)	(0.011)	(0.012)	(0.010)	(0.005)	(0.007)	(0.005)
WS	0.011	0.021	0.010	0.013	0.029	0.016	0.004	0.003	0.004
	(0.009)	(0.010)	(0.011)	(0.009)	(0.010)	(0.010)	(0.002)	(0.002)	(0.004)
PA	0.021	0.022	0.021	0.017	0.020	0.016	0.007	0.007	0.008
	(0.019)	(0.014)	(0.017)	(0.012)	(0.012)	(0.012)	(0.005)	(0.005)	(0.006)
ES	0.011	0.019	0.011	0.010	0.019	0.013	0.003	0.004	0.003
	(0.007)	(0.013)	(0.009)	(0.005)	(0.011)	(0.009)	(0.002)	(0.002)	(0.002)
MO	0.019	0.028	0.014	0.014	0.026	0.015	0.012	0.014	0.011
	(0.012)	(0.019)	(0.013)	(0.016)	(0.011)	(0.014)	(0.007)	(0.011)	(0.007)
EN	0.014	0.018	0.016	0.015	0.016	0.014	0.006	0.007	0.005
	(0.009)	(0.014)	(0.012)	(0.012)	(0.013)	(0.009)	(0.004)	(0.004)	(0.004)
SA	0.011	0.019	0.010	0.008	0.015	0.008	0.010	0.011	0.008
	(0.009)	(0.014)	(0.009)	(0.006)	(0.011)	(0.008)	(0.007)	(0.007)	(0.007)
WN	0.012	0.021	0.011	0.012	0.015	0.012	0.005	0.006	0.005
	(0.015)	(0.014)	(0.008)	(0.014)	(0.013)	(0.011)	(0.004)	(0.004)	(0.003)
MA	0.013	0.023	0.014	0.014	0.018	0.018	0.007	0.006	0.004
	(0.009)	(0.012)	(0.009)	(0.014)	(0.013)	(0.014)	(0.004)	(0.003)	(0.004)
NE	0.011	0.023	0.012	0.007	0.018	0.006	0.005	0.010	0.005
	(0.008)	(0.016)	(0.007)	(0.005)	(0.012)	(0.005)	(0.004)	(0.009)	(0.006)

Table 5

Pricing Errors Book-to-Market Portfolios

This table reports analysis of pricing errors. KEEPM is the Keeping-up-with-the-Joneses model, CAPM is the CAPM, FF is the Fama and French model. All includes book to market sorted portfolios from all 9 divisions. We report the square root of the average squared pricing error for all divisions aggregated together and for the 20 portfolios in each division. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. Standard errors are reported in parenthesis. Data are sampled 1979Q2 to 2002Q4.

	BM All			BM Low			BM High		
	KEEPM	CAPM	FF	KEEPM	CAPM	FF	KEEPM	CAPM	FF
All	0.013	0.014	0.013	0.011	0.012	0.011	0.008	0.009	0.009
	(0.012)	(0.014)	(0.012)	(0.009)	(0.011)	(0.011)	(0.006)	(0.008)	(0.008)
WS	0.007	0.010	0.010	0.007	0.006	0.006	0.004	0.005	0.004
	(0.009)	(0.009)	(0.006)	(0.007)	(0.006)	(0.007)	(0.004)	(0.005)	(0.004)
PA	0.014	0.017	0.017	0.017	0.015	0.014	0.005	0.009	0.009
	(0.014)	(0.014)	(0.017)	(0.009)	(0.015)	(0.015)	(0.004)	(0.007)	(0.008)
ES	0.013	0.014	0.012	0.009	0.010	0.010	0.008	0.009	0.008
	(0.009)	(0.010)	(0.009)	(0.006)	(0.009)	(0.009)	(0.008)	(0.010)	(0.009)
MO	0.021	0.019	0.021	0.014	0.019	0.019	0.011	0.015	0.015
	(0.012)	(0.019)	(0.020)	(0.012)	(0.015)	(0.016)	(0.008)	(0.011)	(0.011)
EN	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.013	0.013
	(0.007)	(0.008)	(0.008)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
SA	0.012	0.016	0.011	0.010	0.012	0.012	0.007	0.007	0.006
	(0.011)	(0.017)	(0.010)	(0.006)	(0.009)	(0.009)	(0.004)	(0.005)	(0.004)
WN	0.012	0.012	0.011	0.009	0.007	0.007	0.006	0.006	0.007
	(0.008)	(0.007)	(0.008)	(0.007)	(0.006)	(0.007)	(0.003)	(0.005)	(0.005)
MA	0.013	0.015	0.012	0.009	0.010	0.010	0.008	0.009	0.008
	(0.008)	(0.012)	(0.008)	(0.006)	(0.009)	(0.008)	(0.008)	(0.010)	(0.009)
NE	0.017	0.015	0.014	0.007	0.012	0.014	0.014	0.009	0.009
	(0.019)	(0.016)	(0.013)	(0.005)	(0.015)	(0.014)	(0.014)	(0.007)	(0.005)

Table 6
Robustness Tests

This table reports results in Panel using the five smallest size portfolios in each region. Panel reports results using the five portfolios with the lowest book to market ratio. Panel C reports results using the 10 small stock portfolios for divisions with the lowest population densities. λ_i is the estimated price of risk for division i. The divisions are indexed with two capital letters: WS is West South Central, PA is Pacific, ES is East South Central, MO is Mountain, EN is East North Central, SA is South Atlantic, WN is West North Central, MA is Middle Atlantic, and NE is New England. λ_m is the market price of risk. Data are sampled 1979Q2 to 2002Q4. Numbers in parentheses are t–statistics. $\overline{R}^2$ is the adjusted R^2.

Panel A: Small Stocks, Low Population Density Divisions

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.019		−0.014		−0.012		−0.012			0.058			0.59
(5.41)		(5.40)		(4.96)		(4.54)			(3.66)			
									0.044			0.06
									(2.88)			
									0.041	0.044	0.0300	0.54
									(2.67)	(4.72)	(2.72)	

Panel B:Very Small Stock Portfolios

λ_{WS}	λ_{PA}	λ_{ES}	λ_{MO}	λ_{EN}	λ_{SA}	λ_{WN}	λ_{MA}	λ_{NE}	λ_m	λ_{smb}	λ_{hml}	$\overline{R}^2$
−0.010	−0.010	−0.004	−0.010	−0.007	−0.006	−0.007	−0.008	−0.007	0.043			0.54
(3.70)	(3.84)	(2.00)	(3.03)	(3.49)	(2.69)	(2.64)	(3.57)	(3.13)	(3.06)			
									0.043			0.11
									(3.06)			
									0.037	0.019	0.020	0.37
									(2.65)	(2.27)	(1.76)	

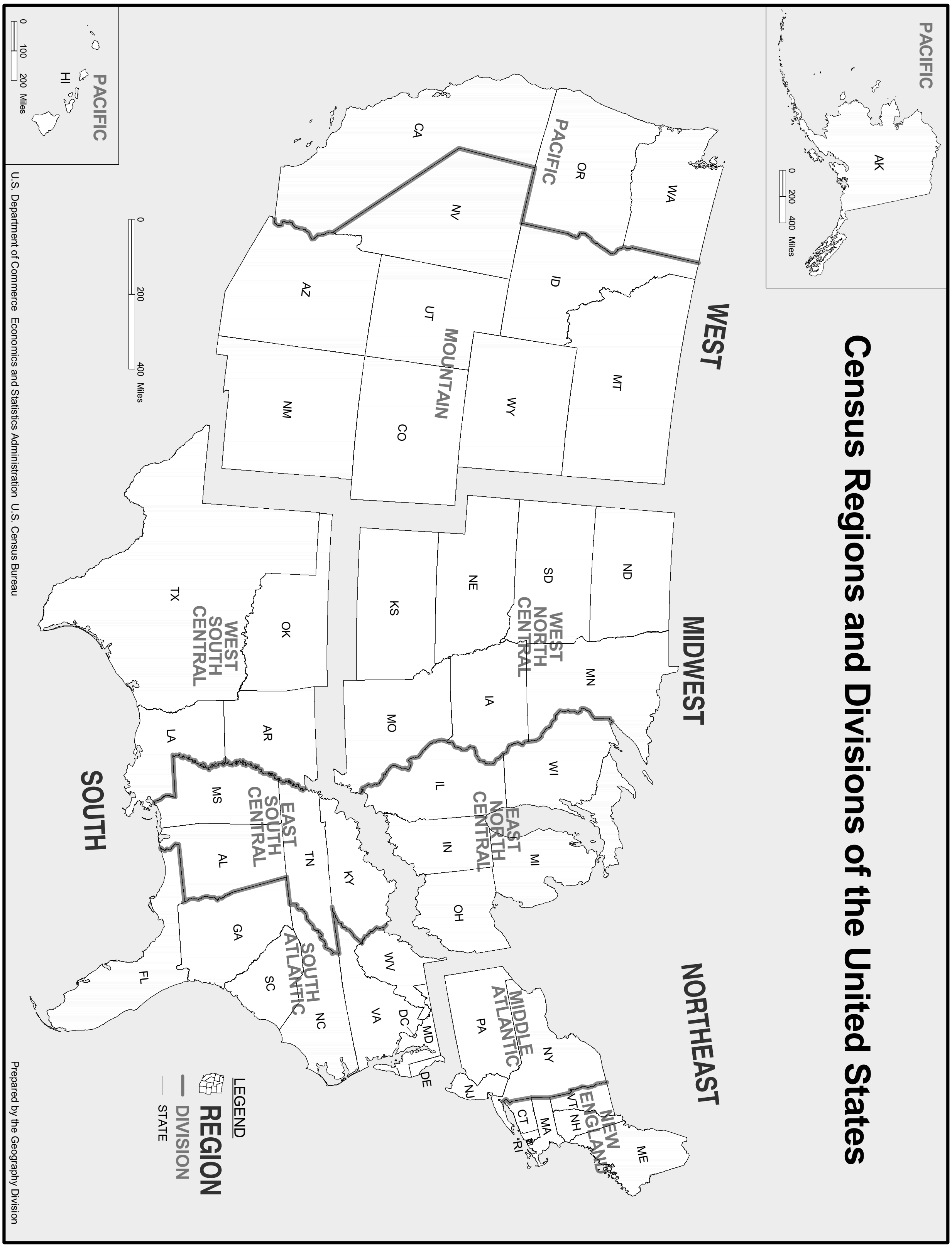

Figure 1: Map of US Census regions and divisions.

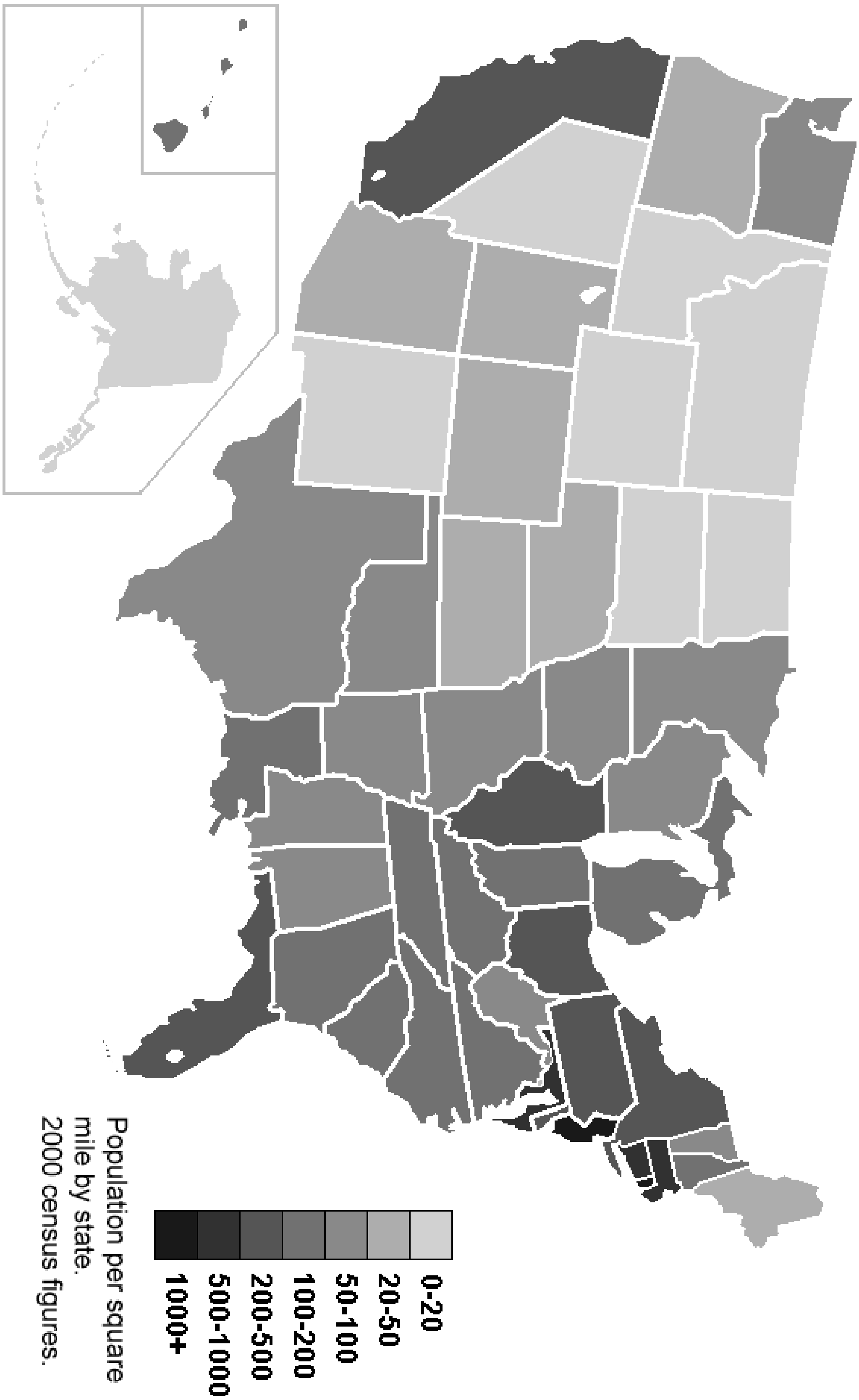

Figure 2: Map of population density by state, according to the last Census (2000).

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